



# Comparative gross anatomical studies on the shoulder girdle of crested serpent eagle (*Spilornis cheela*) and brown wood owl (*Strix leptogrammica*)

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10.18805/ijar.B-3819

## ABSTRACT

The shoulder girdle gives strength and range of motion to the wings of birds and plays a functional role in flight mechanism of birds. The present study was designed to compare the morphological features of shoulder girdle bones in crested serpent eagle and brown wood owl. The shoulder girdle comprised of the scapula, coracoid and fused clavicle i.e. furculum in both species. The proximal extremities of bones of shoulder girdle formed a foramen triosseum in both the species for tendon of supracoracoideus muscle. The proximal end of the scapula of crested serpent eagle presents a pneumatic foramen which was absent in the brown wood owl. The coracoid of crested serpent eagle presents a large pneumatic foramen at the medial surface of the acrocoracoid process. A piercing type of foramen was characteristic in the coracoid of both species. Procoracoid process was triangular in shape with a broad base in both the species with pointed apex in brown wood owl and short apex in crested serpent eagle. The clavicle was thin, slender and highly curved in crested serpent eagle, whereas it was slender and rod-like in brown wood owl. Numerous pneumatic foramina were present in the proximal extremity of the clavicle of the crested serpent eagle, which were few in brown wood owl. The distal extremity of both clavicle fused to form a hypocleideum in crested serpent eagle, which was absent in brown wood owl.

**Key words:** Brown wood owl, Clavicle, Coracoid, Crested serpent eagle, Scapula.

## INTRODUCTION

The crested serpent eagle is a medium sized bird of prey that is found in forested habitats across tropical Asia (Choudhary *et al.*, 2019) with at least 22 recognised races (Dickinson, 2013). The brown wood owl is a resident breeder in south Asia from India, Bangladesh and Sri Lanka, east to western Indonesia, Taiwan, and south China (Choudhary *et al.*, 2018). The brown wood owl is medium large (45-57 cm), with upperparts uniformly dark brown, with faint white spotting on the shoulders. The underparts are buff with brown streaking. The facial disc is brown or rufous, edged with white and without concentric barring, and the eyes are dark brown.

The most characteristic feature of avian class is the diversity in their external morphology. The shoulder girdle is one of the important components of skeletal system associated with flight aspects of birds. It is formed by the scapula, coracoid and clavicle. These bones lead to the formation of foramen triosseum which transmits the tendon of flight muscles (Dyce *et al.*, 2009). Coracoid forms a bridge between the shoulder joint and sternum. Clavicles are two in number, *viz.* right and left, which fuses to form a single bone, commonly called furcula. It acts as a bony strut to maintain distance between two shoulders (Frandsen *et al.*, 2009). Furcula connects the shoulder joint in spring like fashion and helps to brace the girdle against axial skeleton (Dyce *et al.*, 2009). A comprehensive study has been made on the shoulder girdle of domestic fowl (Getty, 1975), pigeon, crow, owl and lapwing (John *et al.*, 2014). But scanty

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**How to cite this article:** Keneisenuo, Choudhary, O.P., Debroy, S., Arya, R.S., Kalita, P.C., Doley, P.J., Rajkhowa, T.K. and Kalita, A. (2020). Comparative gross anatomical studies on the shoulder girdle of crested serpent eagle (*Spilornis cheela*) and brown wood owl (*Strix leptogrammica*). Indian Journal of Animal Research. 54(5): 570-572.

**Submitted:** 09-03-2019 **Accepted:** 15-04-2019 **Published:** 09-11-2019

information is available about the shoulder girdle of crested serpent eagle and brown wood owl; hence the present study was designed with the aim to compare the gross morphological features of the shoulder girdle bones of these species.

## MATERIALS AND METHODS

The specimen were procured from three crested serpent eagle and two brown wood owl, brought from Zoological Park, Aizawl for post mortem examination to the Department of Veterinary Pathology, College of Veterinary Sciences and

Animal Husbandry, Selesih, Aizawl, Mizoram. After post-mortem examination the he collected specimen were macerated as per the standard technique (Choudhary *et al.*, 2015; Choudhary and Singh, 2015 and 2016) and utilized for gross anatomical studies in the Department of Veterinary Anatomy. The length of various bones of the pectoral girdle in both the species was measured in centimetre.

## RESULTS AND DISCUSSION

The shoulder girdle of the crested serpent eagle and brown wood owl was comprised of three pairs of bones namely, scapula, clavicle and coracoid (Fig 1) that supports the wings (Damian *et al.*, 2011).

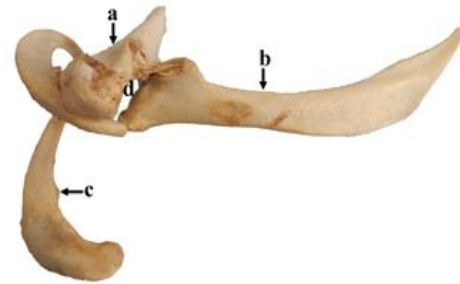
In both the species, the scapula was sword shaped and directed backwards and upwards parallel to the thoracic vertebrae (Fig 2). It consisted of a proximal extremity and a blade. The proximal extremity was thicker and was composed of a medial process and lateral articular facet. The lateral facet articulated with the head of humerus and forms shoulder joint. The medial process articulated with coracoid and clavicle bone to form foramen triosseum. Similar findings have been reported in the scapula of fowl (Getty, 1975) and pariah kite (Tomar *et al.*, 2010). In the present study, crested serpent eagle presented a pneumatic foramen in the proximal extremity of scapula. The blade ended in the form of pointed projection, which was directed downwards and curved inwards, which was also observed in the scapula of the pariah kite (Tomar *et al.*, 2010).

The length of the scapula in crested serpent eagle and brown wood owl was  $6.68 \pm 0.01$  cm and  $6.25 \pm 0.01$  cm, respectively.

The clavicle (Fig 3) was two in number- right and left, which were fused distally to form a single bony structure called furculum in both the species. In crested serpent eagle, the clavicle was thin, slender and broad but in brown wood owl was rod-like. Each clavicle was composed of a proximal extremity, ramus and a distal extremity. The ramus of the clavicle in crested serpent eagle was highly curved, which was straight in brown wood owl. Proximal extremity directed cranially and was wider, thicker than distal extremity in both the species. It bears a facet on its lateral aspect which articulates with the acrocoracoid process of the coracoid bone. Lateral facet was more pronounced in crested serpent eagle than brown wood owl. The lateral surface of the proximal extremity contained numerous pneumatic foramina in the crested serpent eagle, but was scanty in brown wood owl. However, the pneumatic foramina was absent on lateral surface of the proximal extremity of the clavicle in owl (John *et al.*, 2014). The proximal extremity of the clavicle was more elongated in crested serpent eagle than brown wood owl. The pneumatic foramina, which was present on the lateral aspect of the clavicle of crested serpent eagle, varied in each clavicle of the shoulder girdle as also reported in the clavicle of crow (John *et al.*, 2014) and Ramphastidae (Hofling and Alvarenga, 2001). The distal extremity of both clavicle fused to form a hypocleidium in crested serpent

eagle, which was absent in brown wood owl. The furculum formed by two clavicle bones was broad U-shaped in both the species which was also observed in pariah kite (Tomar *et al.*, 2010) and in crow (Patki *et al.*, 2010). However, the furculum was V-shaped in owl (John *et al.*, (2014). The clavicle was strongly developed in crested serpent eagle than in brown wood owl.

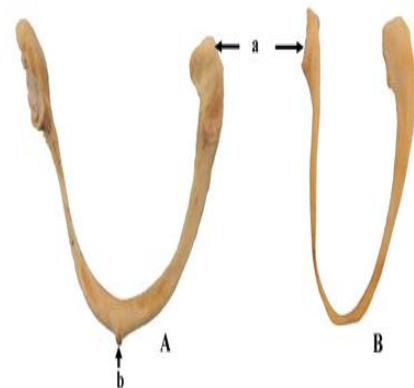
The length of the clavicle in crested serpent eagle and brown wood owl was  $4.37 \pm 0.01$  cm and  $3.91 \pm 0.02$  cm, respectively.



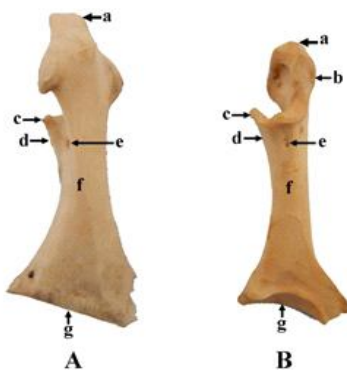
**Fig 1:** Pectoral girdle of the crested serpent eagle showing coracoid (a), scapula (b), clavicle (c) and foramen triosseum (d) for the tendon of supracoracoideus muscle.



**Fig 2:** Scapula of the crested serpent eagle (A), brown wood owl (B) showing medial process for articulation with coracoid and clavicle (a), lateral process for articulation with humerus (b) and blade (c).



**Fig 3:** Furculum (formed by right and left clavicle) of the crested serpent eagle (A), brown wood owl (B) showing articular process (a) and rudimentary median clavicular process (b).



**Fig 4:** Coracoid of the crested serpent eagle (A), brown wood owl B) showing acrocoracoid process (a), glenoid cavity (b), procoracoid process (c), procoracoid notch (d), piercing type of foramen (e), shaft (f) and articular facet for sternum (g).

In both the species, coracoid bones were the strongest bone of the shoulder girdle (Fig 4). Coracoid was short, thick and directed downwards and backwards. It was composed of a shaft and two extremities. The distal extremity was wider than the proximal extremity. The proximal extremity was hook-like structure and showed two processes namely procoracoid and acrocoracoid articulates with the scapula and clavicle to form foramen triosseum for passage of supracoracoideus muscle (Fig 4). A large pneumatic foramen was present at the medial surface of acrocoracoid process in crested serpent eagle. The procoracoid process was triangular in shape with a broad base in both species with pointed apex in brown wood owl and short apex in crested serpent eagle. The presence of hook-like proximal extremity of coracoid facilitates the supracoracoideus muscle for better support and thus aids in flight. The procoracoid process of crested serpent eagle and brown wood owl at its junction with the shaft of coracoids was characterized by the presence of a piercing type of foramen which was also reported in pariah kite (Tomar *et al.*, 2010) and owl (John *et al.*, 2014). The distal extremity was wide, broad and roughly triangular in both the species. It has a transverse elongated concave facet and a lateral process. The distal extremity of coracoids articulates with the anterior end of the sternum through the concave facet which was also reported in pigeon hawk and kite (John *et al.*, 2017).

The length of the coracoid in crested serpent eagle and brown wood owl was  $4.99 \pm 0.03$  cm and  $5.34 \pm 0.01$  cm, respectively.

The present study concluded that the shoulder girdle of both species comprised of scapula, coracoid and clavicle. The lateral surface of the proximal extremity composed of numerous pneumatic foramina in crested serpent eagle, but was few in brown wood owl. The hypocleidium was present in crested serpent eagle and was absent in brown wood owl. The medial surface of acrocoracoid process presents a large pneumatic foramen in crested serpent eagle, which was not observed in brown wood owl. The coracoid of the crested serpent eagle was more strongly developed which

might suggest the strong development of supracoracoideus and sternocoracoideus muscles as an adaptive feature to catch their prey during flight.

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