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Original Research

Gross Morphological and Morphometrical Studies on the Mandible of Adult Broiler Chicken (Gallus domesticus)

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Abstract

The present gross morphological and morphometrical study was conducted on the mandible of ten healthy adult broiler chicken collected immediately after slaughter from the local market of Bhubaneswar, Odisha. It was found that each mandible of chicken consisted of five segments as pars articularis or mandibular condyle with medial curved process, pars supraangularis, pars angularis, splenial and dentary. At the anterior aspect, the dentaries of opposite sides fused with each other forming mandibular symphysis. The right mandibular condyle was much longer cranio-caudally, whereas the left one was comparatively wider transversely at the cranial and middle regions. The left curved process was comparatively longer than the right one. The width of the curved processes decreased progressively from base towards the apex. The coronoid processes were almost equal in size. The left and right pars angularis were almost of similar lengths. The right pars angularis was thicker than the left one at the cranial and caudal aspects, but they were equally thick in the middle. Both the mandibular foramina were wider apart towards the caudal aspect than the middle and cranial regions. The left splenial was comparatively longer than the right one. Both the splenials were almost similar in thickness. The right dentary was comparatively longer and less wide than the left one. The width of the mandibular symphysis increased progressively towards the caudal aspect.

Keywords: Chicken, Mandible, Morphology, Morphometry

Introduction

Adult broiler chicken is probably the most numerous birds in the world largely because of their agricultural importance by serving as a source of protein for human consumption. The skeletal features of the birds represent adaptations for flight and the entire skeleton is compact, lightweight, but very strong (Egwu *et al*., 2012). Many of the bones contain air filled cavities connected to the respiratory system. Bird jaws are powerful tools used for feeding especially in the birds of prey (John *et al*., 2016). The geometric, morphometric analysis on avian anatomy is rare (Degrange and Picasso, 2010) and its use in morphological studies of birds is not common (Morugan-Lobon and Buscalioni, 2006). There is no previously reported information on gross morphometric characteristics of mandible in adult broiler chicken. The present study developed a baseline data on the morphology and morphometry of mandible in adult broiler chicken that could be used for planning future researches in this field.

Materials and Methods

Ten heads of healthy adult broiler chicken were collected from the local market of Bhubaneswar, Odisha. The mandible was dissected and its different segments were studied. The parameters such as diameters of pars articularis, coronoids process and mandibular foramen; length, width and thickness of curved process, pars angularis and splenial; length and width of dentary; distances between two curved processes, mandibular foramina, pars angularis, splenial and distance of coronoid process from pars articularis, etc. were measured with the help of digital weighing balance, scale, thread and digital Vernier's calliper. Further, the measurements were statistically analysed as per the standard methods given by Snedecor and Cochran (1994).

Results and Discussion

The mandible was the largest bone of face of chicken. It was 'V' shaped, which was similar to the findings of Proctor and Lynch (1993) in birds, Moselhy *et al*. (2018) in ostrich and Choudhary *et al*. (2020) in crested serpent eagle (*Spilornis cheela*) and brown wood owl (*Strix leptogrammica*). Each mandible of chicken consisted of five segments as pars articularis or mandibular condyle with medial curved process, pars supraangularis, pars angularis, splenial and dentary. The present findings were in contradiction to the reports given by Moselhy *et al*. (2018) in ostrich, who found four segments in each mandible.

Pars articularis

It was present posteriorly and meant for articulation with the quadrate bone to form movable quadratomandibular joint (Fig.1 and Fig.2). It was in agreement with the reports given by Hassan (2012) in hooded crow and emu (Kumar and Singh, 2014). The articular facets were in the form of condyles known as mandibular condyles. Both the mandibular condyles were oval in shape. These condyles along with the curved processes appeared prismatic in outline, which was in agreement to the findings of Choudhary *et al*. (2020) in crested serpent eagle (*Spilornis cheela*) and brown wood owl (*Strix leptogrammica*). The right mandibular condyle was much longer cranio-caudally, whereas the left one was comparatively wider transversely at the cranial and middle regions. At the caudal aspect, both the left and right mandibular condyles had almost equal transverse diameters. The average cranio-caudal diameters of left and right mandibular condyles were measured as 0.6±0.01 cm and 1.1±0.05 cm respectively. The average transverse diameters of left and right mandibular condyles at the cranial aspect were recorded as 0.6±0.02 cm and 0.5±0.01 cm respectively. Similarly, the average transverse diameters of left and right mandibular condyles at the middle were measured as 0.7±0.01 cm and 0.4±0.01 cm respectively. The average transverse diameters of left and right mandibular condyles at the caudal aspect were recorded as 0.4±0.00 cm and 0.4±0.01 cm respectively.

Behind the pars articularis, the ventral boarder was carried backward and upward in a curved process (Fig. 1 and Fig. 2). The left curved process was comparatively longer than the right one. The average length of left and right curved processes was measured as 0.6±0.02 cm and 0.5±0.01 cm respectively. At the base, the left curved process was wider than the right one, but at the middle and apex, they had equal widths. The average width of left and right curved processes at the base was recorded as 0.6±0.01 cm and 0.4±0.01 respectively. The average width of left and right curved processes at middle was recorded as 0.4±0.00 cm and 0.4±0.01 cm respectively. Similarly, the average width of left and right curved processes at apex was measured as 0.3±0.01 cm and 0.3±0.01 cm respectively. So, the width of the curved processes decreased progressively from base towards the apex. Further, the average distance two curved processes were recorded as 0.8±0.02. The right curved process was comparatively thicker than the right

one. Further, the curved processes were thicker at the base and had almost equal thickness at the middle and apex. The average thickness of left and right curved processes at the base was recorded as 0.2±0.00 cm and 0.3±0.01 respectively. The average thickness of left and right curved processes at the middle was measured as 0.1±0.00 cm and 0.2±0.01 respectively. Similarly, the average thickness of left and right curved processes at the apex was measured as 0.1±0.01 cm and 0.2±0.01 respectively

Pars supraangularis

It was fused caudally with pars articularis and had a coronoid process (Fig.1 and Fig. 2). The present findings were in agreement with the reports given by Nickel *et al*. (1986) in birds and Previatto and Posso (2015) in *Cyclarhis gujanensis.* The coronoid processes were almost equal in size, but the left coronoid process was located far away from the left mandibular condyle than the right one from the right mandibular condyle. The average diameters of left and right coronoid processes were measured as 0.1±0.00 cm and 0.1±0.01 cm respectively. The left coronoid process was present 0.4±0.02 cm away from the left mandibular condyle, whereas the right coronoid process was present 0.2±0.01 cm away from the right mandibular condyle.

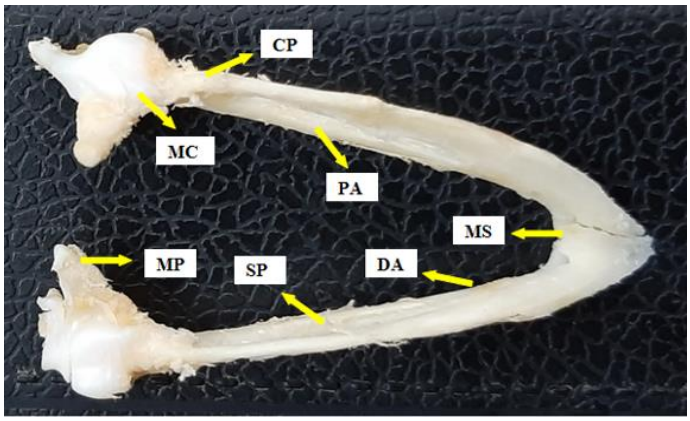

Fig. 1: Dorsal view of mandible of adult chicken showing medial articular process (MP), mandibular condyle (MC), coronoid process (CP), pars angularis (PA), splenial (SP), dentary (DA) and mandibular symphysis (MS)

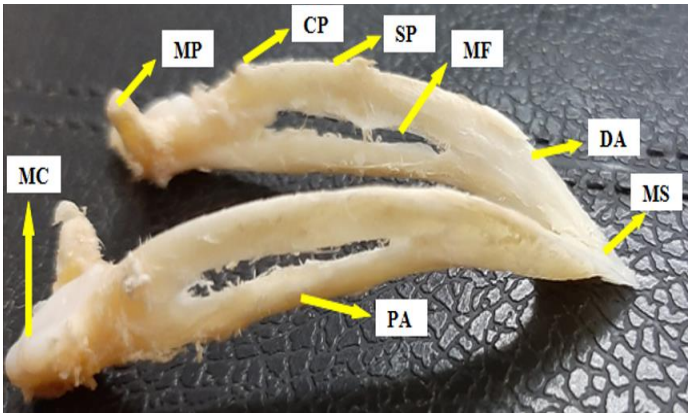

Fig. 2: Lateral view of mandible of adult chicken showing medial articular process (MP), mandibular condyle (MC), coronoid process (CP), mandibular foramen (MF), pars angularis (PA), splenial (SP), dentary (DA) and mandibular symphysis (MS

Pars angularis

It was a slender strip of bone lying along the ventral border of the jaw (Fig.1 and Fig.2). The present findings were in agreement with the reports given by Nickel *et al*. (1986) and Dyce *et al*. (2002) in birds. The left and right pars angularis were almost of similar lengths. The average length of left and right pars angularis was measured as 4.1±0.16 cm and 4.1±0.10 respectively. The left pars angularis was wider than the right one and the width of both the pars angularis progressively increased towards the caudal aspect. The average width of left and right pars angularis at the cranial aspect was recorded as 0.08±0.002 cm and 0.06±0.001 cm respectively. The average width

of left and right pars angularis at the middle was measured as 0.2±0.01 cm and 0.1±0.00 cm respectively. The average width of left and right pars angularis at the caudal aspect was recorded as 0.3±0.01 cm and 0.2±0.00 cm respectively. The right pars angularis was thicker than the left one at the cranial and caudal aspects, but they were equally thick in the middle. Further, the left pars angularis was thicker in the middle than the cranial and caudal aspects. The thickness of left pars angularis at the caudal aspect was more than its thickness measured at the cranial aspect. The right pars angularis was almost equally thick at the cranial and middle region, whereas its thickness increased at the caudal aspect. The average thickness of left and right pars angularis at the cranial aspect was measured as 0.1±0.01 cm and 0.3±0.02 cm respectively. The average thickness of left and right pars angularis at the middle was recorded as 0.3±0.01 cm and 0.3±0.01 cm respectively. The average thickness of left and right pars angularis at the caudal aspect was measured as 0.2±0.00 cm and 0.4±0.02 cm respectively. Further, the distance between the two pars angularis increased progressively towards the caudal aspect. The average distances between the two pars angularis at the cranial, middle and caudal aspects were recorded as 1.1±0.12 cm, 1.4±0.18 cm and 1.7±0.21 cm respectively.

Mandibular foramen

Both the mandibular foramina were almost having similar cranio-caudal diameters, but the left mandibular foramen had higher dorso-ventral diameter than the right one. The average cranio-caudal diameters of left and right mandibular foramina were measured as 1.9±0.15 cm and 1.9±0.08 cm respectively. The average dorso-ventral diameters of left and right mandibular foramina were recorded as 0.5±0.02 cm and 0.3±0.01 cm respectively. Further, both the mandibular foramina were wider apart towards the caudal aspect than the middle and cranial regions. The average distance between the mandibular foramina at the cranial, middle and caudal aspects were measured as 0.9±0.03 cm, 1.2±0.11 cm and 1.6±0.13 respectively.

Splenial

It was present along the medial surface of the mandible as a thin plate of bone (Fig.1 and Fig. 2). It was in line with the findings of Proctor and Lynch (1993) in birds, Moselhy *et al*. (2018) in ostrich and Choudhary *et al*. (2020) in crested serpent eagle (*Spilornis cheela*) and brown wood owl (*Strix leptogrammica*). The left splenial was comparatively longer than the right one. The average length of left and right splenial was recorded as 1.9±0.21 cm and 1.7±0.16 cm respectively. The right splenial was comparatively wider than the left one at the cranial and caudal aspects, but they were almost equally wide at the middle. The left splenial was least thick at the cranial aspect and almost equally thick at the middle and caudal aspects. The right splenial was also least thick at the cranial aspect, but its thickness increased progressively towards the caudal aspect unlike the left splenial. The average width left and right splenial at the cranial aspect was recorded as 0.05±0.02 cm and 0.07±0.02 cm respectively. The average width left and right splenial at the middle was measured as 0.1±0.00 cm and 0.1±0.01 cm respectively. The average width left and right splenial at the caudal aspect was recorded as 0.1±0.01 cm and 0.2±0.01 cm respectively.

Both the splenials were almost similar in thickness. Both the splenials were comparatively thicker at the middle regions than the cranial and caudal aspects. Further, they were almost equally thick at the cranial and caudal aspects. The average thickness left and right splenial at the cranial aspect was recorded as 0.4±0.02 cm and 0.4±0.02 cm respectively. The average thickness left and right splenial at the middle was measured as 0.5±0.02 cm and 0.5±0.01 cm respectively. The average thickness left and right splenial at the caudal aspect was recorded as 0.4±0.01 cm and 0.4±0.01 cm respectively. The splenials became far apart from each other towards the caudal aspect. The average distance between the two splenials at the cranial, middle and caudal aspects was measured as 1.3±0.19 cm, 1.8±0.10 cm and 2.0±0.22 cm respectively.

Dentary

It formed the anterior part of the lower jaw in chicken and fused with its fellow of the opposite side forming mandibular symphysis (Fig.1 and Fig. 2). It contained numerous foramina. It was in line with the findings of Getty *et al*. (1930), Nickel *et al*. (1986), Proctor and Lynch (1993) and Dyce *et al*. (2002) in birds, Moselhy *et al*. (2018) in ostrich and Choudhary *et al*. (2020) in crested serpent eagle (*Spilornis cheela*) and brown wood owl (*Strix leptogrammica*). The right dentary was comparatively longer than the left one. The average length of left and right dentaries was recorded as 1.7±0.16 cm and 1.8±0.13 cm respectively. The left dentary was comparatively wider than the right one. Further, the width of both the dentaries increased progressively towards the caudal aspect. The

average width left and right dentaries at the cranial aspect was recorded as 0.02±0.01 cm and 0.01±0.00 cm respectively. The average width left and right dentaries at the middle was measured as 0.04±0.01 cm and 0.03±0.01 cm respectively. The average width left and right dentaries at the caudal aspect was recorded as 0.07±0.03 cm and 0.05±0.02 cm respectively. The average length of mandibular symphysis at the midline was measured as 0.9±0.01 cm. Further, the width of the mandibular symphysis increased progressively towards the caudal aspect. The average width of the mandibular symphysis at the cranial, middle and caudal aspects was recorded as 0.2±0.00 cm, 0.6±0.02 cm and 1.1±0.05 cm respectively.

Conclusion

From the present study, it can be concluded that each mandible of chicken consisted of five segments as pars articularis or mandibular condyle with medial curved process, pars supraangularis, pars angularis, splenial and dentary. At the anterior aspect, the dentaries of opposite sides fused with each other forming mandibular symphysis. At the caudal aspect, both the left and right mandibular condyles had almost equal transverse diameters. At the base, the left curved process was wider than the right one, but at the middle and apex, they had equal widths. The right curved process was comparatively thicker than the right one. The left coronoid process was located far away from the left mandibular condyle than the right one from the right mandibular condyle. The left pars angularis was wider than the right one and the width of both the pars angularis progressively increased towards the caudal aspect. The distance between the two pars angularis increased progressively towards the caudal aspect. Both the mandibular foramina were wider apart towards the caudal aspect than the middle and cranial regions. Both the mandibular foramina were almost having similar cranio-caudal diameters, but the left mandibular foramen had higher dorso-ventral diameter than the right one. The right splenial was comparatively wider than the left one at the cranial and caudal aspects, but they were almost equally wide at the middle. The splenials became far apart from each other towards the caudal aspect. The width of both the dentaries increased progressively towards the caudal aspect. The width of the mandibular symphysis increased progressively towards the caudal aspect. Further, the various parameters of mandible of adult broiler chicken such as diameters of pars articularis, coronoids process and mandibular foramen; length, width and thickness of curved process, pars angularis and splenial; length and width of dentary; distances between two curved processes, mandibular foramina, pars angularis, splenial and distance of coronoid process from pars articularis showed characteristic biometric differences, which would help to develop a baseline data in this species. This study could lay the pathway for expanded research on this bone in other avian species.

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Conflict of Interests

There is no conflict of interest.

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