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## Gross morphological and morphometric studies on the femur, tibiotarsus and fibula in Emu (*Dromaius novaehollandiae*)

**Rajalakshmi K, Sridevi P and Siva Kumar M**

### Abstract

Femur was a short massive tubular long bone and shaft was slightly curved and had four surfaces and two borders. The proximal extremity was composed of the head with distinct neck and trochanter major. The large distal extremity consisted of a trochlea on its cranial surface and two cylindrical condyles on the caudal surface which were separated by the intercondyloid fossa. Patella was not observed. The tibiotarsus was the strong and longest bone in the hind limb and was twice the length of the femur. It presented a shaft and two extremities. The lateral surface of the shaft had a distinct rough fibular crest near the proximal extremity. The proximal extremity consisted of two condyles which articulated with the femur and two ridges medial and lateral both of which were separated by an intervening Cnemial crest. The smaller distal extremity showed a trochlea on its cranial surface which continued caudally as condyles. An extensor canal was observed on the anterior aspect of the distal extremity just proximal to the trochlea. The fibula was placed along the lateral border of the tibia and extended to two third of the length of the tibia.

**Keywords:** Morphological study, femur, trochlea, supracondyloid crest

### Introduction

In Birds hind limb are the sole structure for support and walking. To overcome the stress during landing, in talking off, running and hunting, most birds have a relatively heavy strong bones. The protraction, retraction, abduction, adduction and rotation are the movements performed in the thigh. Extension and flexion are the main movements exhibited in the knee joint. The tibial length denotes a birds habit, the length is more in walking birds followed by the runners and in the swimming birds. In mammals femur is the longest and the strongest bone whereas in birds the tibiotarsus is the longest and strongest. The pelvic limb in birds is more important because of their bipedal standing, walking as well as running compared with mammals. Emu is wild bird, native of Australia which is considered to be descended from a common ancestor. These birds adapt to varied environmental conditions and are used for meat oil and skin. It exhibits strides of about 100cm at walk, and at a full gallop it can be as long as 275cm. Its legs are devoid of feathers these bones are prone for fracture because of its heavy weight, height, running and its kicking habits. The present study on gross morphological features peculiar to the thigh and leg bones of the wild domestic flightless bird emu was undertaken because the information available on this species was scanty.

### Materials and Methods

The materials for the study were collected from three adult emu birds of either sex brought for post mortem examination to the Department of Veterinary Pathology, Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry, India. The femur and tibio tarsus and fibula was removed by maceration method, cleaned, dried and the various gross anatomical and morphometric features were studied.

### Results and Discussion

Femur was a short massive tubular long bone 20 cm in length. In its proximal end it was 4cm wide, 2.9cm in width in the midshaft and 5cm at its distal end. It was directed downward and forward between os-coxae and tibiotarsus. It consisted of a shaft and two extremities. The distal extremity was larger than proximal with a large pneumatic foramen. Sreeranjini *et al.*, 2013<sup>[6]</sup> in peahen, observed that proximal and distal extremities were almost of equal size with large number of pneumatic foramina.

The shaft was slightly curved and had four surfaces and two borders. The posterior surface of the shaft had a distinct *linea aspera*. Similar finding was noticed in peahen by Sreeranjini *et al.*, 2013 [6] but Nickel *et al.*, 1977 [5] had stated that in chicken and duck it was indistinct. Anterior, posterior and medial surface presented numerous muscular lines. The lateral surface had a rough area with several ridges and rough depressions for muscular attachment. The medial border was smooth and concave in its length. The lateral border was nearly straight and presented in its distal third a supracondyloid crest (Fig.1).

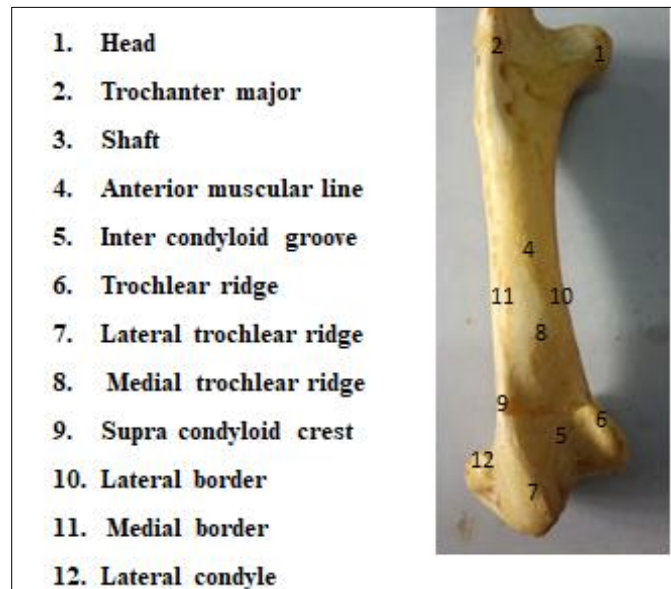


Fig 1: Anterior surface of femur

The proximal extremity was composed of the head and trochanter major. The circular head had a distinct neck (Fig.2) and articulated with the acetabulum whereas Nickel *et al.*, 1977 [5] in domestic birds observed a hemispherical head and with short neck. Fovea capitis was absent which coincides with the observations noticed by Shanthilakshmi *et al.*, 2007 [8, 9]. However an indistinct fovea capitis was observed in one of specimen. Nickel *et al.*, 1977 [5] had observed a fovea capitis in birds. The trochanter major and head were at the same level and separated by a shallow groove. According to Kumar and Singh (2014) [7] in emu reported that trochanter major did not extend above the level of the head. While Sreeranjini *et al.*, 2013 [6] observed that in peahen trochanter major extended above the level of the head. The large well developed pneumatic foramen (Fig. 2) was observed just below the groove on the posterior surface between head and trochanter major. The trochanter major presented a large round nearly flat area on its lateral aspect. A vertical ridge proximally separated the flat area from a medial smooth area which had an oval facet anteriorly for articulation with antitrochater of acetabulum. This is parallel to the findings of Shanthi lakshmi *et al.*, 2007 in emu. A vertical ridge continued anteriorly on its proximal one third. Along the medial border below the head was a rough ridge the trochanter minor (Fig.2).

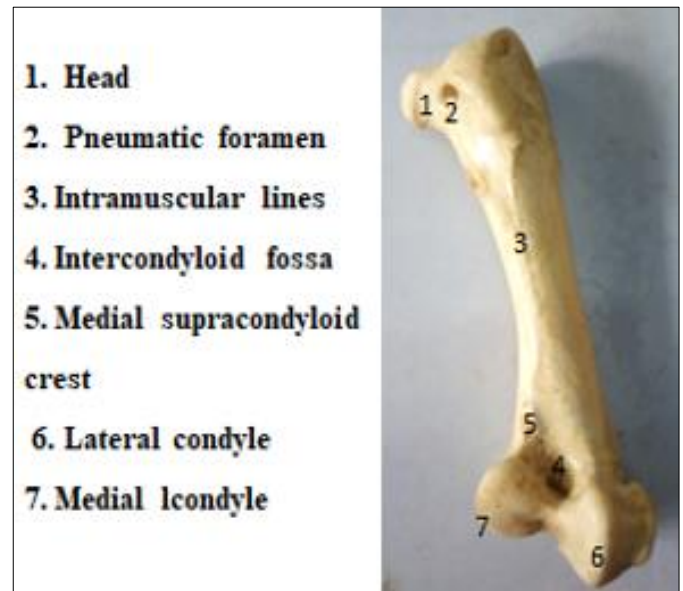


Fig 2: Posterior surface of femur

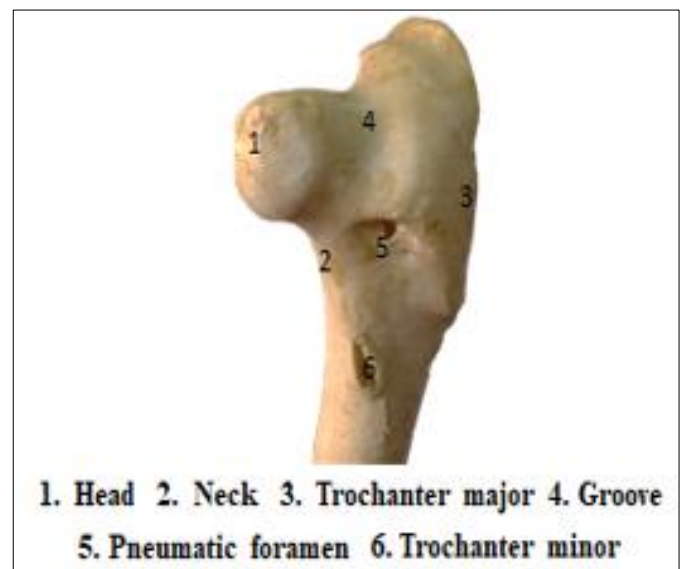
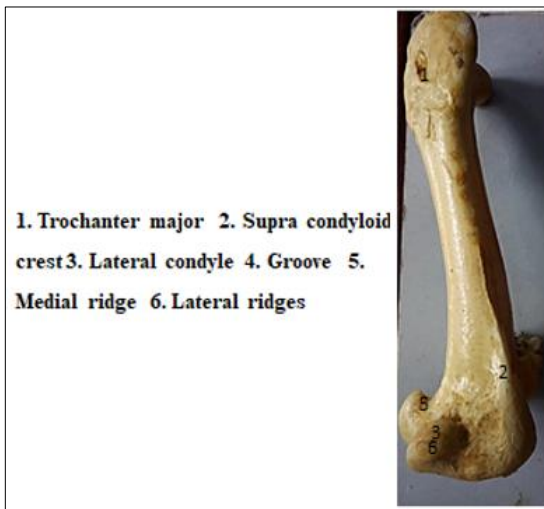


Fig 3: Proximal extremity of femur

Distal extremity was large and had a trochlea on its cranial surface which was composed of two ridges separated by a wider *intercondyloid groove*. This was similar to the observation made by Nickel *et al.*, 1977 [5] in domestic fowl and Sreeranjini *et al.*, 2013 [6] in peahen. The ridges continued caudally as two cylindrical condyles, a small medial and a large lateral condyle the latter was more distally placed and was divided by a wide groove into a large medial and small lateral ridge (Fig.4). The medial ridge in its lower part had a triangular facet for the tibia and the lateral ridge had a similar facet for the head of fibula. A similar finding was reported by Kumar and Singh (2014) [7] in emu. Between the two condyles, on the posterior surface was the intercondyloid fossa which beared laterally a tubercle (Fig.4). The medial border presented in its distal third a crest, the medial supracondyloid crest below which was a supracondyloid

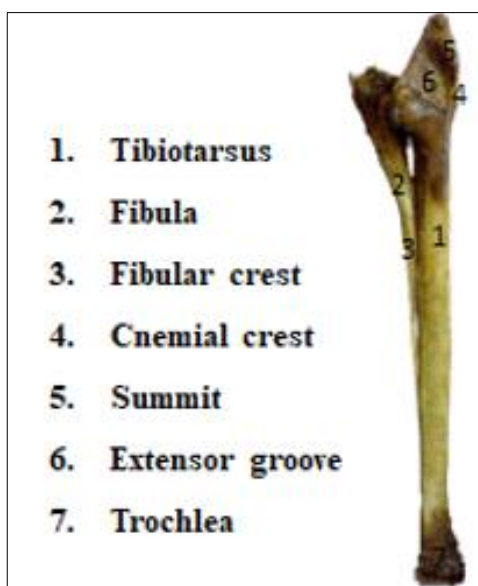
fossa. Patella was not noticed in the present study which coincided with the findings made by Kumar and Singh (2014)<sup>[7]</sup> in emu.



**Fig 4:** Lateral surface of femur

**Tibiotarsus**

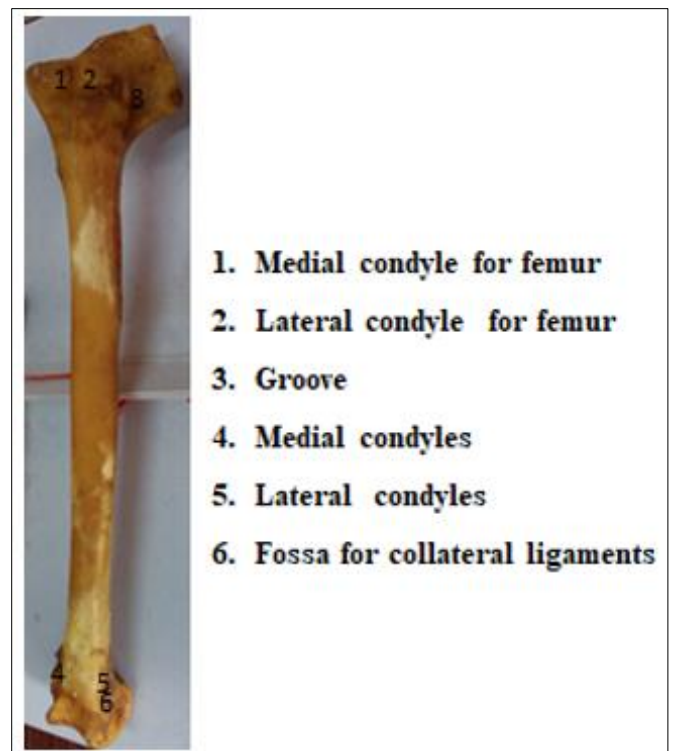
The tibiotarsus was the strong longest bone in the hind limb fused with proximal row of tarsals and was almost twice longer 42cm than the femur. This was similar to findings of Jagapathiramayya *et al.*, 2007<sup>[8, 9]</sup> in emu and Nickel *et al.*, 1977<sup>[5]</sup> in duck and goose, whereas in fowl and pigeon it was only one third longer. In its proximal end it was 8.5cm wide, 3.5cm in width in the midshaft and 4.5cm at its distal end It was placed obliquely downward and backward between femur and tarsometatarsus. It consisted of a shaft and two extremities. The shaft was three sided above and became rounded below. It had three surfaces and three borders. The lateral surface had a distinct rough fibular crest (Fig 5.) for attachment of the fibula which concurs with the findings of Sreeranjini *et al.*, 2013<sup>[6]</sup> in peahen. However, the crest was not well developed in fowl McLelland, (1990)<sup>[4]</sup> and in Coturnix quail (Fitzgerald, 1969)<sup>[2]</sup>. The medial surface was broad above and narrow below marked by muscular lines.



**Fig 5:** Lateral surface of tibiotarsus

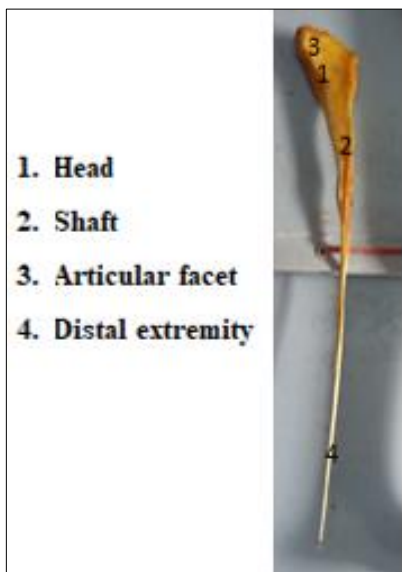
The posterior surface was flat and presented muscular lines. The anterior border on its upper third formed a prominent ridge. The lateral border articulated with fibula while the medial border all most straight.

The proximal extremity was large and made up of two condyles and two ridges. Which concurs with the findings of Kumar and Singh (2014)<sup>[7]</sup> in emu. The two condyles were directed caudally, medial condyle was larger articulated with medial condyle of femur and lateral was small which articulated with lateral part of lateral condyle of femur and they were separated by a small groove. The medial ridge was placed transversely, thin sharp placed at higher level while the lateral ridge was directed laterally, low and tuberos below its middle. Both the ridges were separated by an intervening cnemial crest (Fig. 6). in the proximal third of shaft and the ridges were united proximally and formed summit of the bone. This was in accordance to the findings of Sreeranjini *et al.*, 2013<sup>[6]</sup> in peahen, how ever in fowl, the cnemial crest faded on the shaft itself. Al-Sadi (2012)<sup>[1]</sup> reported, two cnemial crests a cranial larger and a caudal smaller in turkey. According to McLelland, (1990)<sup>[4]</sup> in domestic birds reported that the cnemial crest provided attachment for the main extensor muscle of the knee joint. Between the lateral ridge and the lateral condyle, a large wide extensor groove was observed. The distal extremity was smaller, presented a trochlea on its anterior surface whose ridges were separated by a wide sagittal groove and the ridges were continued posteriorly as condyles. Medial condyle was smaller and placed more distally than lateral condyle. This was in agreement with the findings of Jagapathiramayya *et al.*, 2007<sup>[8, 9]</sup> in emu The condyle of either side presented a fossa for collateral ligaments which coincides with that in fowl Getty, (1975)<sup>[3]</sup>. On the anterior aspect of the distal extremity just proximal to the trochlea was an extensor canal. Similar finding were reported by Sreeranjini *et al.*, 2013<sup>[6]</sup> in peahen.



**Fig 6:** Posterior surface of tibiotarsus

The fibula 29 cm in length and in its proximal end it was 4cm wide, 0.9cm in width in the midshaft and 0.2cm at its distal end (Fig.7). It was placed along the lateral border of tibia and extended the two third portion of tibia where as in peahen Sreeranjini *et al.*, 2013 <sup>[6]</sup> and coturnix, Fitzgerald (1969) <sup>[2]</sup> it terminated freely at about the middle of tibia. The proximal extremity was large and broad and flattened from side to side and the head articulated with lateral condyle of tibia as well as with medial part of the lateral condyle of the femur. The shaft was slender rod like and had smooth lateral surface and rough medial surface. Dorsal surface of the shaft articulated with tibiotarsus. The articular area was interrupted above and below by proximal and distal interosseous space. This was in agreement with the findings of Jagapathiramayya *et al.*, 2007 <sup>[8, 9]</sup> in emu. The distal extremity tapered to a thin bone.



**Fig 7:** Cranial view of fibula

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