RESEARCH ARTICLE

Gross Anatomy of Humerus of Asiatic Lion (*Panthera leo persica*)

Sweta Pandya*, Pradnya Gaikwad, Maitri Patel

Abstract

Gir forest is the sole home of Asiatic lion. In the present study the anatomy of 4 humerus bones of Asiatic lion were studied. The humerus is long bone with spirally twisted shaft. The mean circumference of proximal extremity was 21.11 cm, while that of distal extremity was 18.00 cm. The mean length of shaft was 17.20 cm. The mean diameter of shaft from the middle was 8.62 cm. The musculo-spiral groove was wide, smooth and spiral on lateral surface of humerus. There were three fossae, olecranon fossa at caudal aspect and radial and coronoid fossae at cranial aspect of distal extremity of humerus. Supracondyloid foramen was present on medial side of distal extremity above medial condyle.

Key words: Humerus, Lion, Morphology, Morphometry.

Ind J Vet Sci and Biotech (2023): 10.48165/ijvsbt.19.3.05

Introduction

Gir forest is the sole home of pure Asiatic lion. The lions were characterised by 'critically endangered' in year 2000 and there were only 304 lions in Gir century of Gujarat, India. In 2010 census, there were 411 lions but the population of lion pegged at 523 in the year 2015 (Kaushik, 2017). Recently the forest department of Gujarat has announced an increase in the population of Asiatic lions in Gir forest from 523 to 674 in the year 2022. The steady rise in lion population is indication of robust conservation measures, less incidences of poaching, care of their natural habitat and proper health care management (Kaushik, 2022). The osteological study always helps clinicians to treat lions clinically. Very meagre information is available on anatomical study of bones of lions and so the present study was conducted on arm bones of Asiatic lion.

Materials and Methods

The study was undertaken on humerus of Asiatic lion at the Department of Anatomy, Veterinary College, Anand (Gujarat, India). The study was carried out on 4 humerus bones of adult lions. The gross morphology and morphometry of bones were studied, with the help of simple scale, non-elastic thread and vernier callipers.

Results and Discussion

The humerus was long bone with twisted appearance with two extremities and a shaft (Fig. 1). These findings were similar to the report of Nzalak *et al*. (2010), who reported humerus as a long bone with a spirally twisted shaft. Pandit (1994) in tiger and Petronela *et al*. (2014) in cheetah reported humerus as irregularly cylindrical long bone, slightly curved to look like a letter 'S'.

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How to cite this article: Pandya, S., Gaikwad, P., & Patel, M. (2023). Gross Anatomy of Humerus of Asiatic Lion (Panthera leo persica). Ind J Vet Sci and Biotech. 19(3), 22-25.

Source of support: Nil

Conflict of interest: The authors declare that there is no conflict of interest.

Submitted 03/03/2023 **Accepted** 23/03/2023 **Published** 10/05/2023

Morphometrical measurments of humerus of lion are presented in table 1. In the present study, the average weight of humerus was 201.00 gm. However, Sohel *et al*. (2021) reported the weight of right and left humerus of lion as 408 and 401 gm, respectively, which is double than the present findings. Tomar *et al*. (2014) reported the mean weight of right and left humerus of tiger as 381 and 385 gm, respectively. Podhade *et al*. (2014) reported the mean weight of 108.40 gm for leopard humerus. The weight of humerus was almost double in lion and tiger, but half in leopard than the present findings.

The average total length of humerus in Asiatic lion was 25.10 cm. Sohel *et al*. (2021) reported the length of right and left humerus of lion as 31.23 and 31.10 cm, respectively. Tomar *et al*. (2014) reported the mean length of right and left humerus of tiger as 30.60 and 30.30 cm, respectively, while Pathak *et al*. (2017) recorded average length as 33.62 cm in Indian tiger. Indu *et al*. (2007) and Podhade *et al*. (2014) reported the length of humerus in leopard as 22.5 cm, and

23.15 cm, respectively. Petronela *et al.* (2014) reported the mean length of cheetah humerus as 27.70 cm. The length of humerus in present study was more or less similar to that reported in leopard and cheetah, but little less than that reported in lion and tiger.

Proximal Extremity:

The Proximal extremity of humerus was presented by head, neck, lateral and medial tuberosities and intertuberal groove (bicipital groove) (Fig. 1 & 2). The lateral tuberosity was single and slightly higher than the head. A rough circular facet was present lateral to this tuberosity for attachment of infraspinatus muscle. The medial tuberosity was small and closely attached to the head. Several foramina were present at the fusion point of head with medial tuberosity. The head was smooth and convex and slightly oval in shape with sharp rim and was placed medio-caudally. The head (Fig. 2) was followed by neck which was distinct only caudally. There was a very wide groove between lateral and medial tuberosity, which was inter tuberal/bicipital groove. Similar findings were reported in lion (Sohel *et al.*, 2021; Pathak *et al.*, 2017), tiger (Tomar *et al.,* 2014), leopard (Podhade *et al.*, 2014; Indu *et al.*, 2007) and cheetah (Petronela *et al.*, 2014).

The mean circumference of proximal extremity of humerus in lion was 21.11 cm. Sohel *et al.* (2021) observed the same for right and left humerus of lion as 18.40 and 18.27 cm, while Tomar *et al.* (2014) reported the corresponding figures in tiger as 23.48 and 23.20 cm, respectively. Podhade *et al.* (2014) reported the mean circumference of proximal extremity in leopard as 13.95 cm. This circumference was largest in tiger studied by Tomar *et al.* (2014), followed by Asiatic lion of present study and of Sohel *et al.* (2021), while it was much smaller in leopard.

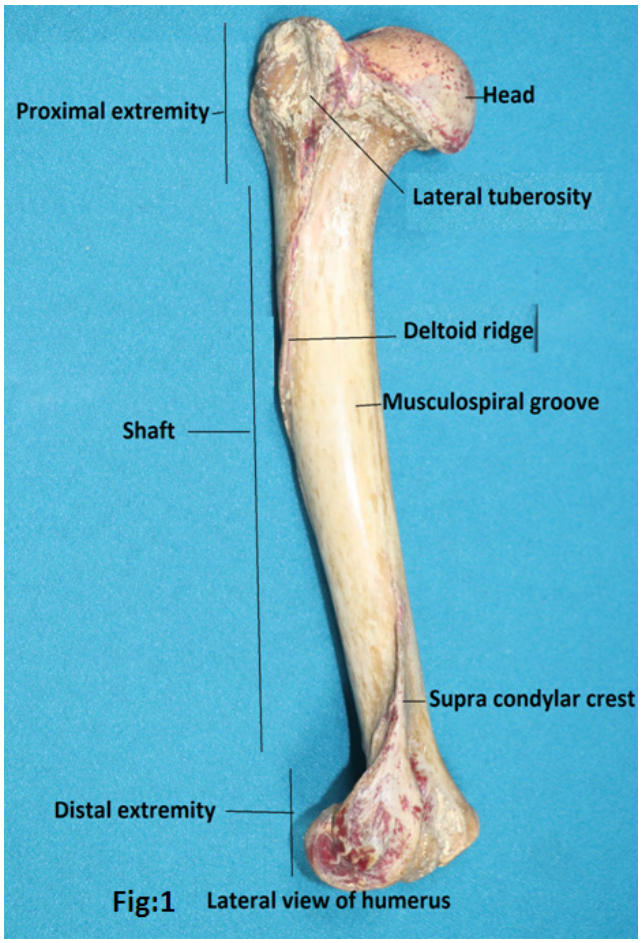

Fig:1 Lateral view of humerus

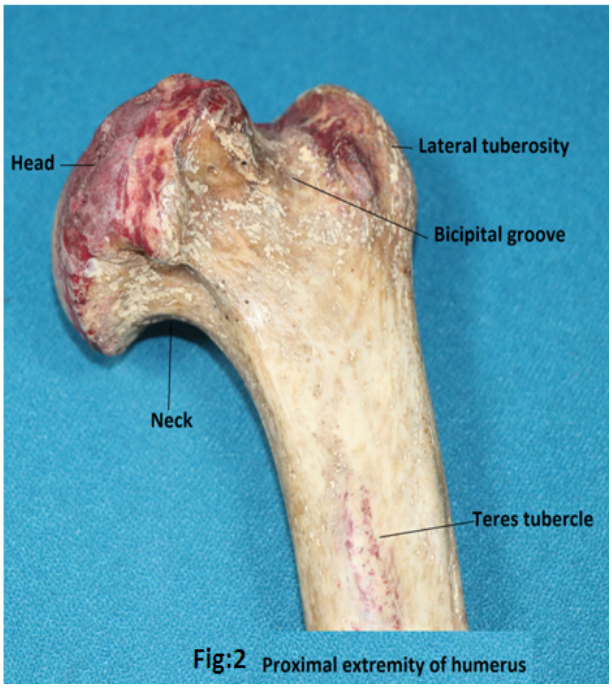

Fig:2 Proximal extremity of humerus

The mean circumference of head of humerus was 13.66 cm in present study. Sohel *et al.* (2021) observed the mean circumference of head of right and left humerus as 17.28 and 17.22 cm in lion, while Tomar *et al.* (2014) reported corresponding values in tiger as 20.82 and 20.64 cm, respectively. Podhade *et al.* (2014) reported the mean circumference of head in leopard as 9.65 cm. At proximal extremity, the circumference of head of the humerus was smallest in leopard and largest in tiger, followed by lions studied by Sohel *et al.* (2021) and in present study. The mean width and depth of bicipital groove (Fig. 2) were 2.70 and 0.81 cm, respectively. There was lack of information on morphometry of bicipital groove of humerus in reviewed literature.

Shaft

The shaft of humerus (Fig. 1) was little twisted and presented with four surfaces as cranial, caudal, medial and lateral surface. The cranial surface was triangular, wide above and narrow rounded below. A bony ridge/ the humeral crest started from between head and lateral tuberosity and ended in the deltoid tuberosity in the middle of the cranial surface. The caudal surface was straight and rounded in outline and distal one third was triangular in shape. The medial surface was flat, broad proximally and narrows distally. The teres tubercle

(Fig. 2) was a roughened area located on the proximal third as 3.36 cm in length. The lateral surface presented with the musculo-spiral groove (Fig. 1), which was wide, smooth and convex. It started from below the head, running downward and forward and ended on the cranial surface of the shaft at distal extremity. The oblique humeral crest formed the upper boundary of the musculo-spiral groove. Distally, the supracondyloid ridge started from just above the lateral epicondyle, running upward obliquely. It formed the lower boundary of musculo-spiral groove.

The mean length of shaft of lion humerus was 17.20 cm and the mean circumference from the middle 8.62 cm. Sohel *et al*. (2021) reported the mean length of right and left shaft as 25.50 and 25.40 cm and the circumference 11.58 and 11.45 cm in lion, respectively, which were more than our findings. Tomar *et al.* (2014) reported the mean length of shaft of right and left humerus in tiger as 20.28 and 20.14 cm, and the circumference at middle as 10.62 cm and 10.44 cm, respectively. Pathak *et al.* (2017) reported the mid shaft diameter of humerus 10.88 cm in tiger. Podhade *et al*. (2014) reported the mean length of shaft in leopard as 14.95 cm. The mean length of shaft was higher in lion and tiger and lower in leopard than the present findings. The mid shaft diameter was thicker in lion followed by tiger and leopard, but the diameter was less amongst all in lion of present study.

The length and width of musculo-spiral groove was 17.40 cm and 3.90 cm, respectively, and the length of deltoid ridge (Fig. 1) was 9.73 cm in present study.

Distal Extremity:

The distal extremity was having lateral and medial condyles and epicondyles, coronoid, radial, and olecranon fossae and supra trochlear foramina (Fig. 3 & 4). The lateral condyle was little larger than medial condyle. Both the condyles were separated by the sagittal groove. The coronoid fossa (Fig. 3) was shallow and located above the lateral condyle. The

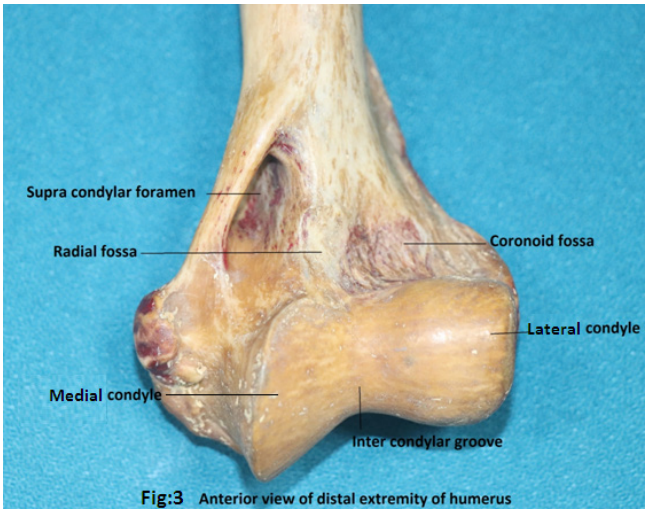

Fig:3 Anterior view of distal extremity of humerus

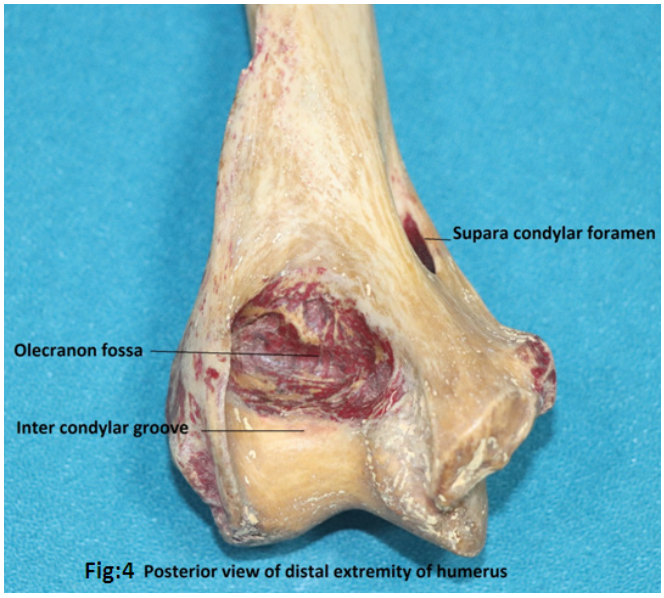

Fig:4 Posterior view of distal extremity of humerus

Table 1: Morphometrical measurements of humerus of lion (in cm; n=4)

Sr. No	Parameters	Mean
1	Weight of humerus (gm)	201.00
2	Total length of humerus	25.10
3	Length of shaft	17.20
4	Circumference of proximal extremity	21.11
5	Circumference of distal extremity	18.00
6	Circumference of head	13.66
7	Width of bicipital groove	2.70
8	Depth of bicipital groove	0.81
9	Circumference of shaft (middle)	8.62
10	Size of teres tubercle	3.36
11	Length of musculo-spiral groove	17.40
12	Max. width of musculo-spiral groove	3.90
13	Length of lateral condyle	6.80
14	Width of lateral condyle	2.46
15	Length of medial condyle	5.62
16	Width of medial condyle	2.26
17	Depth of coronoid fossa	0.46
18	Depth of olecranon fossa	0.96
19	Length of sagittal groove	4.86
20	Length of supra trochlear foramina	2.20
21	Width of supra trochlear foramina	1.10

radial fossa (Fig. 3) was small and present on medial side of extremity. The olecranon fossa (Fig. 4) was deep and placed caudally. There was no communication between coronoid fossa and olecranon fossa as well as between the radial fossa and olecranon fossa. The supra condylar foramina was placed medially above the medial condyle. Similar findings were reported in lion (Sohel *et al*., 2021; Pathak *et al*., 2017), tiger (Tomar *et al.,* 2014), leopard (Podhade *et al*., 2014; Indu *et al*., 2007) and cheetah (Petronela *et al*., 2014) on morphology of distal extremity.

In the present study, the mean circumference of distal extremity was 18.00 cm. Sohel *et al*. (2021) and Tomar *et al*. (2014) reported the mean circumference of distal extremity of right and left humerus in lion as 15.05 cm and 14.97 cm, and in tiger 25.46 cm and 25.22 cm, respectively. The circumference of distal extremity reported by Sohel *et al*. (2021) was lower than our finding. However, it was lower than that of tiger.

The mean length and mean width of lateral condyle were 6.80 and 2.46 cm, and of medial condyles 5.62 and 2.26 cm, respectively. The lateral condyle was larger than the medial condyle. The mean length of sagittal groove between condyles was 4.86 cm. The mean length and width of suparacondylar foramina (Fig. 3 & 4) was 2.20 cm and 1.10 cm, respectively. Literature lacked information on morphometry of condyles in lion.

The depth of coronoid fossa was 0.46 cm and of olecranon fossa 0.96 cm. Sohel *et al*. (2021) reported the mean depth of olecranon fossa in lion as 2.20 cm on right side and 2.10 cm on left side of humerus of lion. Tomar *et al*. (2014) reported the depth of olecranon fossa of right and left humerus in tiger as 2.70 and 2.62 cm, respectively. However, Pathak *et al*. (2017) observed that olecranon fossa in tiger was heart shaped with several foramina.

Conclusion

The humerus of Asiatic lion was with twisted appearance and had average weight 201.00 gm. The length and width of musculo-spiral groove were 17.40 and 3.90 cm, respectively. The length of this groove was almost parallel to the length of shaft of humerus. The length of teres major tuberosity was 3.36 cm and the length of deltoid ridge was 9.73 cm. The lateral condyle was larger than the medial condyle. The mean width and depth of bicipital groove were 2.70 cm and 0.81 cm, respectively. There were 3 fossae, Coronoid and Radial anteriorly and Olecranon posteriorly on distal extremity of humerus. The mean length and width of supracondylar foramina were 2.20 and 1.10 cm, respectively.

Acknowledgment

The authors are thankful to the Dean, College of Veterinary Science & AH, Kamdhenu University, Anand, for providing all the facilities to carry out this study.

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