ANATOMICAL STUDIES ON THE NEURO-CRANIUM OF GREEN-WINGED MACAW

V. R. Indu [1], K. M. Lucy [2], A. R. Sreeranjini [3], S. Maya [4], N. Ashok [5] and J.J. Chungath [6]
Department of Veterinary Anatomy and Histology,
College of Veterinary and Animal Sciences,
Mannuthy Thrissur-680 651, Kerala.

Received - 18.09.2013
Accepted - 31.12.2013

Abstract

A study was conducted on the gross features of the neurocranium of eight year old male Green-winged macaw and their morphological peculiarities were correlated with its possible functions. The occipital was large and situated almost vertically. The basisphenoid had body and temporal wings with very distinct muscular process. The frontal was very large, smooth formed the beautifully rounded vault of the cranium The orbital process lying cranial to the temporal fossa was very stout and long and formed the ventral wall of the complete orbital ring. The zygomatic process did not fuse with orbital process and the temporal fossa present in between them was very deep.

Keywords: *Green-winged macaw, neurocranium, gross anatomy*

The size of neurocranium is largely dependent on the size of the brain. Since the brain volume is relatively constant among the birds, the neurocranium of large birds appeared small while that of small birds seemed to be relatively large (Nickel *et al*., 1986). The Green-winged macaw is an intelligent bird with diverse feeding habits. Information on the anatomical peculiarities of this bird is scanty. Hence an effort has been made to record the morphological variations in the neurocranium and to correlate it with their possible functions.

Materials and Methods

The bones of neurocranium were collected from eight year old male Green-winged macaw died of natural causes and brought to the Department of Pathology for postmortem examination. After natural maceration the bones were cleaned and observed for gross anatomical features.

Results and Discussion

The bones of neurocranium were occipital, sphenoid, frontal, parietal and temporal. These enclosed the brain and organs of hearing and formed parts of oral and nasal cavities. The ethmoid was shared by both neurocranium and splanchnocranium. The boundaries of the individual bones were difficult to identify because the sutures between many of them were lost. These observations were in accordance with Nickel *et al*. (1986) in various avian species.

The occipital was large, well defined and consisted of three fused components *viz*., the basal part basioccipital, paired lateral parts exoccipital and the squamous part, supraoccipital. It was situated almost vertically perpendicular to the basitemporal and the foramen magnum was situated basally (Fig.1). However according to Nickel *et al*. (1986) the occipital was horizontal in pigeon, almost vertical in ducks and in fowl it took a middle

1. & 3. *Assistant Professors*
2. *Professor*
4. *Professor & Head, CVAS, Pookode*
5. *Professor*
6. *Professor and Head*

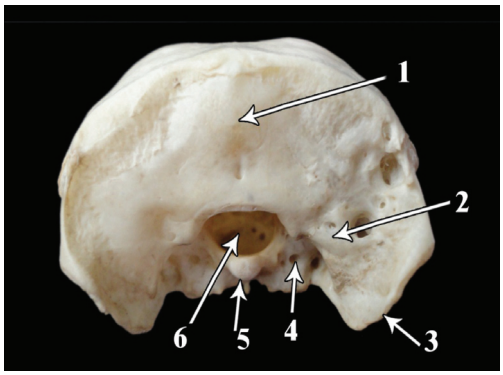

Fig.1. Skull of Green-winged macaw– Caudal aspect

1. Supraoccipital 2. Exoccipital
3. Temporal wings 4. Basioccipital
5. Occipital condyle 6. Foramen magnum

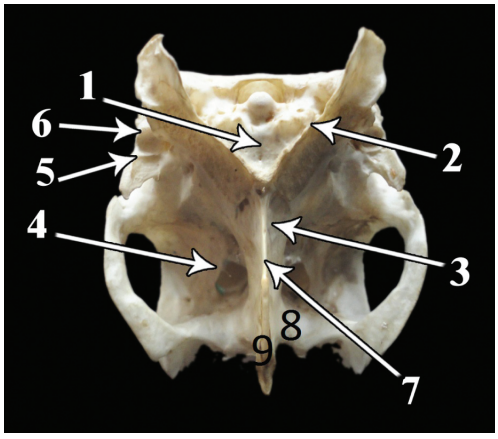

Fig.2. Skull of Green-winged macaw (Premaxilla removed) – Ventral aspect

1. Basisphenoid- body 2. Temporal wings
3. Presphenoid – body 4. Optic foramen
5. Articular groove 6. External acoustic meatus
7. Interorbital septum 8. Ethmoid- horizontal plate
9. Ethmoid- perpendicular plate

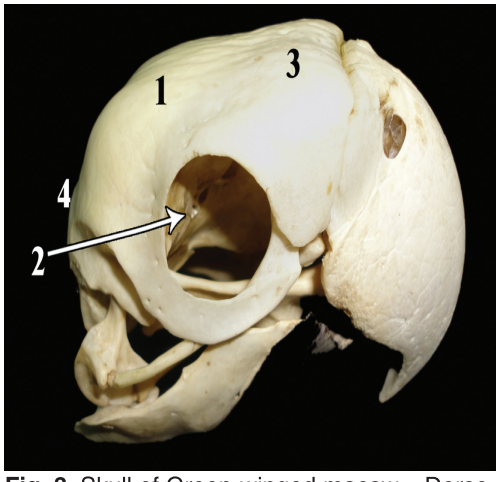

Fig. 3. Skull of Green-winged macaw – Dorso-lateral aspect

1. Pars frontalis 2. Pars orbitalis
3. Pars nasalis 4. Parietal

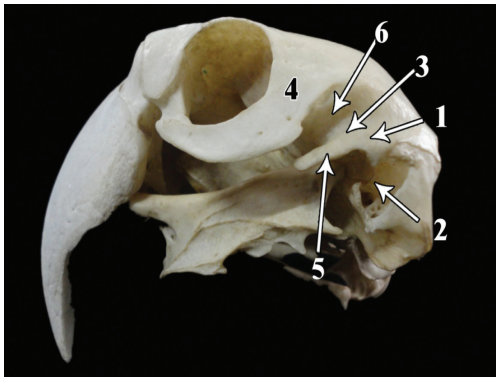

Fig. 4. Skull of Green-winged macaw – Lateral aspect

1.Temporal 2. Otic part
3. Squamous part 4. Orbital process
5. Zygomatic process 6. Temporal fossa

position between these two extremes with the foramen magnum present in the middle of the squamous part. The occipital condyles were small, single and hemispherical. This made the atlanto-occipital joint much mobile and allowed considerable rotation of head. The hypoglossal foramen, foramen caroticum and jugular foramen were located from medial to lateral aspect. The temporal wings of the exoccipitals were curved and very prominent unlike in domestic fowl in which it was reported to be a flat bony plate by Getty (1975). The large temporal wings might be due to the heavy forward weighted head of Green-winged macaw. The supraoccipital articulated with the parietal bone dorsally and temporal laterally. The basioccipital was thick, small and quadrilateral in shape while in domestic fowl it was large and its lower part contributed to the formation of part of temporal cavity as reported earlier in domestic fowl by Getty (1975). The dorsal border of the occipital bone was marked by the external occipital crest which was very distinct and an external occipital protuberance was present medially. However Fitzgerald (1969) stated that in quail the external occipital crest was faint while the external occipital protuberance present medially was very prominent.

The sphenoid was median and unpaired and formed greater part of the floor of the skull

and the caudal wall of the orbit as reported by Getty (1975) in fowl. It presented a triangular caudal portion called basi-sphenoid and a presphenoid. The basisphenoid had body and temporal wings with a muscular process which was very distinct as compared to that of domestic fowl. This might be because of their heavy head which was forward-weighted as reported in ducks and goose (Nickel *et al*., 1986). The lateral borders formed part of external acoustic process. The presphenoid consisted of body and orbital wings. The root of presphenoid was perforated by Eustachian tube and did not show any articulation with the pterygoid. This is in contradiction to the observations of Nickel *et al*. (1986) in fowl that the pterygoid articulated with both the sphenoid and palatine cranially. The orbital wings fused medially to form a bony plate which together with the cranially situated vertical plate of ethmoid formed the interorbital septum. This septum was without vacuities and directly throughout merged with the rostrum of sphenoid beneath it (Fig.2). The quadrilateral foramen observed by Patki *et al*. (2009) in crows could not be seen in the present study. The lower margin of the whole plate was sharp both inferiorly and in front. The bone was very thick in this region since it contained parts of the tympanic cavity and internal ear structures as reported by Fitzgerald (1969) in quails. The optic foramen was very large and double as compared to fowl in which the foramen is single as reported by Getty (1975) in fowl.

The parietal formed a thick bony plate which was inserted between the occipital and frontal bones and formed the caudal part of roof of skull as reported in domestic fowl (Nickel *et al*., 1986) and crow (Patki *et al*., 2009). It presented a convex and smooth parietal surface and a thin concave cranial surface with vascular groove as reported in quails by Fitzgerald (1969).

The frontal presented three parts viz., frontal, orbital and nasal. The frontal was very large, smooth and nearly flat cranially and the caudal aspect became convex gradually to form the beautifully rounded vault of the cranium (Fig.3). Contrarily in quails it was a four-sided pyramid (Fitzgerald, 1969). The dorsal wall of the orbit was formed mainly by the frontal as reported by Mc Lelland (1990) in fowl.

The temporal consisted of otic and squamous parts. It was triangular in outline with the apex directed anteriorly terminating at the point where occurred the naked external double tubed entrance of the Eustachian canals. The squamous part formed the lateral wall of cranium and presented an articular groove for otic process of quadrate and palatine bones while in fowl it articulated with only the quadrate bones as palatine was very thin (Nickel *et al*., 1986). The temporal crest formed the boundary between the frontal and lateral surface the skull and the angle of junction continued forward and inward as the margins of the orbital process. These observations were in concurrence with the observations of Fitzgerald (1969) in Japanese quails. The orbital process lying cranial to the temporal fossa was very stout and long and formed the ventral wall of the complete orbital ring. The zygomatic process did not fuse with orbital process and the temporal fossa present in between them was very deep (Fig.4). Conversely Nickel *et al*. (1986) reported that in fowl the orbital process was slender and the zygomatic process fused with it. Moreover the temporal fossa was shallow and the ventral wall of the orbit was incomplete.

The ethmoid consisted of two parts *viz.*, a horizontal plate which separated the orbital and nasal cavities and a perpendicular plate. The horizontal plate was present craniodorsally and formed the cranial wall of orbit. It was well developed and broad and was filled with diplotic tissue. The paired olfactory foramen located in it, were large and widely separated and served for the passage of the olfactory nerves into the nasal cavity. The perpendicular plate was thick and formed the interorbital septum and continued rostrally into the nasal cavity as the nasal septum. Contrarily in domestic fowl and Japanese quails, the ethmoid was thin and small and formed the cranio-dorsal wall of the orbit and the olfactory foramen was present in the dorsomedial part of the perpendicular plate (Fitzgerald, 1969; Nickel *et al*., 1986). The wide horizontal plate of ethmoid seen in Green-winged macaw might be an adaptation to accommodate the well developed nasal, lacrimal and premaxilla. It also formed the strong posterior base of the cranio-facial hinge.

In the Green–winged macaw bones of the neurocranium were stout and their strongly marked characters clearly distinguished them from other orders of the class aves.

References

Dyce, K.M., Sack, W.O. and Wensing, C.J.G. 2002. *Textbook of Veterinary Anatomy.* (3rd Ed.), W. B. Saunders Company, Philadelphia. 840 p.

Fitzgerald, T.C. 1969. *The Coturnix Japanese quail, Anatomy and Physiology*. The Iowa State University Press, Ames, Iowa. pp : 8-10.

Getty, R. 1975. *Sisson and Grossman's the Anatomy of the Domestic Animals.* Vol II, (5th Ed.), W. B. Saunders Company, Philadelphia. 2095p.

King, A.S. and Mc Lelland, J. 1975. *Outlines of Avian Anatomy.* Bailliere Tindall, London. 152p.

Mc Lelland, J. 1990. *A Colour Atlas of Avian Anatomy.* Wolfe Publishing Ltd., England. 127p.

Nickel, R., Schummer, A. and Seiferle, E. 1986. *Anatomy of the Domestic Birds.* Verlag Paul Parey, Berlin, Hamburg. 202p.

Patki, H.S., Lucy, K.M., Harshan, K.R., Chungath, J.J., and Indu, V.R. 2009. Gross and radiographic anatomy of the neurocranium of Indian common crow (*Corvus sp*.). *Proceedings of the International Congress on Veterinary Anatomy of IAVA*, Nov.4-6, Lucknow. ■