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Gross Anatomical Studies on the Pelvic Girdle of African Grey Parrot (*Psittacus erithacus*)

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Abstract

The pelvic girdle of African grey parrot was large and consisted of two os coxae, each of which was made up of an ilium, an ischium and a pubis. The acetabulum was formed by ilium, ischium and pubis. The ischium was triangular, narrow, elongated curved and slightly thick bony plate, situated ventral to the post acetabular part of ilium. The pubis was a thin which followed the ventral border of the ischium and projected slightly beyond it caudally and bent medially. The pectineal process was absent.

Key words: Os coxae, ilium, ischium, pubis, acetabulum, renal fossa

The African grey parrot is Africa's largest parrot. The plumage of *Psittacus erithacus* is various shades of grey with very distinctive red tail feathers. It typically measures 33cm from head to tail and weigh up to 407g (Melo and Ryan, 2007). The os coxae of the birds is large in size and ventrally-open. It forms a dorsal, roof-like covering for a large part of the body cavity and the organs contained theirin (Nickel *et al.,* 1977). The basic anatomical studies on the African grey parrot are very scanty. Hence, the present study was conducted to contribute gross anatomical information on the pelvic girdle of this species.

Materials and Methods

The dead African grey parrot brought for post-mortem examination to the Department of Veterinary Pathology, Madras Veterinary College, Chennai was utilised for the present study. After the post-mortem examination the specimen was biologically macerated, cleaned, dried and utilized for gross morphological and morphometrical studies.

Results and Discussion

The pelvic girdle of African grey parrot was large and consisted of two os coxae, each of which was made up of an ilium, an ischium and a pubis (Fig.1).The space between the pelvic bones was occupied by rhomboid shape lumbosacral mass (Mc Lelland, 1990).

The pelvis was elongated, narrow in the pre-acetabular part and broad in the post-acetabular part (Fig.1). It was 2.2cm broad at pre-acetabular part, 2.6cm broad at the level of acetabulum and 3.6cm broad at the post-acetabular part. It is in agreement with the observations of Nickel *et al.* (*loc cit.)* in fowl and pigeon. The weight of the os coxae was about 2.39gm and formed about 0.60 per cent of the body weight. It was in accordance with the observations of Sreeranjini *et al.* (2011) in peahen, who reported that the pelvic girdle was extremely light compared to the body size of the bird.

The ilium of the African grey parrot was the longest (5.0 cm) and largest bone of os coxae (Fig.1). The pre-acetabular part was 3.0 cm long, and 1.1 cm wide, the post-acetabular part was 2.0 cm long and 0.6 cm wide. It is in agreement with the observations of Nickel *et al.* (*loc cit.*) in pigeon. In contrary, in duck and goose (Nickel *et al., loc cit.*) and in emu (Barvalia and Panchal, 2019) the post-acetabular part was longer and narrower, whereas the pre-acetabular part was shorter and wider.

The pre-acetabular part was quadrilat-

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eral in shape as observed by Nickel *et al.* (*loc cit.*) in fowl. The cranial border was convex in the African grey parrot (Fig.1). Barvalia and Panchal (*loc cit.*) observed that in emu, the cranial border was notched in the middle and projected laterally. Tamilselvan *et al.* (2015) noticed that in ostrich the cranial border at the middle projected laterally forming a notch.

In the present study, the lateral border was convex cranially and slightly concave caudally and formed the lateral iliac crest. The dorsal border formed the dorsal iliac crest. Cranially the dorsal iliac crests of both the ilia were very close to each other. The caudal half of pre-acetabular part the dorsal iliac crests were deviated, and formed a V-shaped structure (Fig.1).It is in agreement with the observations of Keneisenuo *et al.* (2019) in crested serpent eagle but he noticed that in brown wood owl they were not close to each other. Mehta *et al.* (2014) noticed that, in coturnix quail the dorsal borders were fused with the dorsal spines of lumbosacral bone. Deshmukh *et al.* (2016) observed that in peafowl the dorsal border of the ilium did not fuse with dorsal spine of the lumbosacral bone.

The gluteal (dorsal) surface was concave and smooth. It is in total agreement with the observations of Rezk (2015) in cattle egret. Barvalia and Panchal (*loc cit.*) noticed that, in emu the lateral surface was wide, concave and presented several muscular ridges on it.

The pelvic surface of the pre-acetabular part of ilium was fused with the spines of the synsacrum dorsally and with the transverse process ventrally (Fig.2), enclosing a space in between, which opened cranially but closed caudally.In contrary, Nickel *et al.* (*loc cit.*) observed that in chicken, the *canalis ilioneurales* were produced, which were bounded by the ilium and the spinal and transverse processes of the synsacrothoracic vertebrae. Lavanya *et al.* (2017) observed that the *canalis ilioneuralis* was formed in guinea fowl, but in pigeon the ilium was not fused with the dorsal spines of lumbosacral mass, so that dorsally opened narrow *canalis ilioneuralis* was noticed. The pelvic (ventral) surface of the pre-acetabular part of ilium was excavated to accommodate the kidney (Fig.2), as observed by Rezk (*loc cit.*) in cattle egret.

The pre and post-acetabular parts of ilia were clearly demarcated by a sharp ridge which was the continuation of dorsal iliac crest, and extended up to the craniodorsal border of ischiatic foramen. This crest continued as the lateral border of the post-acetabular part, as observed by Sarma *et al.* (2018) in Indian eagle owl and Keneisenuo *et al.* (*loc cit.*) in crested serpent eagle and brown wood owl. In ostrich, the pre-acetabular and post-acetabular parts were well demarcated by a bony prominence at its lateral surface (Tamilselvan *et al., loc cit.*).

The post-acetabular part of ilium was convex, narrow and facing dorsally (Fig.1) as observed by Sarma *et al.* (*loc. cit*) in Indian eagle owl. In emu, the ilium was lying vertical to the long axis of the body (Santhilakshmi *et al.*, 2007).

The lateral border of post-acetabular part showed the crest, which was the continuation of dorsal iliac crest of pre-acetabular part. It extended up to the end of the caudal process of ilium, and formed the lateral border (Fig.1). It is in agreement with the observations of Sarma *et al.* (*loc cit.*) in Indian eagle owl and Keneisenuo *et al.* (*loc cit.*) in crested serpent eagle and brown wood owl.

The post-acetabular parts of ilium were separated widely from each other by a bony plate formed by the fused transverse process of synsacrum. The medial borders of the post-acetabular parts of ilium and the transverse processes of synsacrum were joined syndesmotically (Fig.1), as reported by Nickel *et al.* (*loc cit.*) in birds. In peahen, only the caudal two thirds of medial border united with the transverse processes of lumbar and sacral vertebrae of synsacrum (Sreeranjini *et al., loc cit.*). But in emu, the medial surface of the ilium was completely fused with synsacrum (Barvalia and Panchal, *loc cit.*).

In the present study it was noticed that the medial borders, behind its union with the transverse process of synsacrum deviates laterally and met with the lateral border at the tip of the caudal process (Fig.1). The caudal process was present at the caudal part of the post-acetabular part of ilium. It was a short, narrow caudally extended process, projecting ventrally. Its ventral surface fused with the

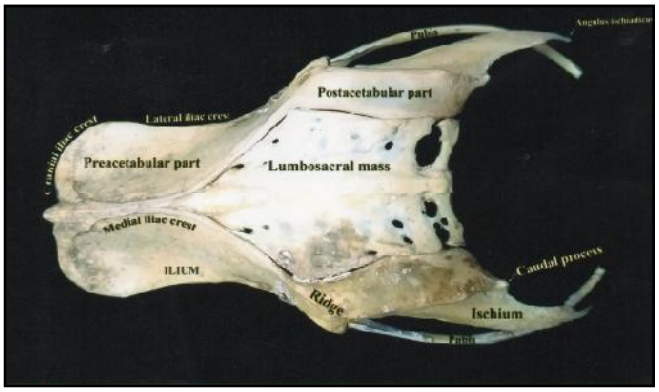

Fig 1. Photograph showing dorsal view of the pelvic girdle of African gray parrot.

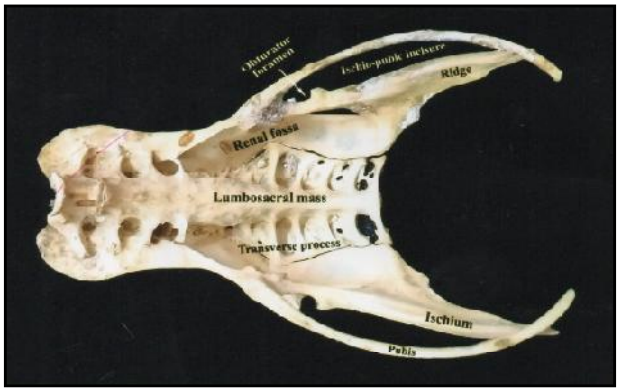

Fig 2. Photograph showing ventral view of the pelvic girdle of African gray parrot.

ischia. The caudal process was very distinct and projected dorsally in fowl and pigeon (Nickel *et al.*, *loc cit.*), distinct in spot - billed pelicans (Sathyamoorthy *et al.*, 2012) and in guinea fowl (Lavanya *et al., loc cit.*). But the caudal process was not very distinct in peahen (Sreeranjini *et al.*, *loc cit.*).

In the present study, the pelvic surface of the post-acetabular part of ilium, showed the renal fossa which was deeply concave, narrow in front and slightly wider behind (Fig.2). The renal fossa was present in fowl, duck, goose and pigeon (Nickel *et al., loc cit.*), in cattle egret (Rezk, *loc cit.*), peafowl (Deshmukh *et al., loc cit.*), Indian eagle owl (Sarma *et al.*, *loc cit.*), and in crested serpent eagle and brown-wood owl (Keneisenuo *et al., loc cit.*). But in emu (Mehta *et al., loc cit.*) and in bar-headed goose (Sasan *et al.*, 2017) renal fossa was not present.

Rezk (*loc cit.*) observed that in cattle egret the renal fossa was continued caudally as an invagination between the post-acetabular ilium and the ischium to form the renal caudal recess. But no such recess was noticed in the present study in African gray parrot.

In African grey parrot the acetabulum was formed by ilium, ischium and pubis. The acetabulum was 0.6cm in diameter. The floor of the acetabular rim was broadest, the cranial part was slightly broader and the caudal part of the rim was narrower. It was perforated and circular in outline, as observed by Nickel *et al.* (*loc cit.*) in turkey and goose. In contrary in fowl and duck (Nickel *et al., loc cit.*) and in cattle egret (Rezk, *loc cit.*) the pubis was not involved in the formation of acetabulum.

The caudodorsal part of the rim of the acetabulum showed a large bony prominence with sharp edges, carrying a triangular facet, the anti-trochanter as observed by Rezk (*loc cit.*) in cattle egret and Sarma *et al.* (*loc cit.*) in Indian eagle owl. McLelland (*loc cit.*) reported that, the antitrochanter-femur articulation reinforces weak adductor muscles and limits abduction of the limb. Hertel and Campbell (2007) reported that, the antitrochanter serves as a brace to prevent abduction of the hindlimb and to absorb stresses that would otherwise be placed on the head of the femur during bipedal locomotion.

The ischium was extending from the caudal rim of the acetabulum, situated caudo-ventral to the ischiatic foramen and ventral to the post-acetabular part of ilium. It was triangular, narrow, elongated curved and slightly thick bony plate. It was 3.5cm long, broad cranially and terminated in a pointed end caudally. Its cranial narrow part participated in the formation of caudal rim of the acetabulum, as observed by Nickel *et al.* (*loc cit.*) in pigeon.

In the present study, between the dorsal border of the ischium caudal to the acetabulum and the ventral and lateral borders of the cranial half of the post-acetabular ilium, a large, oval opening the ischiatic foramen (1.0cm long and 0.7cm wide) was noticed, as reported by Nickel *et al.* (*loc cit.*) in fowl and pigeon. In duck and goose, the ischiatic foramen was an elongated oval opening with a pointed end. McLelland (*loc cit.*) reported that, this foramen transmitted the ischiatic nerve in birds. In emu, the foramen ischiadicum was in the form of a long ilio-ischiatic incisures (Barvalia and Panchal, *loc cit.*).

Caudal to the ischiatic foramen a short dorsal border of the ischium was fused with the ilium, as reported by Nickel *et al.* (*loc cit.*) in birds. In contrary, in cattle egret, the caudal part fused with the ilium formed a broad bony plate (Rezk, *loc cit.*).

In the African gray parrot, caudal to the fusion with ilium, the ischium was highly elongated, narrow, triangular plate of bone and terminated in a pointed end, the angulus ischiadicus, facing ventrally, as observed by Lavanya *et al.* (*loc cit.*) in pigeon, and Sarma *et al*. (*loc cit.*) in Indian eagle owl. It was connected to the pubis by connective tissue as reported by Nickel *et al.* (*loc. cit*) in fowl, duck, goose and pigeon. Deshmukh *et al*. (*loc. cit*) reported that in peafowl, the angulus ischiadicus, the ventral end of the caudal border of the ischium was blunt and did not fuse with the pubis. Barvalia and Panchal (*loc cit.*) noticed that, in emu, the caudal extremity of the ischium was slightly broad and fused with the caudoventral end of the ilium, and remained separate at the caudodorsal region of the pubis.

In African gray parrot, the caudal border of the pelvis was formed by a short caudal part of ilium and long caudal border of ischium. The caudal border was long and extended in a sloping direction. The dorsal border of ischium behind the fusion with ilium was concave in front and convex behind.

The ventral border of the ischium was sharp, and showed a large, wide, pubo-ischiatic incisures along with the dorsal border of the pubis. In the present study, it was noticed that, the ventral border of ischium about the level of middle of the ischiatic foramen and the dorsal border of the pubis about the same level presented bony projections, which in life, may be connected by a connective tissue band and converted into a foramina, the foramen ovale. Behind this the incisures remained as ischio-pubic incisures. Hence, in African gray parrot, the long ischio-public incisure was converted into a foramen ovale cranially and long ischio-public incisure behind this and closed by the union of angulus ischiadicus and the pubis. It is in agreement with the observations of Barvalia and Panchal (*loc cit.*) in emu who observed that, the ischio-pubic incisure was large and incompletely divided by a blunt projection of ischium into oval obturator foramen cranially and an elongated slit caudally.

Nickel *et al.* (*loc cit.*) reported that, the pubo-ischiatic incisure was not divided but was a narrow elongated oval incision in duck and goose. In fowl and pigeon, the middle portion of the pubis formed a synostosis with the ischium, so that the pubo-ischiatic incision was divided into the obturator foramen which lied near the acetabulum and a more caudal slit.

In the present study, the lateral surface of the ischium was convex and smooth. The medial surface was concave and showed a ridge extending from acetabulum up to the tip of angulus ischiadicus (Fig.2).

The pubis was a thin, long (4.0cm), curved, rod-like bone which followed the ventral border of the ischium and projected slightly beyond it caudally and bent medially. It formed a connective tissue connection with the short angulus ischiadicus as observed by Nickel *et al.* (*loc cit.*) in fowl and pigeon. In duck and goose, the pubis extended considerable distance beyond the caudal border of the ilium and ischium, and formed a syndesmotic junction with the plate-like angulus ischiadicus and increases in width from here onwards. In goose, it terminated in a shovel -like process which was curved medially. Mehta *et al.* (*loc cit.*) reported that, in Japanese quail the pubis did not project beyond the ilium and ischium. Sarma *et al*. (*loc cit.*) reported that, in Indian eagle owl the caudal end of the pubis was bent medially to meet with its fellow of opposite side.

The cranial half of the pubis was thin, whereas the caudal half was slight thick, as observed by Sarma *et al*. (*loc cit.*) in Indian eagle owl. The lateral surface was convex and the medial surface was concave. Its cranial end participated in the formation of acetabulum. Nickel *et al.* (*loc cit.*) observed that, in pigeon and goose the pubis participated in the formation of acetabulum, but in fowl and duck it was fused with the ischium below the acetabulum.

In ostrich (Tamilselvan *et al*., *loc cit.*) the pubis was a long slender bone, dorsally concave in front and convex behind. Its caudal extremity extended beyond the ilium and ischium and bent medially and formed pubic symphysis. The

pubic symphysis supported the weight of the abdomen. The caudal one third of pubis also fused dorsally with the ischium.

The pectineal process was not present in the African gray parrot. Nickel *et al.* (*loc cit.*) reported that the pectineal process was long thorn-like in the fowl, absent in pigeon, and rudimentary in duck and goose. The pectineal process was rudimentary in peahen (Sreeranjini *et al.*, *loc cit.*), absent in Japanese quail (Mehta *et al., loc cit.*), Indian eagle owl (Sarma *et al., loc cit.*), and spot-billed pelicans (Sathyamoorthy *et al., loc cit.*). Kumar and Singh (2014) reported that, in emu the pectineal process was slightly broader towards the cranial extremity of pubis to participate in the formation of acetabulum. He also informed that, under development of this process might lead to paralysis of hind limb.

In the present study, it was noticed that the os coxae was not showing pneumatic foraminae. In contrary, Sreeranjini *et al.* (*loc cit.*) observed that the pelvic girdle of peahen showed large number of air cavities.

Summary

In African gray parrot, the ilium was the longest and largest bone of os coxae. The acetabulum was formed by ilium, ischium and pubis. The caudal process was short, narrow and projected ventrally. The ischium was triangular, narrow, elongated curved and slightly thick bony plate. The pubis was a thin, rod-like bone which followed the ventral border of the ischium and projected slightly beyond it caudally and bent medially. The pectineal process was absent. The os coxae were less pneumatised.

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