MORPHOLOGICAL STUDIES ON THE STERNUM OF UMBRELLA COCKATOO *(CACATUA ALBA)*

A. R. Sreeranjini*, N. Ashok, S. Pramod, S. Maya and J.J. Chungath
Department of Veterinary Anatomy and Histology
College of Veterinary and Animal Sciences
Mannuthy, KVASU, Kerala – 680 651.

ABSTRACT

The present study was conducted on the sternum of a five year old, male umbrella cockatoo brought for post mortem examination to the Department of Veterinary Pathology at the College of Veterinary and Animal Sciences, Mannuthy, Thrissur. The sternum was a light, quadrilateral bone with dorsal concave and ventral convex surfaces and four borders. The dorsal surface presented a few pneumatic foramina. The ventral surface furnished a large, boat shaped keel. The anterior and posterior borders were convex. The lateral border on either side presented five costal facets. The anterior extremity showed two distinct facets for coracoid. Craniolateral processes were short and hook shaped. Caudolateral processes fused with the median trabecula and hence the oval foramina were not present. The bifid rostrum was strong, tall and wide. The ratio of width of the sternum and its height was found to be 1.32mm. In overall appearance, the sternum of umbrella cockatoo showed the morphological features of flying group of birds.

Keywords: Morphology, sternum, umbrella cockatoo, white cockatoo

INTRODUCTION

The Umbrella Cockatoo is a medium-sized white cockatoo endemic to tropical rainforests of Indonesia. Since they are very affectionate, intelligent, easily trained and naturally acrobatic birds, they have been used in zoos, amusement parks and live animal shows. Their numbers in the wild have declined due to capture for cage-bird trade and habitat loss. In birds, thoracic and abdominal cavities are continuous due to the absence of diaphragm. The sternum or breast bone in birds is a single bone occupying the ventral aspect of thoracic and part of abdominal cavities. Because of the caudal extension of sternum towards abdominal cavity, abdominal palpation is difficult in birds compared to mammals. Based on the presence or absence of a well-developed keel on the sternum, birds are referred to'carinates' and 'ratites' (Mc Lelland, 1990). The sternum articulates anteriorly with the coracoid bone and supports the viscera. In young birds, the caudal end of sternum remains cartilaginous and hence, its flexibility is an indicator of age (Dyce et al., 1996). The anatomical features of sternum vary in birds according to their habits, especially flying ability. Several studies have been conducted on the sternum of coturnix quail (Fitzgerald, 1969), chicken, duck and goose (Nickel et al., 1977), bald ibis (Nejdet et al., 2002), emu (Jagapathi et al., 2007), ostrich (Predoi et al., 2009) and Pariah Kite (Tomar et al., 2011). But, scanty information is available regarding the sternum of Umbrella cockatoo. Hence, the present study was conducted to evaluate the anatomical features of the sternum of Umbrella cockatoo in order to identify the

*Corresponding author: Email: sreeranjiniar@yahoo.com

species based on the morphological features of the sternum and to compare the differentiating features with that of other birds.

MATERIALS AND METHODS

The present study was conducted on the sternum of a five year old, male umbrella cockatoo brought by a pet owner from Thrissur for post mortem examination to the Department of Veterinary Pathology at College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala, India. The bird was reported to have anorexia, dyspnoea, melaena and was unresponsive to therapy for seven days. Post mortem examination revealed severe hemorrhagic enteritis, pneumonia, severe haemorrhage in caecal tonsils and congestion in kidneys. The sternum was taken out by maceration method, 10% to 15% Sodium bicarbonate was added for whitening, was dried and its weight, width and height was measured using a Vernier caliper. The ratio of width of the sternum and its height was determined. Various gross anatomical features like number of costal facets, presence of pneumatic foramina, shape and height of keel were studied.

RESULTS AND DISCUSSION

The body of sternum was quadrilateral with concave dorsal and convex ventral surfaces and four borders as in duck and goose (Nickel et al., 1977), ostrich (Predoi et al., 2009) and Pariah Kite (Tomar et al., 2011). Jagapathi et al.,, (2007) reported that in emu the sternum was large and bowl shaped while Dewangan et al.,, (2014) noted that the sternum of pigeon was oval in shape. Anterior two thirds of the dorsal (visceral) surface presented a few pneumatic foramina (Fig. 1). In domestic fowl, a single large pneumatic foramen is often seen behind the cranial border of sternum (Nickel et al., 1977). Hogg (1984) recorded that the sternum had a very low incidence of pneumatisation in the adult domestic fowl. But in bald ibis, 15-20 pneumatic pores were noticed on the visceral surface of sternum (Nejdet et al., 2002). Pneumatic foramina communicate with clavicular air sac and help to lower the wing load without loss of strength. The ventral surface furnished a large, boat shaped keel along its median line. The anterior extremity of this surface showed two rough, transverse facets for coracoid, guided by dorsal and ventral lips. The incisura ovalis seen at the caudal part of sternum in fowl, duck and goose and the oval foramina seen in the sternum of pigeon were not observed in the present study.

The anterior border was thick and convex similar to duck and goose (Nickel et al., 1977), whereas it was triangular in domestic fowl, pigeon and Pariah Kite (Tomar et al., 2011). On either side of the midline, the anterior border presented two small pointed prominences. Reports about the presence of such prominences could not be traced. The facets for coracoid were located immediately below the anterior border. The lateral border was concave with almost double the length of the anterior border (Table 1) and on either side presented five articular facets for sternal ribs. Between each facet, fossa containing pneumatic foramina was present as in fowl. According to Predoi et al.,, (2009), the sternum of goose presented 6-7 facets and that of ostrich and rhea contained six and four facets respectively. The short, broad, posteriorly pointed and hook- like craniolateral process was located at the junction of the anterior and lateral borders on either side. In fowl, the process is long and anteriorly directed, in pigeon small and directed outward and upward (Dewangan et al., 2014), in duck and goose small (Nickel et al., 1977), and in emu short, wide and flattened (Jagapathi et al., 2007)

The posterior border was convex and caudolateral processes fused with the median trabecula on either side. Caudolateral processes were not present in the sternum of emu (Jagapathi et al., 2007) and Pariah kite (Tomar et al., 2011). The incisura ovalis seen at the caudal part of

sternum in coturnix quail (Fitzgerald, 1969) and in fowl, duck and goose, and the oval foramina seen in the sternum of pigeon (Nickel et al., 1977) were not observed in the present study. When notches are present, they are closed in life by fibrous membranes to strengthen the body wall. Due to the absence of notches and foramina at the caudal part of sternum, the body of sternum which occurs as a single piece of bone may provide more structural integrity and support to the abdominal wall in the white parrot.

The bifid rostrum (manubrium/ sternal spine) was stronger, taller and wider than that in fowl. (Tomar et al., 2011) reported that the sternum of Pariah Kite is devoid of rostrum. In white parrot, it was located just below the anterior border. But in fowl, the rostrum projects as a continuation of the dorsal surface of the body of the sternum. The transverse foramen present in the rostrum of fowl was not observed in the present study. The sternoclavicular membrane which holds the sternum, coracoid and clavicle together, originates from the rostrum. A stronger rostrum in white parrot might be indicative of a better developed sternoclavicular membrane.

The sternum presented a well-developed keel, located along the ventro-median aspect of the body of sternum. It was boat shaped with height decreasing cranio-caudally as in fowl, pigeon and Pariah Kite. But, Powlesland et al.,, (2006) noted that there was marked reduction in the keel in kakapo, a large parrot. The convex anterior end of the keel was located a little anterior to the anterior border of the sternum. But in fowl, the concave anterior end of the keel was located at about the middle of the body of the sternum. In duck and goose anterior end of the keel is straight (Nickel et al., 1977). The ventral border of keel in white parrot was in the form of a steep, caudally directed arch as in pigeon. In fowl, duck and goose, it is slightly concave (Nickel et al., 1977). According to Mc Lelland (1990), keel is prominent in birds with well developed powers of flight and it gives attachment to the two important flight muscles namely pectoral and supracoracoideus. So, the extent of development of the keel bears direct relation with the extent to which a bird moves its wings, whether in flight or in swimming. Birds that fly by stroke of wings have large breast muscles and correspondingly large sternum. Birds requiring greater muscle power to take off quickly or to fly at low speeds have large keels. Duzler et al.,, (2006) observed that the width (W) of the sternum (the distance between two craniolateral processes) and the height (H) of the sternum (the distance between midpoint of anterior border and highest point of sternal crest) were approximately equal in flying birds. According to them, the W/H value in flying group of birds was 0.96 to 1.35mm. In the present study, the above ratio was found to be 1.32mm. Hence, the morphological features of sternum of umbrella cockatoo conform to that of flying group of birds.

The morphological and morphometrical data regarding the sternum of umbrella cockatoo has been established. The sternum of umbrella cockatoo presented characteristic features like hook shaped craniolateral processes, prominences in anterior border, absence of caudolateral processes, absence of incisura ovalis and foramen ovale, etc. Present study will be helpful academically and forensically to identify the species based on the morphological features of the sternum.

ACKNOWLEDGEMENT

The authors are thankful to the staff, Department of Veterinary Pathology at College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala for providing the specimen for the present study.

REFERENCES

Dewangan, B.K., Ingole, S.P., Chaurasia, D. and Singh, J. (2014). Morphometry of Sternum

of Blue Rock Pigeon (Columba livia). Indian Veterinary Journal, 91: 47- 49.

Duzler, A., Ozgel, O. and Dursun, N. (2006). Morphometric Analysis of the Sternum in Avian Species. Turkish Journal of Veterinary and Animal Sciences, 30: 311-314.

Dyce, K.M., Sack, W.O. and Wensing, C.J.G. (1996). Textbook of Veterinary Anatomy. W.B Saunders Company, Philadelphia. p: 818.

Fitzgerald, T.C. (1969). The Coturnix quail, Anatomy and Physiology. The Iowa State University Press, Iowa. pp: 20-22.

Hogg, D.A. (1984). The distribution of pneumatisation in the skeleton of the adult domestic fowl. Journal of Anatomy, 138: 617-629.

Jagapathi, R.P., Chandrasekhara, R.T.S., Shanti, L.M. and Ravindrareddy, Y. (2007). Gross anatomical studies on the sternum and ribs of Emu (Dromaius novaehollandiae). Indian Journal of Poultry Science, 42: 112-114.

Mc Lelland, J. (1990). A Colour Atlas of Avian Anatomy. Wolfe Publishing Ltd, England. pp: 38-39.

Nejdet, D., Ayhan, D., Uman, B.E. and Ozgel, O. (2002) Macro-anatomical investigations on sternum in bald ibis. Indian Veterinary Journal, 79: 160-165.

Nickel, R., Schummer, A. and Seiferle, E. (1977). Anatomy of the Domestic Birds. 2nd ed. Verlag Paul Parey, Hamburg, pp: 10-12.

Powlesland, R.G., Merton, D.V. and Cockrem , J.F. (2006). A parrot apart: the natural history of the kakapo (Strigops habroptilus) and the context of its conservation management. Notornis, 53: 3-26.

Predoi, G., Belu, C., Dumitrescu, I., Georgescu, B., Seicaru, A., Rosu, P., Carmen, B. and Dumitrescu, F. (2009). Comparative researches regarding the sternum in Ostrich (Struthio camelus) and Nandu (Rhea Americana). Lucrari Stiinłifice Medicina Veterinara, 42: 342-346.

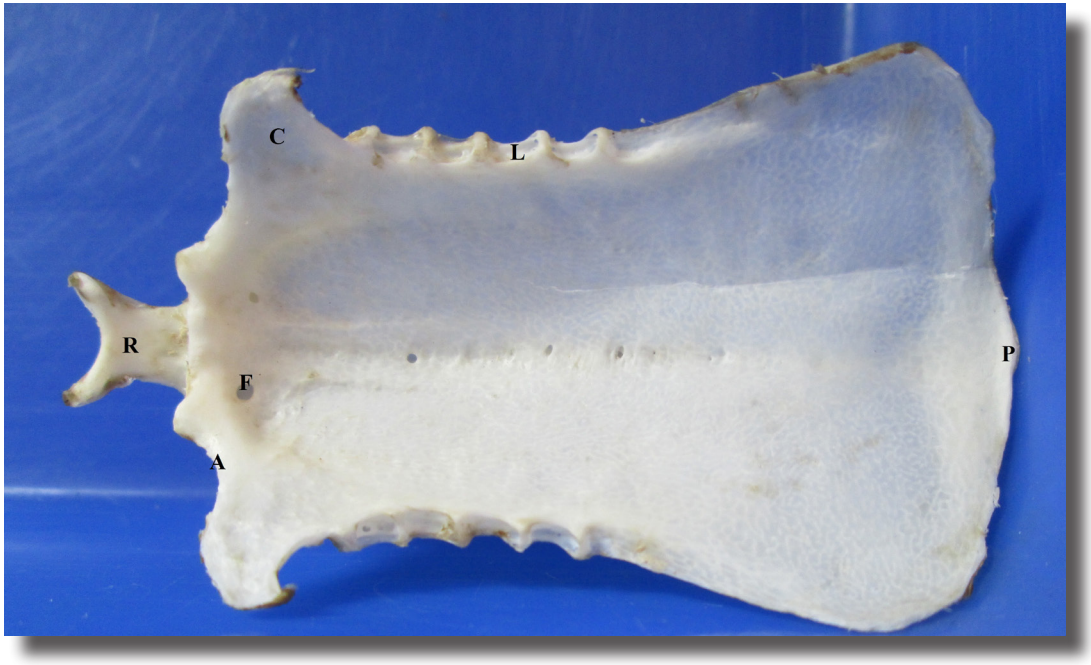
Tomar, M.P.S., Vaish, R., Parmar, M.L., Shrivastav, A.B. and Tiwari, Y. (2011). Gross morphometrical studies of sternum of Pariah Kite (Milvus migrans). Veterinary World, 4: 171-172.

Table - 1

Different parameters of the sternum of umbrella cockatoo

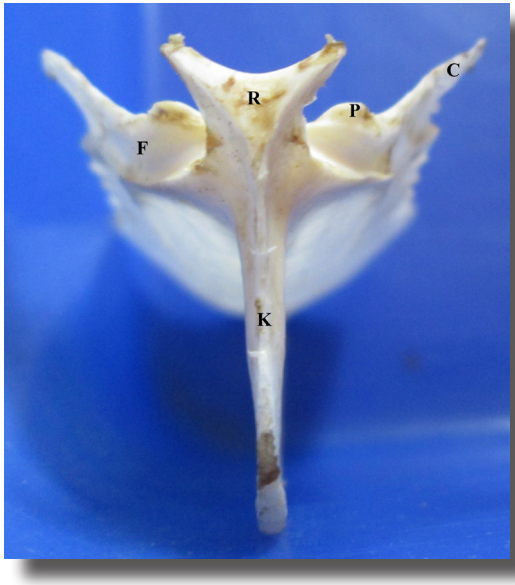
Parameter	Measurement (mm)
Distance between two craniolateral processes (W)	30.76
Distance between midpoint of cranial border and highest point of sternal crest (H)	23.30
Distance between lateral ends of facets for coracoid (Ww)	24.60
Width of anterior border	22.00
Width of posterior border	34.80
Length of lateral border	45.00

Figure. 1 - Sternum of umbrella cockatoo: Dorsal view



R- Rostrum, A- Anterior border, F- Pneumatic foramina, C- Craniolateral process, L- lateral border, P-Posterior border.

Figure. 2 - Sternum of umbrella cockatoo: Anterior view



F- Facet for coracoid,

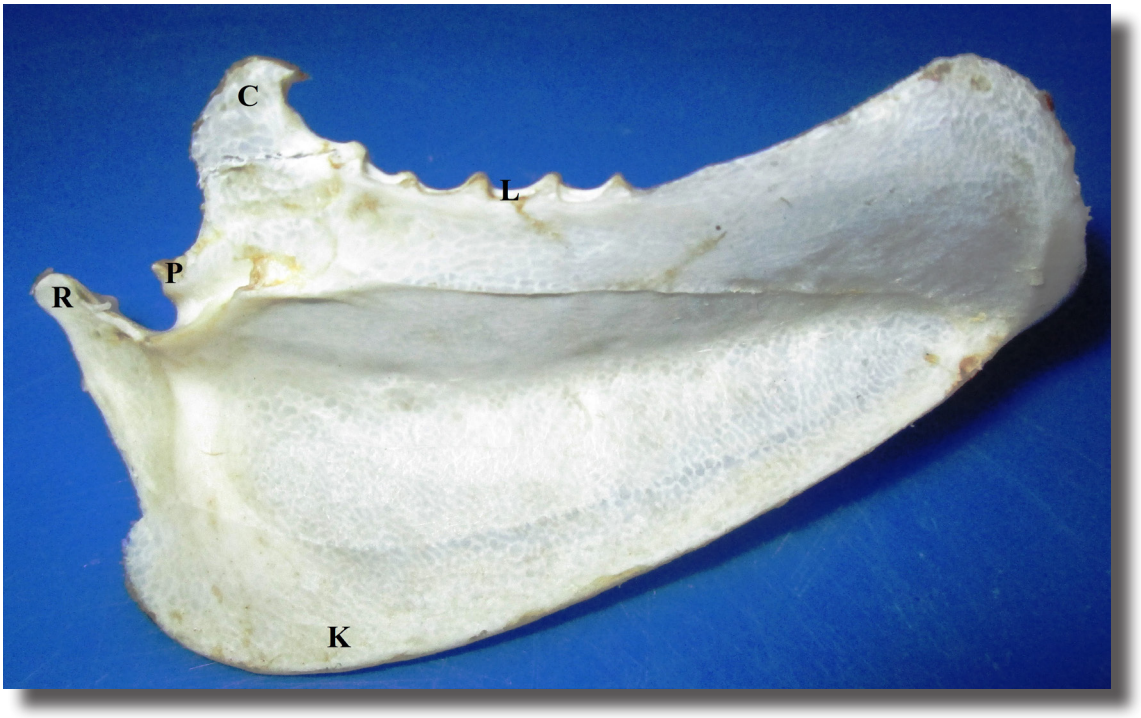
R- Rostrum,

K- Keel,

P- Prominence on the anterior border,

C- Craniolateral process.

Figure.3 -Sternum of umbrella cockatoo: Lateral view



R- Rostrum,
P- Prominence on the anterior border,
C- Craniolateral process,
L- lateral border,
K-Keel.