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# Morphological and Morphometrical Studies on the Tibia and Fibula of Tiger (*Panthera tigris*).

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## ABSTRACT

The study reports gross anatomical details of the tibiaand fibula of tiger. Bones of five adult tigers of either sex were studied out of which 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 (NDVSU), Jabalpur (M.P.).The tibia was the larger of the two bones in the leg region. Tibia was long, prismatic and distinctly curved at its upper two third and cylindrical at its lower third. The mean circumference of the shaft was 16.72 $\pm$ 0.29 cm, 10.06 $\pm$ 0.17 cm and 10.18 $\pm$ 0.18 cm at its upper, middle and lower parts, respectively.The proximal extremity presented two condyles and a tibial tuberosity. The distal extremity showed two cranio-caudally directed oblique articular groove of which the medial was deeper than the lateral. The fibula was very thin and flattened mediolaterally and curved distally. It presented a shaft and two extremities. It weighed 28.52 + 0.46 g and was 29.26 $\pm$ 0.28 cm in length. The shaft was thin and cylindrical in the proximal third and flat in the lower two third. However, it differed nonsignificantly in morphometry.

**Keywords:**Tiger, Tibia, Fibula, Leg bones

## INTRODUCTION

The tiger (*Panthera tigris*), biggest cat in the Felidae family, is only outmatched in strength and ferocity by the lion (*Panthera leo*). It is listed as Endangered on the IUCN Red List of Threatened Species, as its range is thought to have declined by 53% to 68% since the late 1990s. Because of its strong swimming ability, the tiger can readily cross rivers up to 8 km (5.0 mi) wide. Due to its size, it is often less able to climb trees than many other cats, though cubs younger than 16 months old may frequently do so. In general, the femur, tibia, and fibula are important hind limb bones that support body weight, allow for mobility and ambulation (walking) and provide structural stability. The tibia and fibula carry the weight of the lower leg, with the tibia bearing the majority of the weight, while the femur supports the weight of the upper body. Because of their skeletal structure, leg bones are essential for hunting because they enable the strong and quick movements necessary for tracking, pursuing, and capturing prey as well as for giving body strength to endure trauma and physical strain.

Anatomical studies on domestic felines and canines have been conducted (Sisson, 1975) and little information is available on a 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 literature on the characteristic .anatomical features of leg bones of tiger, So, keeping in mind about the versatility of this species the present study was conducted to keep on record the gross anatomical features of the tibia and fibula bones of tiger. The information obtained in the present study will be useful not only for identification of bones but also aid in Wildlife forensic studies.

## MATERIALS AND METHODS

Gross anatomical and radiographic study was conducted on leg bones of appendicular skeletons 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

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Animal Husbandry Madhya Pradesh Pashu chikitsa Vigyan Vishwavidyalaya (NDVSU), Jabalpur (M.P.). All the terminology was adopted as per Boyd *et al*. (2001) in domestic cat, Budras *et al*. (2007) in dog and Nomina Anatomica Veterinaria (2017). Morphometry was performed with nonelastic thread and data wasanalyzed for arithmetic mean and standard error.

## RESULTS AND DISCUSSION

Tibia and fibula bones were well developed and the tibia was the larger of the two bones in the leg region. The mean weight and length of right tibia was 318.92 ± 1.12 g and 30.52 ± 0.20 cm, respectively. In cat, the length of tibia was reported 11.58 ± 0.38 cm (El- Ghazali and El-Behery, 2018). It had a shaft and two extremities. The shaft was prismatic at its upper two third and cylindrical at its lower third (Fig 1). Similar observations were made by Sisson (1975) in dog. The mean circumference of the shaft of tibia was 16.72 ± 0.29 cm, 10.06 ± 0.17 cm and 10.18 ± 0.18 cm at its upper, middle and lower parts, respectively. Lateral surface was smooth and deeply concave at its upper fourth and straight in its distal three fourth (Fig 3). Medial surface of the shaft was rough and slightly concave close to the proximal extremity and smooth and straight distally (Fig 4). Caudal surface was straight and had two distinct oblique popliteal lines in its upper half (Fig 2). Similar statements were quoted by Podhade (2007) in leopard. El Ghazali and El-Behery (2018) reported that, the popliteal line (*Linea m. poplitei*) was absent in the cat. The posterior surface was flattened from side to side as reported by Raghavan (1964) in ox, Getty (1975) in horse, Smuts and Bezuidenhout (1987) in dromedary and Choudhary *et al.* (2015) in blackbuck. This surface was marked by a number of rough lines same as described by Raghavan (1964) in ox, Miller *et al.* (1964) in dog, Getty (1975) in horse; Choudhary *et al*. (2015) in blackbuck; however, Getty (1975) noted the absence of rough lines in sheep and goat. Nutrient foramen was present on the upper fourth of the caudal surface very close to the lateral border. Similar findings were reported by Sisson (1975) in dog. El Ghazali and El-Behery (2018) reported the presence of nutrient foramen on the proximal third of the caudal surface toward the lateral border in the cat while the nutrient foramen was situated on the popliteal line in horse according to Getty (1975). The anterior border was in the form of crest which faded out distally and ended over the craniomedial aspect of the distal extremity (Fig 1).The crest was thin sharp in rabbit while thick and slightly curved laterally in cat (El Ghazali and El-Behery, 2018). Lateral border was sharp in whole length whereas the medial border was small and merged with medial popliteal line in upper third of the length. The lateral popliteal line was in whole length and terminated on to the caudomedial aspect of the distal extremity (Fig 2). The proximal extremity was much larger than the distal extremity. It had medial and lateral condyles (Fig 2). Similar report was presented by Ray and Ray (1994) and Podhade (2007) in leopard. The mean circumference and width of the proximal extremity was 22.66 ± 0.34 cm and 8.00 ± 0.14 cm, respectively. The mean length and width of the medial condyle (5.68 + 0.09 and 3.52 ± 0.14 cm, respectively) was more than the lateral condyle (5.40 ± 0.13 cm and 2.66 ± 0.05 cm, respectively). The proximal extremity was reported to be large with three tuberosities and two condyles in the blue bull (Bharti and Singh, 2020). Further it was reported that the three tuberosities were separated by intertuberal fossa by Raghavan (1964) in ox and Konig and Liebich (2006) in dog, Akers and Denbow (2008) in ruminants and Choudhary *et al.* (2015) in blackbuck. The intercondyloid eminences (medial and lateral) were more or less of same height (Fig 2). The free edge of medial eminence was ill defined while that of lateral one was blunt (Fig 3) while, Podhade (2007) reported the presence of sharp medial eminencein leopard. In front of the lateral condyle, there was a large elliptical smooth area. Such area was absent in front of the medial condyle. Cranial part of proximal extremity presented tibial tuberosity, which was rough at its upper part and smooth at its lower part (Fig 1). Similar finding was mentioned by Sisson (1975) in dog. Sulcus muscularis on the cranial aspects of the lateral condyle was shallow (Fig 3). Popliteal notch was distinct on the caudal aspect of the proximal extremity between two condyles.

There were two small facets on caudo-lateral aspect on the lateral condyle for articulation with proximal extremity of the fibula bone.

The distal extremity was smaller than the proximal extremity. The distal extremity presented two cranio-caudally directed oblique articular grooves. Similar reports were made by Raghavan (1964) in ox and Choudhary *et al*. (2015) in blackbuck.The mean circumference and width of the distal extremity was 15.76 ± 0.15 cm and 6.10 ± 0.13 cm, respectively. The medial articular groove was much deeper than lateral one. Laterally, the distal extremity presented an articular facet, which articulated with distal extremity of fibula. Medial malleolus presented rough area for the attachment of collateral ligament (Fig4 ). These findings supported the observation of Podhade (2007) in leopard. On the contrary, the lateral groove was separated by a sharp border which articulated with the lateral malleolus as revealed by Raghavan (1964) in ox, Choudhary *et al.* (2015) in blackbuck and Bharti and Singh (2020) in blue bull. On the antero-lateral aspect of the distal extremity, a small tubercle was present.

**Fibula:**

It was very thin and flattened mediolaterally and curved distally. It presented a shaft and mean circumference of the shaft was 4.12 ± 0.07 cm, 3.80 ± 0.09 cm and 3.50 ± 0.11 cm at its upper, middle and lower part,respectively. The shaft was thin and cylindrical in proximal third and flat in the lower two third. The medial surface was highly concave in its middle portion and did not come in contact with tibia (Fig. 5) whereas, Podhade (2007) reported flat medial surface in leopard. Lateral surface was convex and faced laterally in upper two third (Fig 6). The cranial border was very sharp in the upper three fourth. The caudal border was blunt in upper two third and became sharp in lower one third. The mean circumference and width of the proximal extremity was 6.66 ± 0.18 cm and 3.36±0.09 cm, respectively. The proximal extremity was compressed transversely. Laterally, there were two eminences viz. cranial and caudal separated by a vertical sulcus. The mean circumference and width of distal extremity were measured 8.82 ± 0.13 cm and 3.84 ± 0.28 cm, respectively. The distal extremity was also compressed medio- laterally and much thicker than proximal extremity. The medial surface on its cranial aspects had a wider articular facet which articulated with the tibia and also with the fibular tarsal. There was another articular facet caudally which articulated only with fibular tarsal bone. On the lateral aspect of the extremity there was deep, vertical groove known as the *sulcus malleolaries lateralis*. These observations were in support of thereport of Podhade (2007) in leopard.

The left fibula was morphologically similar to right fibula. However, it differed nonsignificantly in morphometry. Left fibula was 28.38 + 0.44 g in weight and 29.36 + 0.18 cm in length. Its circumference measured at its upper, middle and lower part of shaft was 4.02 + 0.09 cm, 3.80 + 0.12 cm and 3.50 + 0.06 cm, respectively. The mean circumference and width of the proximal extremity was 6.66 + 0.17 cm and 3.22 + 0.08 cm, respectively. The mean circumference and width of its distal extremity was 8.50 + 0.19 cm and 3.76 + 0.31 cm, respectively.The fibula was reported as long, thin and rudimentary bone which was reduced to a small, short blunt, pointed prolongation as described by Raghavan (1964) in ox, Frandson *et al.* (2009) in dog and pig and Choudhary *et al.* (2015) in blackbuck while it was in disagreement with Getty (1975) in horse and Smuts and Bezuidenhout (1987) in dromedary camel, who described that the fibula was laterally compressed bone and the proximal part of the fibula was represented by a blunt tuberosity on the lateral condyle whereas the head and distal extremity of the fibula was very prominent as reported by Kirberger *et al.* (2005) in lion and the tibia-fibula were fused almost in the distal half as reported by Ozkan (2002) in hedgehog. The tibia and fibula were partially fused at the tips as elucidated by Oliveira *et al.* (2007) in paca.

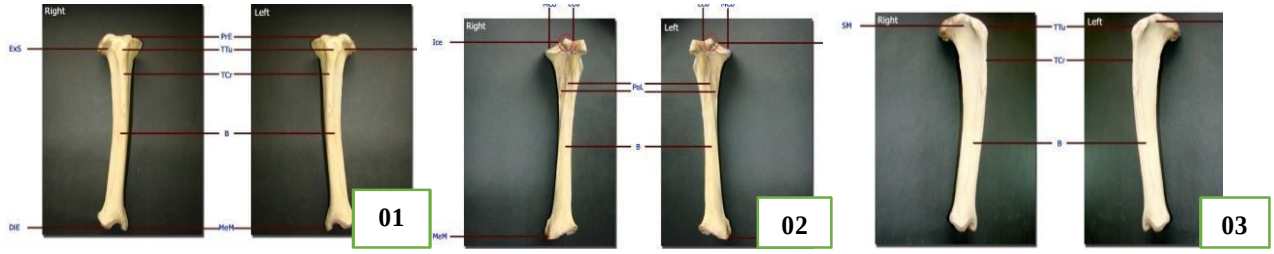


**Fig 1:** Anterior aspect of the tibia showing proximal extremity (PrE), Distal extremity (Dr E), Tibial tuberosity (Tbr), shaft (B) and Tibial crest (TCr), **Fig 2:** Posterior aspect of the tibia showing medial condyle (MCo), Lateral condyle (LCo),Inter condyloid eminence (Ice), Popliteal line (POL) shaft (B) and Medial malleolus (MeM), **Fig 3:** Lateral aspect of tibia showing sulcus muscularis (SM), Tibial tuberosity (TTu), Tibial crest (TCr) and shaft (B).

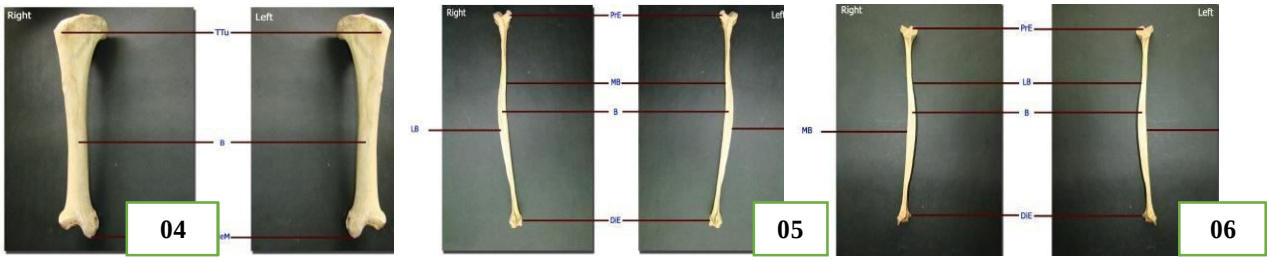


**Fig 4:** Medial aspect of tibia showing Tibial tuberosity (TTu) shaft/body (B) and Medial malleolus (MeM), **Fig 5:** Anterior aspect of fibula showing Proximal extremity (PrE), MediaL border (MB), shaft (B), Lateral border (LB) and distal extremity (DiE), **Fig 6:** Posterior aspect of the fibula showing Proximal extremity (PrE), Distal extremity (DiE) , Lateral border (LB), Medial border(MB) and shaft (B).

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