



## Comparative Gross Anatomical Studies on the Sternum of Emu, Turkey and Duck

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### ABSTRACT

Study was undertaken to provide a reference for the gross anatomy of the sternum of emu as one of the ratite species and also to compare the structural differences with sternum of duck and turkey. The sternum from four adult emu, turkey and duck were collected and used for the present study. The sternum was a large unsegmented bone located on the antero-ventral aspect of the body cavity, bowl-shaped in emu, triangular in turkey and rectangular in duck. It consisted of deeply concave dorsal surface, more convex ventral surface without keel in emu, with prominent keel in turkey and duck and had two extremities and two borders. An upward and antero-laterally directed flat antero-lateral process was observed and was long in turkey, short and curved in emu and very small in duck. The posterior extremity or metasternum was triangular and flattened in emu. It had very long posterior process and carried ventrally a thin plate of bone called keel in duck and turkey. Single and divided postero-lateral process was noticed in duck and turkey respectively but was absent in emu.

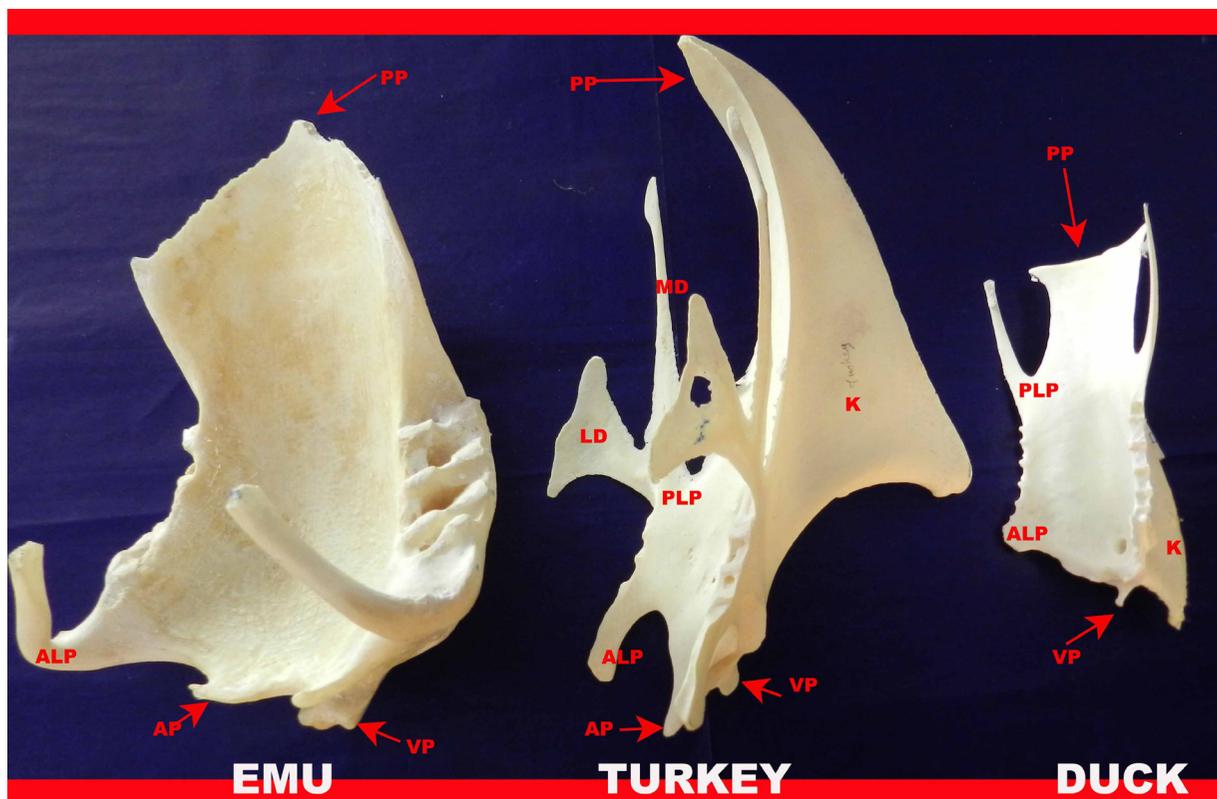
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Ratites derive their name from the Latin word *ratis*, meaning raft, which describes their unique sternum with its concave shape. This anatomical structure hampers visualization of the ventral aspect of the cranially situated organs (heart and liver) (Wagner *et al.*, 2001). The sternum is one of the largest bone in the bird skeleton, provides an anchor for articulation of wing bones and a keel like structure gives attachment to wing muscles. It acts as leverage for flight muscles thereby facilitates flight mechanism. But in walking birds and poor fliers, the differences in the keel and sternum makes them unable to fly. Plenty of information is available on gross anatomy of sternum of domestic fowl but it is lacking on comparative aspects of sternum of poor fliers such as duck and turkey with large flightless ratite species emu. Therefore, the study was undertaken to study the gross anatomy of sternum in detail.

The study was conducted on four adult emu, turkey and duck in the Department of Veterinary Anatomy and Histology, Veterinary College and Research Institute,

Namakkal. The sternum with pectoral muscles were collected from the local slaughter houses in and around the Namakkal and were macerated by wet method of maceration. The disarticulated sternum was cleaned and utilized to study the gross anatomical features.

The sternum of emu was a large unsegmented bowl shaped bone located on the antero-ventral aspect of the body cavity and gives attachment to the coracoid and sternal ribs. Sathyamoorthy *et al.* (2012) mentioned that the sternum of the Spot-billed pelican was large, broad and quadrilateral in shape. Brett and Hopkins (1991) reported that all ratites have a broad smooth, bowl-shaped breast plate or sternum without a keel. Murray and Fowler (1991) also described soup plate like sternum in Emu. The sternum consisted of two surfaces, two extremities and two borders. The dorsal surface was deeply concave and the ventral surface was more convex which gives broad area for attachment to the breast muscles. The sternum was rectangular with very shallow dorsal surface in duck. The dorsal surface of the body was pierced by numerous



**Figure 1.** Photograph of the sternum of Emu, turkey and duck showing AP – Anterior Process, PP – Posterior Process, ALP – Antero-lateral Process, PLP – Postero-lateral Process, MD – Medial Division, LD – Lateral Division, VP – Ventral Process and K - Keel

small foramina in turkey and duck whereas these foramina were absent in emu. In duck and turkey the ventral surface was encroached by keel (Nickle *et al.*, 1977).

In emu, the anterior extremity was broad and its anterior border bore two short blunt processes with a notch in between them. Below the notch, there was a blunt ventral process and on either side of it flat facets for articulation with coracoid bone was noticed. Contrast to this, in duck and turkey the anterior process or rostrum or manubrium sternum was short, on either side of the root of the rostrum, a deep concave groove or elongated facet was observed for articulation with the coracoid. Nickle *et al.* (1977) reported that the dorsal and ventral process noticed on either side of the groove fuse with each other into a median vertical bony plate leaving an opening between them in turkey. But in duck only the ventral process is present.

An upward and caudally directed antero-lateral process (Fig.1) was noticed on either side of the lateral aspect of the anterior extremity in emu as mentioned by Jagapathi Ramayya *et al.* (2007). In duck and turkey, lateral to the articular surface for the coracoid, antero-laterally directed flat antero-lateral process was observed which was long in turkey and very small in duck.

The posterior extremity or metasternum was triangular and flattened in emu. The posterior extremity had very long posterior process and carries ventrally a thin plate of bone called keel or sternal crest in duck and turkey. The keel and posterior process was absent in emu as observed by Jagapathi Ramayya *et al.* (2007) and it was prominent in turkey and moderately developed in duck although they are poor fliers. The keel (Fig.1) was broad anteriorly and fades out posteriorly and the sharp anterior end of the keel

appeared as triangular plate and concave anteriorly in turkey (Chamberlain 1943) and the anterior end was thin and straight in duck.

As reported by Jagapathi Ramayya *et al.* (2007) the postero-lateral process (Fig. 1) was absent in emu. The sternum of duck has thin rod like postero-lateral process on either side behind the lateral border of the body and a deep oval notch was formed between this process and body of the sternum. In turkey, the postero-lateral process on the lateral border was divided into medial and lateral process. The lateral division was broad and plate like. The medial division was long and narrow and formed the oval incisures between it and lateral border of the body and also between it and lateral division (Nickle *et al.*, 1977).

In all the species, the lateral border of the sternum caudal to the antero-lateral process presented articular areas corresponds to the number of sternal ribs on either side. The articular facets varied according to the number of sternal ribs viz. 4 pairs in emu and turkey and 7 pairs in duck as recorded by Brett and Hopkins (1991) and (Nickle *et al.*, 1977). Between these articular areas, small air holes (pneumatic foramen) which leads into the sternum were noticed (Jagapathi Ramayya *et al.*, 2007). Chamberlain (1943) reported that the lateral border of the sternum was occupied with foveal costal articular and inter articular surfaces in gallus, gallopavo, anser and cygnus.

It is concluded that the gross anatomy of sternum varies with species of bird and its shape confined to its flying

habits. In the present study, the sternum was large unsegmented bowl shaped with rudimentary processes in emu, triangular with well developed keel in turkey and rectangular with very shallow dorsal surface in duck. In all the species, articular facets for ribs were noticed in the lateral border.

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