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RESEARCH ARTICLE

Gross anatomical study on humerus of tiger (*Panthera tigris*)

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Abstract

In recent years the number of tigers is continuously decreasing due to poaching, diseases and destruction of habitat. The poaching is considered as one of the most important cause for reduction of their population and bringing them at the verge of extinction. So the present study was planned to record the characteristic features of the humerus in the tiger. The study was conducted on humerus of five adult tigers. Which was comprised of shaft and two extremities. The shaft was compressed antero-posteriorly in its upper third, cylindrical in middle third and compressed medio-laterally in its remaining part. It had tricipital lines, deltoid tuberosity, brachial groove and supracondyloid foramen similar to other felines. Tricipital line was in the form of oblique crest which formed the upper boundary of the brachial groove and terminated into deltoid tuberosity. The distal extremity had two separate coronoid and radial fossae which was 2:1 in ratio. Humerus bone of both the sides were morphologiocally similar but a non significant difference was observed in right and left side bones in all the skeletons ($t < 0.05$). Right humerus of the tiger weighed 381.22 $\pm$ 5.55 g and the mean total length was 31.36 $\pm$ 0.31 cm where as left humerus was weighing 384.94 $\pm$ 5.54g and 31.08 $\pm$ 0.29 cm. The mean circumference of the shaft on its upper, middle and lower part was 13.58 $\pm$ 0.12 cm, 10.62 $\pm$ 0.15 cm and 11.04 $\pm$ 0.12 cm, respectively in the right humerus where as they were 13.20 $\pm$ 0.08 cm, 10.44 $\pm$ 0.12cm and 10.90 $\pm$ 0.12 cm, respectively in left humerus. These differences may be of some biomechanical importance.

Introduction

The tiger is the national animal of India. It acquires the upper most position of a food web in forest. Madhya Pradesh is considered as 'The Tiger state' because of their highest population in the country. In the world many subspecies of tiger are found namely Royal Bengal tiger, Siberian tiger, Indochinese tiger, Malayan tiger etc., out of them the Bali tiger, Javan tiger and Caspian tiger have become extinct from the world. In recent years the number of tigers is continuously decreasing due to poaching, diseases and destruction of habitat. The poaching is considered as one of the most important cause for reduction of their population and bringing them at the verge of extinction.

The tiger is a member of the family felidae and carnivorous in habit. The anatomical studies on domestic felines and canines have been conducted (Sisson, 1975) and some information is available on few bones of leopard (Kale et al., 1999 and Kumar, 2008), Panther (Patil et al., 1998) and Asiatic lion (Pandey et al., 2004). There is

paucity of the literature on systematic information of characteristic anatomical features of bones of tiger. Keeping this fact in mind the present study was planned to record the gross anatomical feature of humerus in tiger.

Materials and methods

Gross anatomical study was conducted on humerus of 5 adult tigers of either sex, two procured from Department of Wildlife Health and management and three from Department of Veterinary Anatomy and Histology, College of Veterinary Science and Animal Husbandry, Madhya Pradesh Pashu Chikitsa Vigyan Vishwavidyalaya, Jabalpur (M.P.) India. All the terminology was adopted as per Boyd et al., 2001. The morphometrical data were recorded with a thread and scale having calibration in millimetres. These all measurements included all the elevations, depressions and curvatures present on the bones to understand the biomechanics of tiger skeleton. The statistical analysis was carried out with Microsoft excel 2007.

Results and discussion

Right humerus of the tiger weighed 381.22 $\pm$ 5.55 g and the mean total length was 31.36 $\pm$ 0.31 cm. The shaft was compressed antero-posteriorly in its upper third, cylindrical in middle third and compressed medio-laterally in its remaining part. Similar finding was mentioned by Pandit (1994). Medial surface was flattened in its upper half whereas rounded in the lower portion. The mean length of shaft was 20.28 $\pm$ 0.39 cm. The mean circumference of the shaft on its upper, middle and lower part was 13.58 $\pm$ 0.12 cm, 10.62 $\pm$ 0.15 cm and 11.04 $\pm$ 0.12 cm, respectively (Table. 2).The brachial groove (musculo-spiral groove) was wide and its surface was convex. Similar statement was reported by Podhade (2007) in leopard.

Tricipital line was in the form of oblique crest which formed the upper boundary of the brachial groove and terminated into deltoid tuberosity (Fig. 4). Similar findings were recorded by Boyd et al. (2001) in domestic cat. Lateral to the middle of the deltoid crest there was a very small smooth tubercle. Another crest that started from the lower part of greater tubercle (lateral tuberosity) ran straight and ended at middle of the lateral border into the tuberosity for teres major muscle (Fig. 1). Supracondyloid ridge started from just above the lateral epicondyle, which ran upward obliquely on the caudal surface. It formed the lower boundary of brachial groove (Fig. 2). Caudal surface had broad elongated area medial to the lateral crest.

The proximal extremity was comprised of head, greater tubercle (lateral tuberosity), lesser tubercle (medial tuberosity) and intertubercular groove (bicipital groove) as shown in Fig. 1 & 2. Head was convex and oval in shape and faced caudally (Fig. 3). The articular surface was bounded by a sharp rim except cranially. The greater tubercle (lateral tuberosity) was slightly higher in level than head and it was single. The lateral surface presented longitudinally oriented, elongated depression on its caudal part and anterior to it there was prominent eminence. Caudo-medially, greater tubercle (lateral tuberosity) had smooth eminence that formed the lateral boundary of the intertubercular groove (bicipital groove). Lesser tubercle (medial tuberosity) was small and closely attached to the head. It formed the medial boundary of intertubercular groove (Fig. 1). The mean circumference and width of proximal extremity was 23.48 $\pm$ 0.26 cm and 10.58 $\pm$ 0.25 cm, respectively (Table. 2).

Distal extremity was comprised of two condyles, epicondyles, supracondyloid foramen medially, radial fossa anteriorly and olecranon fossa posteriorly similar to other felines (Boyd et al., 2001). The medial condyle was in the form of trochlea which had a sharp border and the lateral condyle, the capitulum was convex and smooth (Fig. 1). The circumference and the width of the distal extremity was 25.46 $\pm$ 0.32, respectively (Table. 2).

A small, oval shaped facet was present just lateral to the supracondyloid foramen. Radial fossa was small and present on the medial side of the distal extremity. Presence of radial fossa was also reported by Podhade (2007).

The coronoid fossa was shallow and located above the lateral condyle (Fig. 1). Olecranon fossa was inverted heart shaped and had one bean shaped shallow depression. The medial boundary of olecranon fossa was smooth while the lateral boundary over hanged the fossa and became sharp distally. Comma shaped, wide and shallow rough depression was present which started from the olecranon fossa and ended at medial condyle (Fig. 2). The olecranon fossa was 2.70 $\pm$ 0.07 cm deep (Table. 2). The olecranon fossa was not communicating with the radial fossa where as presence of supratrochlear foramen (communication between radial and olecranon fossae) was reported by Sisson (1975) in dog.

Morphologically, the left humerus was similar to the right one but morphometrically, it was weighing 384.94 $\pm$ 5.54 g and 31.08 $\pm$ 0.29 cm long and the circumference of the shaft on proximal, middle and distal part

was 13.20 ± 0.08 cm, 10.44 ± 0.12 and 10.90 ± 0.12, respectively. The circumference of head was 20.64 ± 0.28. The depth of the olecranon fossa was 2.62 ± 0.09 cm. The circumference and width of proximal extremity was 23.20 ± 0.29 and 10.42 ± 0.24 cm, respectively. The circumference and width of distal extremity was 25.22 ± 0.31 cm and 9.66 ± 0.54 cm, respectively (Table. 2). The difference in various morphometrical data between right and left humerus was not significant ($t < 0.05$) but this difference may attribute to some biomechanical importance.

Table.3: Morphometrical data for different parameters of humerus

S. No	Parameters	Skeleton I		Skeleton II		Skeleton III		Skeleton IV		Skeleton V	
		R	L	R	L	R	L	R	L	R	L
1	Weight (gm)	370	372	374	382	380	383	402.1	405.6	380	382.1
2	Length (cm)	30.6	30.3	31	30.8	32	31.7	32.2	31.8	31	30.8
3.	Shaft										
	Length (cm)	19.4	19.4	20	20	21	20.6	21.4	21.1	19.6	19.6
	• Upper part	13.2	12.9	13.5	13.2	13.7	13.2	13.9	13.4	13.6	13.3
	• Middle part	10.2	10.1	10.5	10.4	10.8	10.6	11.1	10.8	10.5	10.3
	• Lower part	10.7	10.6	11	10.9	11.2	11	11.4	11.3	10.9	10.7
4.	Head (cm)										
	• Circumference	20.1	19.9	20.5	20.4	21.2	21	21.6	21.5	20.7	20.4
5.	Head (cm)										
	• Olecranon fossa	2.5	2.4	2.7	2.5	2.8	2.7	2.9	2.9	2.6	2.6
6.	Proximal extremity (cm)										
	• Circumference	22.9	22.6	23.5	22.8	23.9	23.7	24.2	24.1	22.9	22.8
	• Width	10.8	10.7	11.2	11	9.9	9.8	10.1	9.9	10.9	10.7
7.	Distal extremity (cm)										
	• Circumference	24.7	24.6	25.3	24.9	26	25.7	26.4	26.2	24.9	24.7
	• Width	9.1	8.9	11.2	11.8	9.2	9.1	9.4	9.3	9.3	9.2

Table. 4: The range, mean and SE for various parameters of humerus

S. No	Parameters	Range		Mean		SE	
		R	L	R	L	R	L
1	Weight (gm)	370.0-402.1	372.0-405.6	381.22	384.94	5.55	5.54

2	Length (cm)	30.6-32.2	30.3-31.8	31.36	31.08	0.31	0.29
3	Shaft						
	Length (cm)	19.4-21.4	19.4-21.7	20.28	20.14	0.39	0.32
	Circumference(cm)						
	· Upper part	13.2-13.9	12.9-13.4	13.58	13.20	0.12	0.08
	· Middle part	10.2-11.1	10.1-10.8	10.62	10.44	0.15	0.12
	· Lower part	10.7-11.4	10.4-11.3	11.04	10.90	0.12	0.12
4	Head (cm)						
	· Circumference	20.1-21.6	19.9-21.5	20.82	20.64	0.26	0.28
5	Depth(cm)						
	· Olecranon fossa	2.5-2.9	2.4-2.9	2.70	2.62	0.07	0.09
6	Proximal extremity (cm)						
	· Circumference	22.9-24.2	22.6-24.1	23.48	23.20	0.26	0.29
	· Width	9.9-11.2	9.8-11.0	10.58	10.42	0.25	0.24
7	Distal extremity (cm)						
	· Circumference	24.7-26.4	24.6-26.2	25.46	25.22	0.32	0.31
	· Width	9.1-11.2	8.9-11.8	9.64	9.66	0.39	0.54

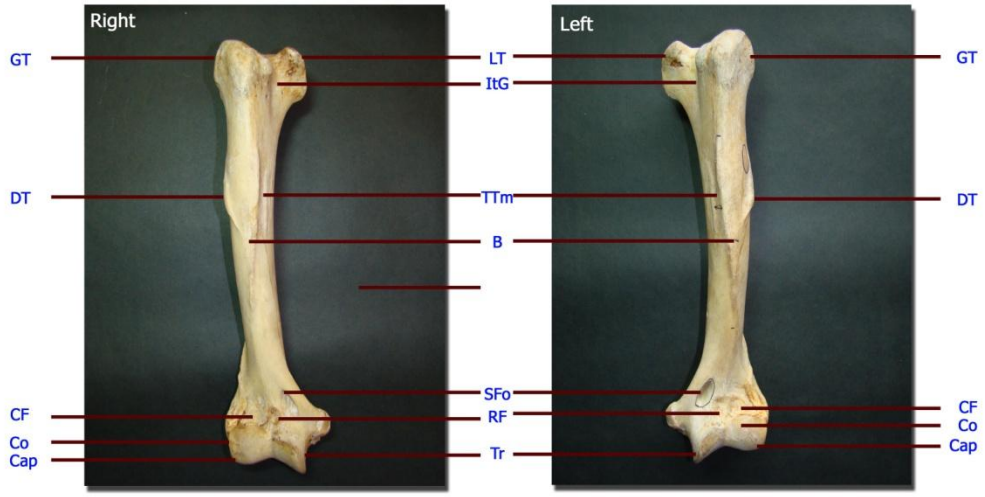

Fig .1 : Anterior aspect of humerus showing GT (greater tubercle), DT (deltoid tuberosity), Co (condyle), Cap (capitulum), Tr (trochlea), Rf (radial fossa), SFo (supracondylar foramen), B (body), TTm tuberosity for tere major), LT (lesser tubercle), CF (coronoid fossa)and ItG (intertubercular groove).

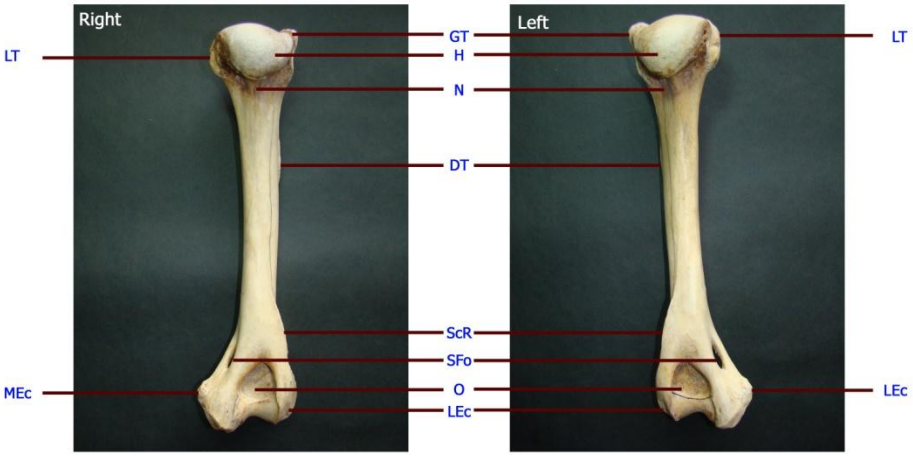

Fig . 2 :Posterior aspect of humerus showing GT (greater tubercle), H (head), N (neck), DT (deltoid tuberosity), ScR (supracondyloid ridge), SFo (supracondyloid foramen), B (body), O (olecranon fossa) LEc (lateral epicondyle), MEc (medial epicondyle) and LT (lesser tubercle).

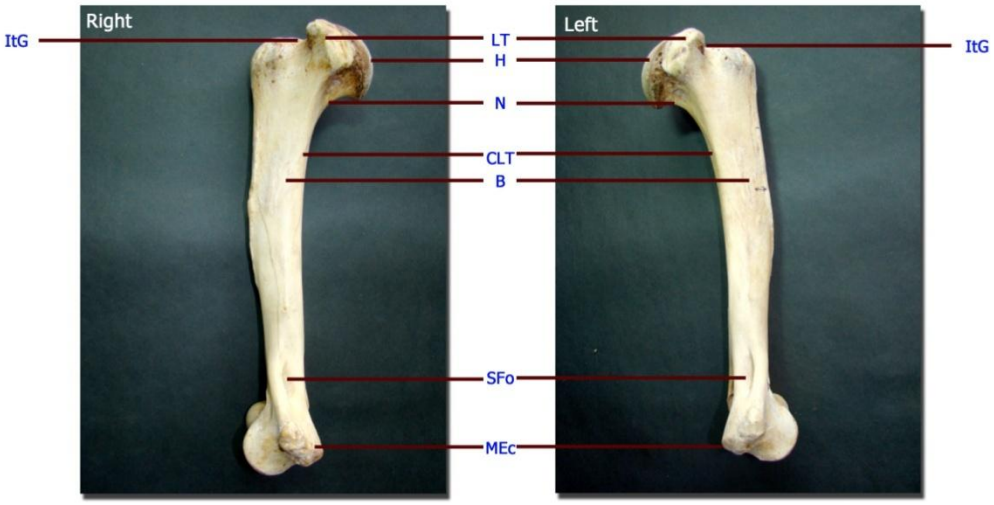

Fig . 3 : Medial aspect of humerus showing H (head), N (neck), SFo (supracondyloid foramen), B (body), MEc (medial epicondyle), LT (lesser tubercle), CLT (crest of lesser tubercle) and (ItGintertubercular groove) .

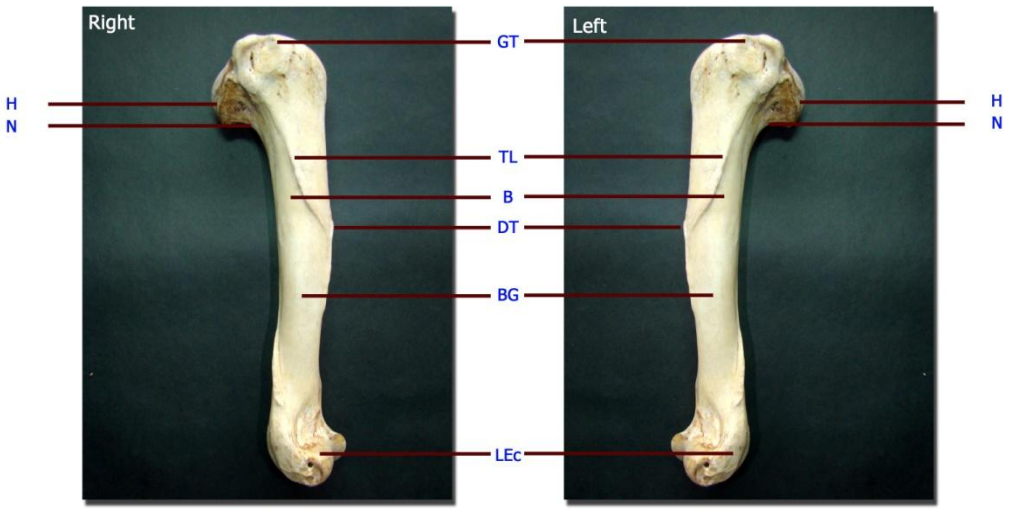

Fig . 4 : Lateral aspect of humerus showing H (head), N (neck), TL (tricipital line), DT (deltoid tuberosity), BG (brachial groove), B (body), LEc (lateral epicondyle) and GT (greater tubercle).

Conclusion

From the present study we can conclude that presence of supracondyloid foramen, tricipital line, separate radial and coronoid fossa and the ratio of these fossae can be used for the identification of humerus of tiger for forensic purpose. Simultaneously, the morphometrical difference may be used for biomechanical studies with some larger sample size.

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