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Axial Skeleton of Homing Pigeon (*Columba livia*)

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ABSTRACT: The uniqueness of a bird includes its ability to fly, high metabolic rate and beak without teeth. The bones of birds are called as pneumatic bones since they are filled with air spaces. The pigeons are small billed birds with long wings and powerful flight musculature. They are strong and swift fliers and comes under Columbidae. The axial skeleton includes skull, vertebral column, ribs and sternum. The study is intended to provide a complete osteological profile of axial skeleton of Homing pigeon which supplement the anatomical data on pigeon and also to differentiate pigeon skeletal framework from other avian species.

Keywords: Skull, vertebra, pigeon, sternum, ribs

INTRODUCTION

The unique characteristics of a bird include its ability to fly, small size, wings, feathers, high metabolic rate and beak without teeth. In mammals, the bones are filled with marrow while in birds since many bones are pneumatic, air spaces make up the majority of bones volume and hence they are harder and stronger but lighter. The axial skeleton includes skull, vertebral column, ribs and sternum.

Vertebral (spinal) column literally 'backbone' is a unique anatomical feature which categorizes the birds (Class Aves) under Phylum vertebrate. The neck of the bird is longest not only because of more number of cervical vertebras but is also more flexible due to its shape, allows a greater degree of movement *i.e.,* a bird can move its head to groom lowest part of the body with its beak (Tarray *et al.,* 2019). Compared to mammals, the trunk region with thoracic and lumbar segments of vertebra is less flexible in birds which make them to withhold the massive force generated by the flight muscles while moving its wings. This is because of synsacrum, fused thoracic vertebra, keeled sternum and ribs.

Although the bones in the skeletal framework of birds look alike, there exists a significant difference in their proportion among different avian species. The study is intended to provide a complete osteological profile of axial skeleton of Homing pigeon which supplement the anatomical data on pigeon and also to differentiate pigeon skeletal framework from other avian species.

MATERIALS AND METHODS

The present study was conducted on the homing pigeon carcass obtained dead to the department of Veterinary Anatomy, Veterinary College and Research Institute, Udumalpet, Tamil Nadu. The bones of pigeon were processed and collected by natural maceration technique (Raghavan, 1964). The different bones of various regions were segregated and then the morphological details of the individual bones were studied and compared with other avian species.

RESULTS AND DISCUSSION

The axial skeleton of Homing pigeon comprised of skull, vertebral column, ribs and sternum (Nickel *et al*., 1977).

Skull. The structure of bird's skull has many implications on their feeding characteristics. As reported by Getty *et al* (1975), the suture between the bones of pigeon skull were also ossified and fused together. Nickel *et al* (1977) stated that the bones in the skull of a bird can be categorized into neurocranium and splanchnocranium. The neurocranium was formed by occipital, sphenoid, parietal, frontal, ethmoid and temporal bones. The splanchnocranium included premaxilla, nasal, lacrimal, maxillary, zygomatic, palatine, pterygoid, vomer, quadrate and mandible.

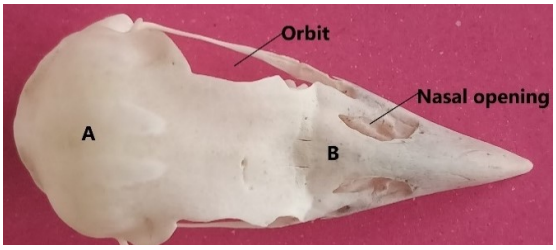

Fig. 1. Dorsal view of skull.

As reported by Aurell *et al.* (2011), the orbits in the cranium of homing pigeon were larger. The occipital bone presented a single occipital condyle below the foramen magnum which indicated that skull of homing pigeon was monocondylic which facilitated the bird to swirl its head upto 270 degrees. As described by Nickel *et al* (1977), the upper portion of beak and anterior boundary of nasal opening was formed by premaxilla which consisted of three processes – nasal, maxillary and palatine processes. The posterior boundary of nasal opening and the roof of nasal cavity was formed by nasal bone and was found in front of the frontal. The lacrimal bone formed the anterior margin of orbit as in domestic fowl (Getty *et al.,* 1975). The palatine bone formed the lateral boundaries of posterior nasal opening and part of roof of oral cavity.

Vertebral Column. Vertebral column of homing pigeon was formed by the bones called vertebrae. Vertebral canal of vertebral column lodged the spinal cord as in mammals (Getty *et al*., 1975). The vertebral column of pigeon consisted of

1) Cervical vertebrae
2) Thoracic vertebrae
3) Fused lumbar and sacral vertebrae *i.e.* Lumbosacral mass
4) Coccygeal vertebrae

In homing pigeon, the neck region that connects the head to the trunk was formed by 12 cervical vertebras whereas in fowl it was 14 (Egwu *et al*., 2012), and in goose it was 17 (Nickel *et al.*, 1977). Tarray *et al.* (2019) reported that number and shape of vertebras in the neck varied among different species of birds.

As reported by Nickel *et al.* (1977), first cervical vertebra – atlas, was ring shaped and was thinner than all other cervical vertebras. The dorsal arch of atlas was thinner in its middle than the ventral arch. Anteriorly, the ventral arch had a concavity for articulation with single occipital condyle and a small foramen above. Posteriorly, a transverse shallow facet was noticed in the ventral arch of atlas for articulation with odontoid process of axis - second cervical vertebra.

The bodies of 3rd to 12th cervical vertebrae were rod-like and the anterior extremity of body of each vertebra was concave in transverse direction and convex in dorso-ventral direction whereas posterior extremity was *vice-versus as stated by* Nickel *et al* (1977) in domestic fowl. The vertebras that were well connected to ribs were referred as thoracic vertebra. As described by Getty *et al* (1975) in fowl, 7 thoracic vertebras were found in pigeon whereas in duck and goose it was 9. Thoracic vertebras were not fused with each other as stated by Nickel *et al.* (1977) in domestic fowl. The transverse processes were broad, plate-like and in its lateral border had a small facet for articulation with ribs.

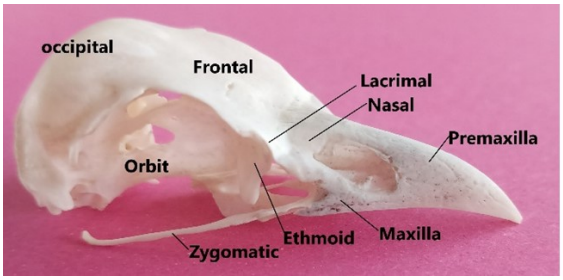

Fig. 2. Lateral view of skull.

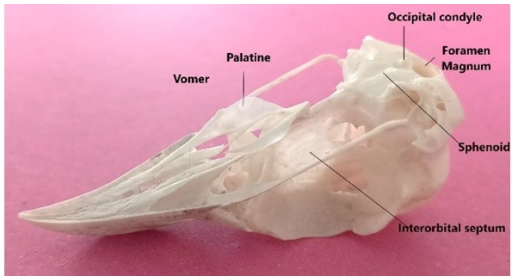

Fig. 3. Ventral view of skull.

Fig. 4.

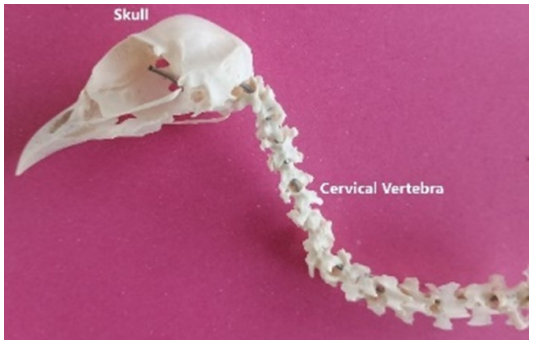

Fig. 5. Skull and Cervical vertebra of Homing Pigeon.

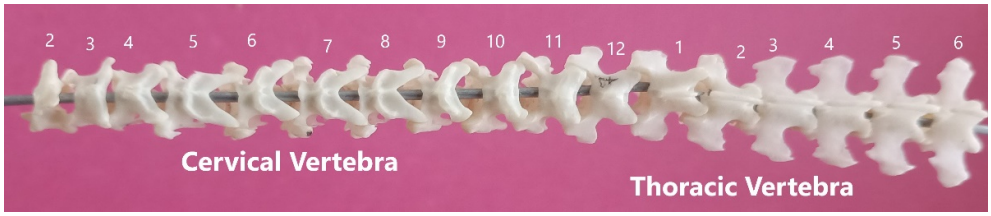

Fig. 6. Cervical and Thoracic vertebra – Homing Pigeon.

As reported by Egwu *et al*. (2012), the lumbar and sacral vertebra in homing pigeon were fused and formed synsacrum or lumbosacral mass as in avian species. Synsacrum was found wedged between the pelvic bones *i.e.* ilium of either side. Anteriorly, the dorsal spines and transverse processes of synsacrum united with ilium whereas posteriorly only the transverse processes were connected with the ilium. The terminal part of vertebral column had coccygeal vertebra. The last three fused and formed three-sided pyramid called pygostyle.

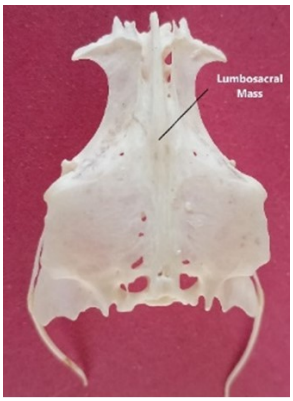

Fig. 7. Lumbosacral mass.

Ribs. As described by Aurell *et al.* (2011), there were 07 pairs of ribs. The ribs were curved and had a head and tubercle in its proximal end. The ribs articulated with thoracic vertebra dorsally and to the sternum ventrally as in domestic fowl (Nickel *et al*., 1977). In middle of the shaft of first five ribs, there were projections directed posteriorly called as uncinate processes which was peculiar to birds.

Sternum. The sternum of pigeon was a flat quadrilateral bone with deeply concave dorsal surface (John *et al*., 2014) and convex ventral surface as in fowl (Nickel *et al*., 1977) and Pariah kite (Tomar *et al.,* 2011). One of the unique features of a flying bird is the keeled or carinate sternum. The keel projected vertically from the ventral surface of sternum was broad, flat and well developed which indicated the power of flight in pigeon (Aurel *et al.,* 2011). The keel was absent in non-flying birds like ostrich and emu (Jayachitra *et al.,* 2015). The cranial border of keel was concave and thickened ventral border was steep and like an arch. The cranial angle of keel was pointed in pigeon whereas it was rounded in Pariah kite (Tomar *et al.,* 2011).

The anterior border of the sternum presented two deep grooves on either side of rostrum for articulation with distal extremity of coracoid bone as noticed by Sathyamoorthy *et al.* (2012) in spot billed pelican. The rostrum was prominent in pigeon as in domestic fowl (Nickel *et al*., 1977) while it was absent in Pariah kite (Tomar *et al.,* 2011).

A short antero-lateral processes directed anteriorly were observed in antero-lateral angle as in duck (Jayachitra *et al.,* 2015). Behind the antero-lateral processes, articular facets for four sternal ribs were found whereas in pigeon hawk (John *et al*., 2014), six articular facets were reported. A long flat postero-lateral processes directed caudally with two divisions were also observed from the lateral border of sternum. Among the two divisions, the medial divisions were short whereas the lateral divisions had shovel like broad endedas in domestic fowl (Nickel *et al*., 1977).

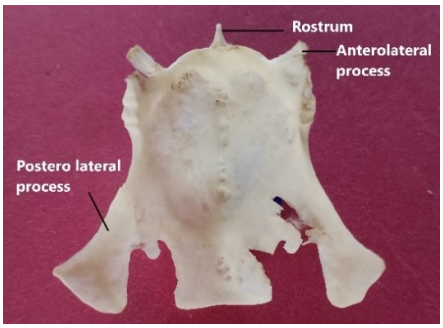

Fig. 8. Dorsal view of sternum.

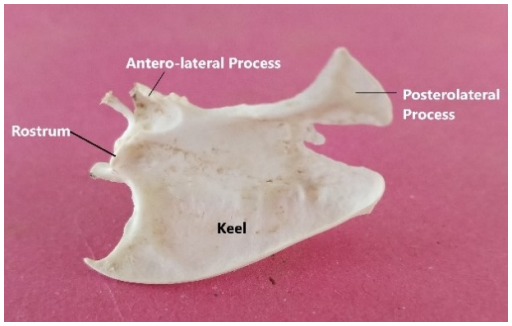

Fig. 9. Lateral view of sternum.

FUTURE SCOPE

Pigeon as on date is a semi-domestic animal and an integral part of every household due to the ascending stress curve. Hence the clinical medicine and treatment for pigeon has been in increasing stature. Though poultry practitioners are supposedly thinking that pigeon is another fowl it is not so as per the literature screened. Hence pigeon medicine is going to be an important area for poultry practitioners and hence pigeons anatomy and physiology deserves more attention. Hence this article will contribute in a long shot for pigeon and its effective treatment as the disease occurrence trend is becoming more and more.

Conflict of Interest. Nil.

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