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A STUDY OF SOME BONES OF QUAILS AND ITS CONVENCIENT TO THE MODE LOCOMOTION

(With 2 Tables and 8 Figures)

By

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دراسة على عظام الحزام الصدري والحزام الحوضي والقص في السمان ومدى ملاءمتها للحركة

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استخدم لهذه الدراسة ستة عشر من طيور السمان تم احضارها من العريش – احدى مدن الساحل الشمالى – والمعروف، طبقا للمراجع، أن آباء هذه الطيور كان في الأصل سلاله مهاجرة قدمت الى مصر من أوربا – ولكن لوحظ أن السلاله الناتجة من تربية هذه الطيور تكون غير قادرة على الطيران، وتهدف هذه الدراسة الى التعرف على مدى ملاءمة الشكل التشريحي، لبعض العظام، لكيفة حركة هذه الطيور. وقد أوضحت النتائج أن عظام الحزام الحوضي أثقل مرتين من عظام الحزام الصدري وأن أغلب الصفات التشريحية والقياسية للعظام الأخرى وخاصة العظمة الغرابية وعظمة القص تشبه تلك التي وردت في المراجع عن الطيور التي تمشي على الأرض مما يعني أن التركيب التشريحي لعظام هذه الفصيلة المستأنسة – من السمان موضوع الدراسة – تلائم المشي على الأرض أكثر من الطيران في الهواء.

A STUDY OF SOME BONES

SUMMARY

The present work was conducted on the bones of the thoracic and pelvic girdles as well as the sternum of quails. Sixteen birds of domesticated species were submitted to this study brought from El-Arish city. The studies comprised a quantitative and the most characterestic features of the bones which could be summerized as follow: The pneumatic foraminae of the sternum and coracoid are absent., The coracoid is relatively well developed., The weight of the pelvic girdle is two folds that of the thoracic girdle. Comparison of these features and others with that reported in the available literature revealed that the bones of the domesticated quails are similar to that of the walking birds more than the flying ones.

INTRODUCTION

WALLACE and MAHAN (1975) divided the birds according to the mode of locomotion into scansorial *(climbing)*, satatorial *(jumping)*, curosolial, wading, swimming, diving and flying birds. *FEDUCCIA (1975)* investigated that many birds, particularly those of the order Galliformes have become terrestrial through domestication, yet still possess a skeleton that is basically adopted for flight. The evolutionary outcome of becoming a fully terrestrial birds is to be seen in its skeleton.

The quails used in this work is of migratory one which has come to Egypt from Europe. The unability of this species to fly paid our attention to study the characterestic features of its bones. *ABDEL-MONEIM (1992)* studied the bones of the wing and pelvic limb of quails.

The present study aims to investigate the adaptation of the bones of the girdles and sternum to the pattern of movement.

MATERIAL and METHODS

Sixteen birds of the species of quails were used in the present work. The specimens were brought from El-Arish city one of the north cost cities of Egypt overlooking the Mediterrnean sea. After slaughtering the muscles were removed and the bones of the thoracic girdle, pelvic girdle and sternum were dislocated. The attached soft tissues were taken away by putting the bones in a water to which 1% solution of hydrogen peroxide was added. Until the bones become clean and bright.

The main morphological features as well as the weight and other linear measurements were recorded and interpretted.

Statistical analysis of the obtained data was carried by using *SAS (1988).*

The nomenclature used in this study was that adopted to Nomina Anatomica Avium of *BAUMEL* et al. *(1979).*

RESULTS

Thoracic girdle (Fig. 1):

The bones of the thoracic girdle (Fig. 1) are Clavicula, Scapula and Coracoid.

Clavicula: In quails as most species of birds, the two clavicles are fused at an acute angle ventrally to form the Clavicula or Furcula (Fig. 2).

The average length of the Furcula is 3.7 cm, its height is 3.5 cm and its width is 1.4 cm. Consequently the percentage of the width to length is 37% and to height is 40%. In the omal (dorsal) extremity the acrocoracoid process (2/1) is weakly developed and the acromion process (2/2) bears an elongated concave facet for the scapula. In the sternal *(ventral)* extremity the Apophysis furculae (2/3) is in the form of sagittal bony plate.

Scapula: The scapula (Fig. 3) is the longest bone of the thoracic girdle (Table 1). Its shaft is flattened with thin and sharp dorsal border and grooved lateral surface (3/1). In its cranial extremity the acromion process (3/2) is well distinct and carries the Facies articularis clavicularis which is elongated and convex. It also present the Facies articularis humeralis (3/3) which is rounded and concave.

Coracoid: The coracoid (Fig. 4) is relaively long in quails and its weight is the heaviest among the bones of the thoracic girdle (Table 1). The acrocoracoid proces (4/1) is more prominent. The Sulcus m. supracoracoidei is found between it and the procoracoid. The facies articularis humeralis (4/3) is saddle-shaped and concurs with that of the scapula to form a continuous facet for the head of humerus. On the dorsal surface of the shaft, the pneumatic foramen was not observed.

Pelvic girdle:

The pelvic girdle (Fig. 5,6) is formed of the two pelvic bones which articulate dorsally with the synsacrum (5,6/1,2). Each one consists of illium, ischium and pubis. The ischium and pubis (5,6/1,2) don't fuse ventrally to form the pelvic symphsis.

The widest region of the pelvic girdle is at the acetabulum (1.9 cm), while at the cranial border is 1.7 cm and at the apex of the pubis is 1.2 cm.

The preacetabular wing of ilium (5/3) is longer (2.3 cm) than the postacetabular one (1.4 cm) (5/4). The later is flattened dorsoventrally and meets the ischium at right angle forming the dorsolateral crest (5/5). The Tuberculum preacetabular (Proc. pectinealis) is well developed (5,6/6). The intermediate iliac crest (6/7) is prominent in quails and dividing the renal fossa into a small cranial *(ischiatic)* part (6/8) and a larger caudal *(pudendal)* one (6/9). The foramen ilioischiadicum (5/10 ostrum) is diamond in shape. The Incisura caudalis pelvis (6/11) is triangular in quail. The free caudal part of the pubis is relatively short (2.5 cm) and the apex is slightly widened. The weight of the pelvic girdle is two folds that of the thoracic girdle. Their percentage to the total weight of the skelton is 9.9% and 4.8% respectively (Table 2).

Sternum: The sternum (Fig. 7,8) is the heaviest bone in the body (0.57 gm) of quails (Table 2) and forms most of its ventral boundary. It weight 0.57 gm and forms 7.9% of the skelton (Table 2). It consists of Corpus sterni (7,8/1), Rostrum sterni (7/2) and Carina sterni (Keel), (8/3).

In quails the body of the sternum is long and in the form of narrow triangle. Its length is 5.4 cm and its width at the middle is 0.9 cm. The craniolateral process (7,8/4) is well developed in quails where it reaches 1.1 cm in length. The length of the thoracic process (7,8/5) is 2.1 cm and that of the caudolateral process (7,8/6) is 3.2 cm. The later two processes arise from the body a common stem and encircle between them the Fenestra lateralis (7,8/7). The caudal margin of the body is very narrow and ventraly it has no Planum postcarinale. Neither the Foramen pneumaticum nor the pori pneumatici were observed. The Pila coracoidea (8/8) carries the Sulcus articularis coracoidea which is very deep. On the lateral margin, the Pila costalis (8/9) carries three costal processes.

In the Rostrumsterni, the Spina interna (7/10) and Spina externa (7/11) are present. They are connected with each other leaving between them the Foramen rostri (7/12).

The Carina sterni has a pointed apex (7/13) and possesses on its cranial margin, the Crista mediana between the two Cristae laterales. The Carina extends caudally to the caudal margin of the body and consequently no planum postcarinale is found on the ventral aspect of the body as mentioned before at

the apex, the width of the Carina is 1.7 cm and its length is 4.5 cm.

Table 1: Average length, weight and percentage of each bone of the thoracic girdle and its percentage to its total length and weight.

Bone of the thoracic girdle	Length	Length %	Weight	Weight %
Clavicula*	3.7 cm	34.60%	0.15 gm	21.00%
Two Scapula	4.1 cm	38.30%	0.22 gm	31.00%
Two Coracid	2.9 cm	27.10%	0.34 gm	48.00%
Total	10.7 cm	100.00%	0.71 gm	100.00%

*: Clavicula *(Furcula)* means the two fused claviccles.

No clear correlation was found between the percentage of the length and weight of each bone of the thoracic girdle to the total length and weight of the girdle except the weight percent of the scapula in relation to the total weight of the girdle where r=0.89953.

Table 2: Average weight and percentage of thoracic girdle, pelvic girdle and sternum to the total weight of the skelton.

Part	Weight	Weight %
Thoracic girdle	0.71 gm	9.90%
Pelvic girdle	0.35 gm	4.80%
Sternum	0.57 gm	7.90%
Total weight of the skelton	7.19 gm	100.00%

Highly significant correlation was recorded between the weight of the thoracic girdle (r=0.99090) and sternum (r=0.099684) to the total weight of the skelton.

DISCUSSION

Quails are similar to fowel in that the hypocledium *(Apophysis furculae)* is in the form of sagittal bony plate *(FEDUCCIA, 1975)* and the angle between the two clavicles is acute *(BRADLEY and GRAHAM, 1960)*.

KING and MCLELLAND (1984) stated that the scapula is the longest bone in the strongly flying birds and very small in flightless ones. However, *MOAD (1988)* stated that the scapula decreases in length from walking to flying birds. The present finding complies with that of the walking birds in case of scapula but the other bones of the thoracic girdle, the statistical analysis investigated clear correlation between the

weight of the scapula and the total weight of the thoracic girdle (r=0.89953).

NICKEL SCHUMMER and SEIFERLE (1977) stated that the coracoid is the heaviest bone in the thoracic girdle in walking birds. The same was found in quails. *KENT (1978)* added that the coracoid braces the wing against the sternum and that is essential if the limbs were to push more and more forcefully against the earth.

The intermediate iliac crest is more prominent in walking and swimming birds *(BOAS, 1933)*. Also the Tuberculum preacetabulare is found in quails as walking and swimming group and absent in the flying ones *(MOAWD, 1988)*.

The preacetabular wing of ilium in quails is longer than the post acetabular one. *HIFNY et al. (1988)* added that the postacetabular wing is connected to the ischium at right angle in flying birds whereas in the walking ones the two bones appear to be continuous with each other. In this respect quails simulate the flying birds.

KING and MCLELLAND (1984) stated that the general shape of the pelvis is closely correlated with mode of locomotion. For example, the pelvis tends to be relatvely wide in running birds. The present study also investigated that the pelvis of quails is wide particularly at its middle.

In the bipedal animals, the three bones of the pelvic girdle are adaptively modified in size, shape and relationship. The ilium and ischium are greatly expanded to accomodate the musculature for bipedalism *(KENT, 1978)*. The shape and measurements of the pelvis in quails come in agreement to these features accomodating bipedalism.

Neither the Pneumatic foramen nor Pori pneumatici that decreased by *HIFNY et al. (1988)* in all studied birds are visible on the sternum of quails. The craniolateral process is found in quails, the thoracic and caudolateral process originate by a common stem and encircles the Fenestra laterails.
all these features are similar to that of the walking birds studied by *MOAWD (1988)*.

YOUNG (1981) mentioned tht the Keel *(Carina)* serves to carry the weight of the body to wing. *NICKEL et al. (1977)* added that the size of the Keel varies according to the ability of brds to fly. It's very wide in the flying birds to give a large surface area for the attachment of powerful muscles of flight. In quails the size if the Carina *(Keel)* as well as the shape of the body of the sternum greatly correspond those of the walking birds.

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LEGENDS

Fig. 1: Bone of the thoracic girdle: 1,Clavicula, 2,Coracoid, 3,Scapula.

Fig. 2: Clavicula, Caudal aspect, left, lateral aspect, right. 1,Acrocoracoid process, 2,Acromion process, 3,Apophysis furrculae, 4,Scapus claviculae, 5,Corpus coracoidei, 6,Angulus medialis, 7,Processus Lateralis.

Fig. 3: Right scapula of quails.
Lateral surface, left, medial surface, right.
1,Grooved lateral surface, 2,Acromion process, 3,Facies articularis humeralis.

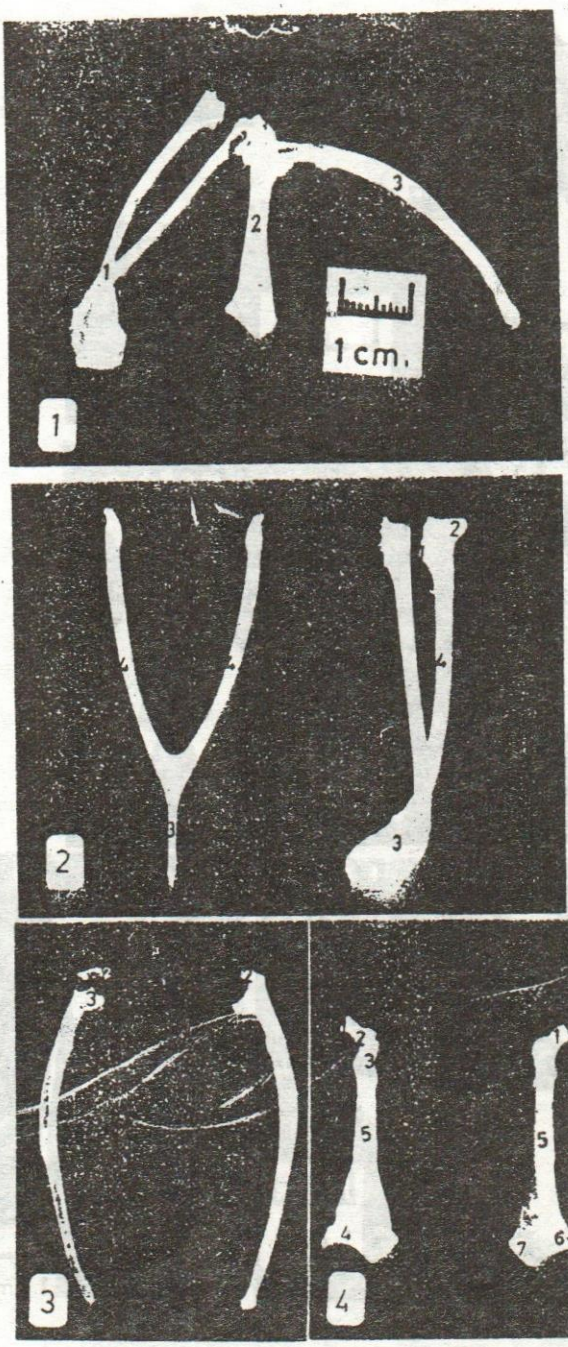
Fig. 4: Right Coracoid of quails.
Dorsal surface, left, ventral surface, right.
1,Acrocoracoid process, 2,Sulcus m.supracoracoidei, 3,Facies articulars humeralis.
4,Facies articularis sternalis.

Fig. 5: Right pelvic bone of quails lateral view.

Fig. 6: Pelvic girdle, dorsal view, left ventral view, right.
1,Pubis, 2,Ischium, 3,Preacetabular wing of the ilium, 4,Postacetabular wing, 5,Dorsolateral crest, 6,Tuberculum preacetabulare, 7,Intermediate iliac crest, 8,Pars ischiadica of fossa renalis, 9,Pars pudenda of fossa renalis, 10,Foramen ilioischiadicum, 11,Incisura caudalis, 12,Synasacrum.

Fig. 7: Sternum, Lateral view.

Fig. 8: Sternum, Dorsal view.
1,Corpus sterni, 2,Manibrium sterni, 3,Carina sterni *(Keel)*, 4,Craniolateral process, 5,Thoracic process, 6,Caudolateral process, 7,Fenestral lateralis, 8,Pila coracoidae, 9,Pila costalis, 10,Spina externa, 11,Spina interna, 12,Formen rostri, 13,Apex of the Carina.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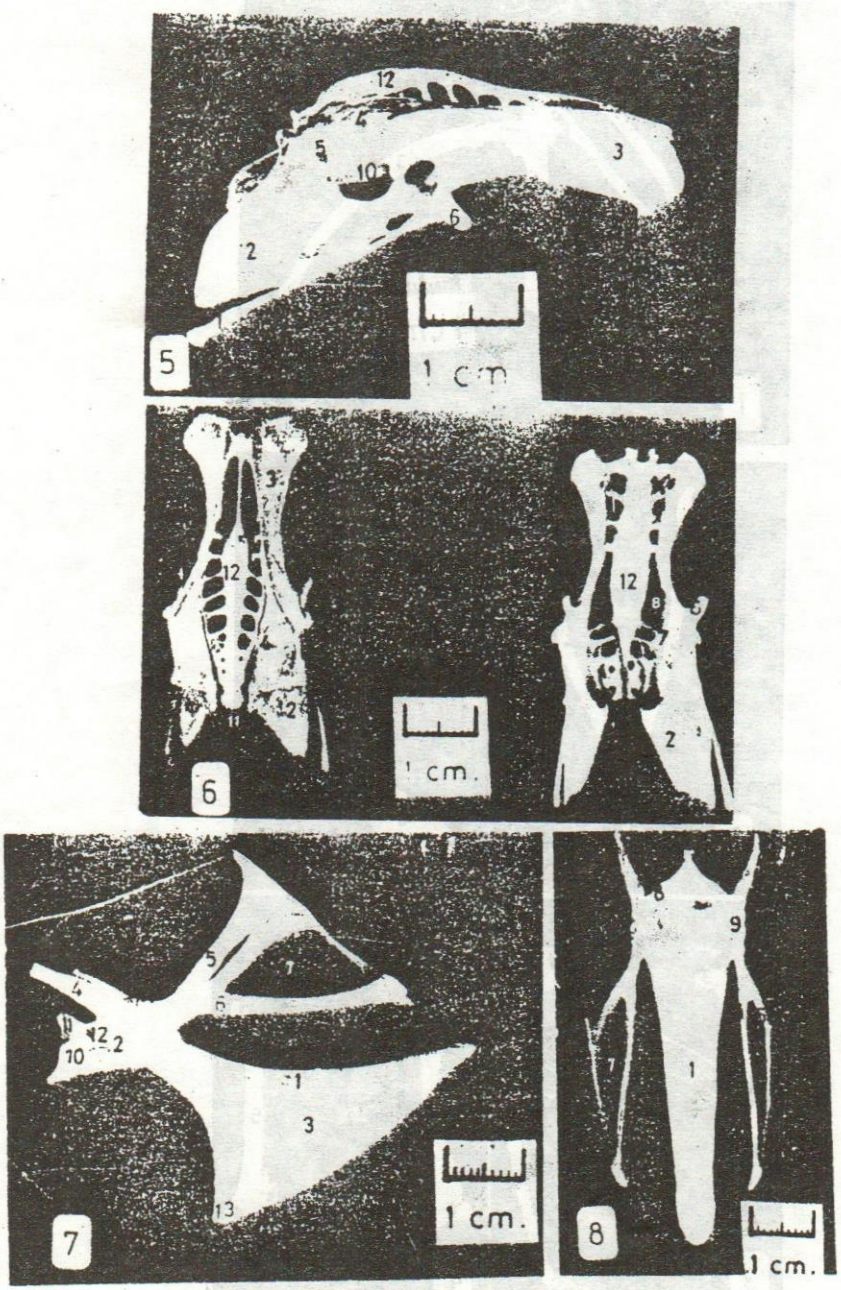
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