Dept. of Zoology,
Faculty of Science, Assiut University,
Head of Detp. Prof. Dr. M.K. El-Naffar.

STUDIES ON THE POST-CRANIAL MYOLOGY OF CHAMAELEON VULGARIS, FAMILY: CHAMAELEONTIDAE I- AXIAL MUSCLES: CERVICAL REGION

(With 4 Figs.)

By
M.T. WAHBA; A. KHALIL and N.A. SHAWKI

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دراسات على العضلات خلف الجمجمة للحرباء : كاميليون فولجاريس ،
فصيلة كاميليونتيـــــــذي

محمد وهبـــة ، عبد الحميد خليـل ، ناهد شوقـــــي

تقدم في هذا البحث دراسة على مجموعة العضلات الخاصة بمنطقة الرقبة للحربـــاء ويقارن بينها وبين بعض السحالي الأخرى مثل البرص وقاضي الجبل : وقد تم وصـــف ثلاث عضلات جديدة في الحرباء لم توجد في أي من السحالي السابق وصفها .

SUMMARY

Studies of the present work revealed that, the cervical muscles of chamaeleon vulgaris are relatively short due to the reduction of the neck region and the anterior shift of the foramen magnum in respect with the parietal crests. The dorsal cervical muscles (no 1,2,3) are very short in length so that those muscles may fix the skull to the neck region instead of elevating the head dorsally as in other lizards. Three small new muscles are found and described.

INTRODUCTION

Due to the absence of a comprehensive study of the post-cranial myology of a single lizard in the literature, the authors of the present work started a project by establishing a standard, detailed and comprehensive study of the post-cranial myology of Uromastyx aegyptia (KHALIL, et al. 1977) and Psammophis sibilans (KHALIL, et al. 1987 1,2,3,4 & 5).

In fact, in that work the authors described every detail of the muscular structure, put a new order of nomenclature which is helpful to a zoologist and not derived from

human anatomy system of nomenclature, and finally introduced for the first time a new system for the arrangement of those muscles like: axial, pectoral and pelvic muscles ... etc.

The present work represents another step in this project dealing with the post-cranial myology of chamaeleon vulgaris (F:Chamaeleontidae). This lizard, as well as, Tarentola annularis and Agama mutabilis were selected for investigation on the basis that those lizards are widely divergent in their mechanism of locomotion, living localities and feeding habits. This may lead us to consider the difference in myological structure of functional adaptation rather than of phylogenetic significance.

Details of the post-cranial myology of body regions of each lizard of the present study will be given serially in a complete set of papers. At the end of the present series of work, we will evaluate the whole results of the studied lizards in a separate paper.

MATERIAL and METHODS

The lizard examined in this study is Chamaeleon vulgaris Daud. Specimens were collected from the north Egyptian coastal regions. Muscles were exposed by normal technique of dissection but with very high accuracy, fine parts were dissected under stero-dissecting binocular. Dissected parts were first photographed and then they were drawn.

RESULTS

1 - Cranio-spinal (Semispinalis capitis of Gray's):

(Figs. 1 a,b,c and 2 a,b)

The cranio-spinal is a delicate muscle which is located median to the dorsal head of the cranio-costal muscle (3). Since both muscles have a vertical surface of origin, the cranio-spinal muscle is completely hidden in a surface view. The cranio-spinal muscle originates on a short narrow vertical area found on the median side of the posterior surface of the supra-occipital. It should be noted that the parietal bones of chamaeleon are highly reduced, and cannot serve for muscle attachments. Thus in chamaeleons, the supra-occipital and exoccipital bones serve for the muscle attachments instead of the parietals. The cranio-spinal muscle is inserted by one tendon on the lateral side of the neural spine of the fifth cervical vettebra (Fig. 1c).

2 - The cervical inner semispinal units:

(Figs. 1c & 2b)

In the species studied, there are five cervical vertbrae, which means that the neck region is relatively short. Further, the foramen magnum lies anterior to the posterior edges of the dorsally arching parietals. Consequently, the atlas, axis and third cervical vertbrae are located anteriorly under the arch of the parietals, a fact which adds to the shortening of the neck region. Two elongated semispinal muscle units are present; one outer to the other . The inner semispinal muscle unit originates on a vertical line on the neural spine and small part of the neural arch of the second dorsal vertebra. It also collects muscle fibres from the first dorsal and fifth cervical vertebrae. The muscle tapers anteriorly to be inserted by a short tendon on a dorsal most posterior area of the axial neural spine.

3 - Cranio-costal (Longissimus capitis of Gray's):

(Figs. 1 a,b&c, 2 a,b and 3a)

The cranio-costal muscle consists of a dorsal inner element (3a) and a ventral lateral element (3b). The element (3a) is an extensive muscle that originates by five short tendons on the lateral sides of the last four cervical and the first dorsal prezygapophyses. It is inserted all along the long ascending process of the supra-occipital and the dorsal rim of supra-occipital, exoccipital and paroccipital process (Fig. 1a). The ventral outer element (3b) originates on the lateral sides of the prezygapophyses of the second to fourth cervical vertebrae. It extends antero-ventrally to become inserted on the inner surface of the squamosal.

Due to the great reduction of the neck region and to the narrow angle of attachments between origin and insertion of that muscle, it is clear that the cranio-costal muscle has a little effect on the movements of the head.

4 - Cervical vertebral adductor (Longissimus cervicis of Gray's):

A muscle similar to that found in Uromastyx (KHALIL, et al. 1977) was not found in Chamaeleon vulgaris.

5 - Suprascapulo-atlas (Levator scapula of Gray's):

(Figs. 1c, 2b and 3a)

The suprascapulo-atlas is a fan-shaped muscle, but due to the great reduction of the suprascapula, the muscle originates on the anterior edge of the scapula and thus it is a wide and strong. It extends anteriorly to be inserted by its narrow end on the transverse process of the atlas. It is a strong suspensorial muscle of the scapula, which may antagonise the effect of the serrated muscle.

6 - Costo-atlas (Ilio-costal cervicis of Gray's):

(Figs. 1c & 2 a,b)

The costo-atlas consists of two overlapping muscle sheets. The outer sheet originates on the connective tissue, that separates the costo-atlas from the cranio-costal (3) just in the region of the first dorsal rib, while the inner sheet originates on the dorsal surface of the proximal end of the first cervical rib (fourth cervical vertebra). The two sheets become fused together and form a thin triangular muscle which is inserted by a short ligament on the transverse process of the atlas.

7 - Dorsal cranio-vertebral (Rectus capitis of Gray's):

(Figs. 1 a,c and 2 a,b)

The dorsal cranio-vertebral muscle originates on the lateral side of the neural arch of the atlas, as well as the neural spines of both axis and third cervical vertebrae. That muscle is inserted on the supra-occiptial, exoccipital and paroccipital process (opithotic) just ventral to the place of insertion of element (3a) of the cranio-costal muscle. This muscle could share in fixing the head on the vertebral column.

8 - Sternocleidomastoid:

(Figs. 1a and 3a)

The sternocleidomastoid is a short, thin and sheet-like muscle that originates, by a single head, on the anterior most ventral surface of the sternum. The muscle extends antero-dorsally at a sharp angle due to the reduction of the neck region of the chamaeleon to be inserted on the inner surface of the squamosal. The description of the morphological relationships of that muscle shows clearly that it is a typical rotating muscle of the head.

9 - Cervical costo-vertebral (Anterior part of the intercostal of Gray's):

(Figs. 1 b,c; 2 a,b and 3c)

The cervical costo-vertebral muscle runs between the separate rib of the fourth cervical vertebra and the transverse process of the atlas.

10- Lateral cranio-vertebral (Obliquus capitis of Gray's):

(Fig. 1 a,c)

The lateral cranio-vertebral muscle of chameleon originates by a ligament on the antero-ventral side of the axis and is inserted on the tip of the cranial tubera.

11- Omohyoid (Omohyoideus of Gray's):

(Figs. 3b and 4)

The omohyoid is a ribbon-like narrow elongated muscle, that originates on the posterior end of the xiphisternum (notice the very short neck region of chamaeleon) and is inserted on a median small region of the first ceratobranchial.

12- Sternohyoid (Sternohyoideus of Gray's):

(Figs. 3b & 4)

The sternohyoid is a broad, fan-shaped and sheet-like muscle. It originates on a long median line that extends on the posterior region of the ventral surface of the sternum and anterior half of the xiphisternum (notice the short neck which leads to a posterior shift of the region of that muscle). It is inserted by a narrow end on a lateral region of the first ceratobranchial.

13- Ventral cranio-vertebral:

(Figs. 2b & 3c)

That muscle originates on a mid-ventral line extending along the anterior seven body vertebrae and is inserted by a short tendon on the ventral cranial tubera. It should be noticed that in the case of chamaeleon, which has five cervical vertebrae, the ventral line of origin extends posteriorly along the first two dorsal vertebrae. Again, this muscle shares in the fixation of the skull on the column.

14- Constrictor colli:

In the case of Uromastyx aegyptia (KHALIL, et al. 1977), that muscle is sheet-like that externally covers the neck half cylinders on both sides. Ventrally it originates on a median longitudinally extending ligament that runs between the corpus of the hyoid and anterior median tip of the episternum. Dorsally it is inserted along the mid-dorsal line of the neck on a vertical connective tissue median septum that is connected to the successive neural spines. The function of this muscle is the wrapping and protection of the neck.

In chamaeleon, the constrictor colli is very similar, in its anatomical relationships, to that of Uromastyx. However, in chamaeleon, due to the shortness of the neck, the constrictor colli is relatively short and it covers a small ventro-lateral region of the neck.

14'- New muscles (a,b & c):

(Figs. 1 a,c & 3b)

In the case of chamaeleon, three extra small axial cervical muscles were found. These muscles were not met with in any of the other lizards examined (Uromastyx aegyptia, Tarentola annularis and Agama mutabilis). Those muscles will be called in the present work a,b and c.

14'-a

It originates on the exoccipital and is inserted by a short ligament on the transverse process of the atlas.

14'- b

It extends between the axial neural spine and the postzygapophysis of the atlas.

14'- c

It is a narrow elongated muscle which extends between the lateral side of the upper end of the scapula and the ventral side of the corpus of hyoid. During the course of extension of that muscle, it runs inner to the deltoid (39) and sternohyoid (12) and then passes through the lower end of the boundary between those two muscles to reach the hyoid corpus.

DISCUSSION

Chamaeleons have some specialized morphological features in comparison with the other lizards. Their bodies are laterally compressed with very characterized skulls. The foramen magnum is shifted anteriorly from the posterior edges of the dorsal arching parietals. Also, the skulls have an akinetic structure (KESTEVEN, 1944; LUBOSCH, 1933; MIVART, 1870; PARKER, 1881 and VERSLUYS, 1898). The neck region is very short, and the cervical vertebrae are reduced to only five vertebrae (CAMP, 1923 and GANS, 1967). Thus, the anterior three cervical vertebrae are located anteriorly under the arch of the parietal crests, a fact which explains the shortening of the neck region.

From the results of the present study on the myology of the cervical region of Chamaeleon vulgaris, one may notice the following. The dorsal muscles: cranio-spinal (1), cervical inner semispinal (2), and cranio-costal (3), which elevate the head from the substrate in Uromastyx (KHALIL, et al. 1977) and in Tarentola and Agama (WAHBA, et al. 1992-1&2), are in chamaeleon very short in length and with a very narrow angle of pull. Such anatomical relations may explain that those muscles (1, 2 & 3) act in fixing the skull of chamaeleons to the neck rather than to elevate the head dorsally. However, it should be mentioned that chamaeleons, which lost the great mobility of the head movements, are adapted to overcome such a difficulty by the synchronized movements of their eyes (BELLAIRS, 1969; WILSON, 1957). In general, muscle sternocleidomastoid (8) is inserted on the inner side of the squamosal instead of the posterior end of the quadrate as in Tarentola & Agama (WAHBA, et al. 2&3). Also, it should be noted that in Tarentola and Uromastyx the sternocleidomastoid (8) is attached on both the calvicle and sternum, but only to sternum in Agama, while the calvicle is absent in Chamaeleon. Most probably that arrangement has some phylogentic significance. If as CAMP (1923) reported that the Chamaeleontidae evolved from the Agamidae, consequently, Agama represents an intermediate state between the lower Agamidae as represented by Uromastyx and Chamaeleontidae. Also, it is important to mention

that such changes may be considered as functional adaptations to the arboreal life of chamaeleon (GANS, 1969 and KATHLEEN, 1986). It should also be noted that three very minor muscles are found only in chamaeleon and not in any of the other lizards. Those muscles are named by GRAY (1967), in human anatomy as superior and inferior obliquus capitis and are lettered in the present text M## 14'a, b and c.

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EXPLANATION OF LETTERING

AT.-atlas; AX.-axis; C.HY.-ceratohyal; CB. 1&2-first and second ceratobranchials; C.V.3-8-third to eighth cervical vertebrae; D.V.1- first dorsal vertebra; E.OC.-exoccipital; HY.C.-hyoid corpus; I.PR.-interparietal; P.OC.-paroccipital process; PR.-parietal; PR.Ll.-processus lingulais; QU.-quadrate; S.OC.-supraoccipital; SQ.-squamosal; TU.-tubera; 1st D.R.-first dorsal rib; 3rd C.R.-third cervical rib.

EXPLANATION OF FIGURES

Fig. 1:

a) Posterior view of the skull of Chamaeleon vulgaris showing the attachments of muscles numbered 1, 3, 6, 8, 10 and 14'a.

b) Lateral view of the cervical and anterior part of the trunk regions showing muscles numbered 1, 3, 9, 16, 17 and 18.

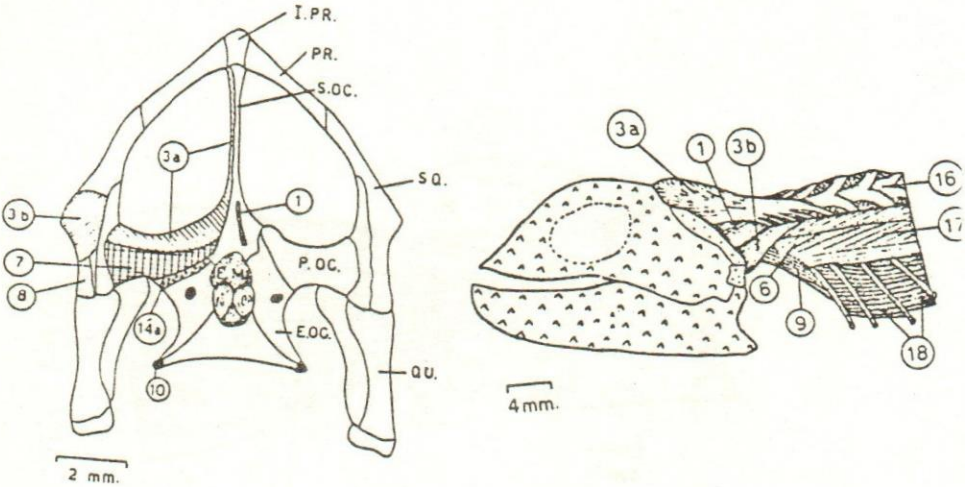
c) Lateral view of the anterior part of the vertebral column to show the attachements of muscles numbered 1, 3, 5, 6, 7, 9, 10, 14'a, 15, 16 and 17.

Fig. 2: a) Lateral view of the cervical and anterior part of the trunk regions showing muscles numbered 1, 3, 6, 7, 9, 15, 16, 17 and 19.
b) Transverse hand section of the cervical region to show muscles numbered 1, 2, 3, 5, 6, 7, 9, 13 and 15.

Fig. 3: a) Lateral view of the anterior region of the body showing muscles numbered 3, 5, 8, 16, 18, 32, 39, 40, 41 and 43.
b) Ventral view of the hyoid apparatus to show the attachments of muscles numbered 11, 12 and 14'c.
c) Ventral view of the cervical and trunk regions showing muscles numbered 9, 13, 18 and 24.

Fig. 4: Ventral view of the cervical and anterior trunk regions to show muslces numbered 11, 12, 19, 39 and 43.

Fig.(1)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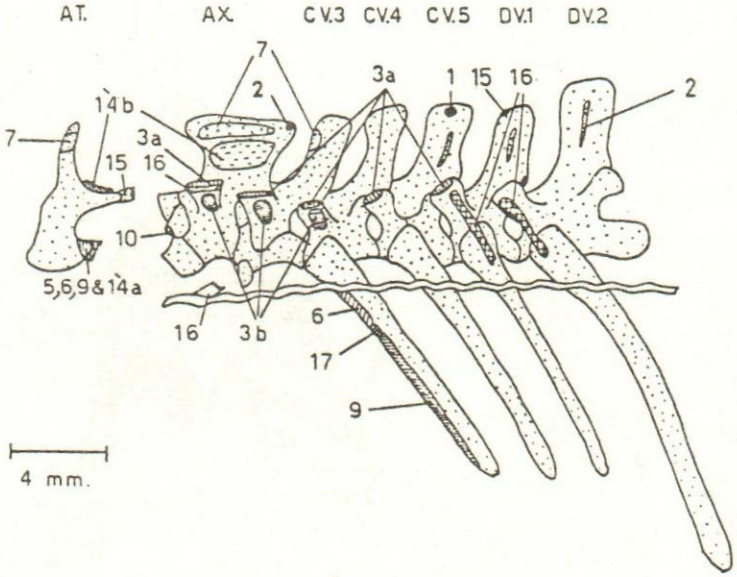
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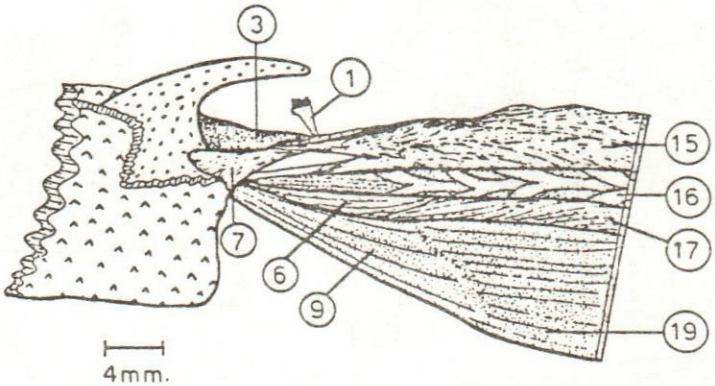
Fig.(2)



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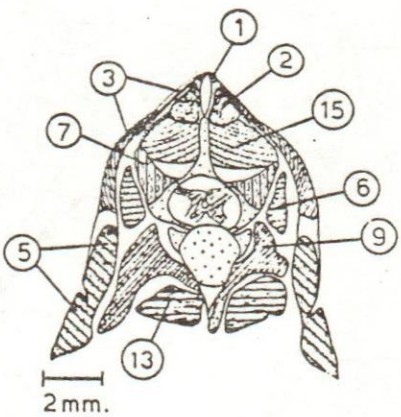

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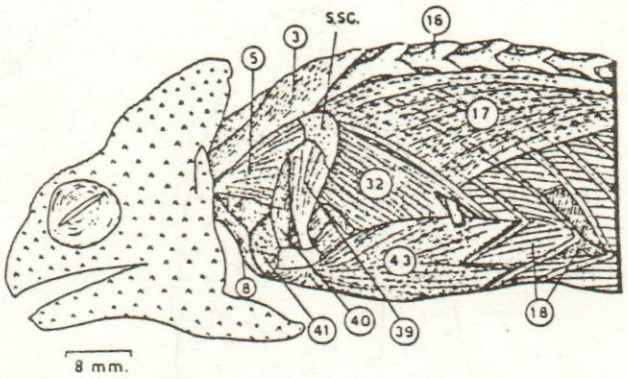
Fig.(3)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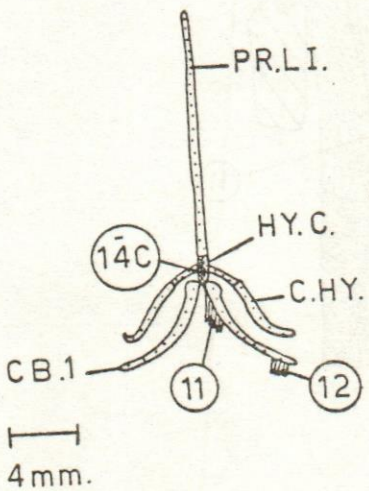
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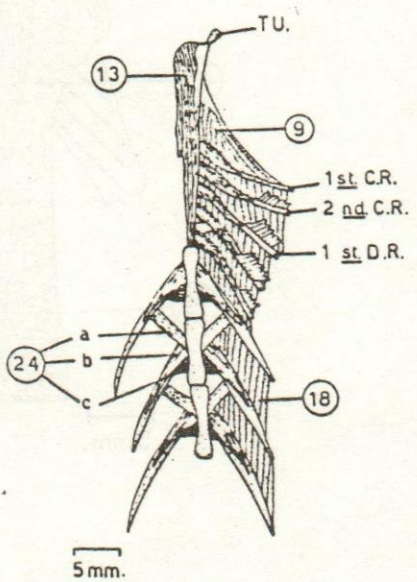
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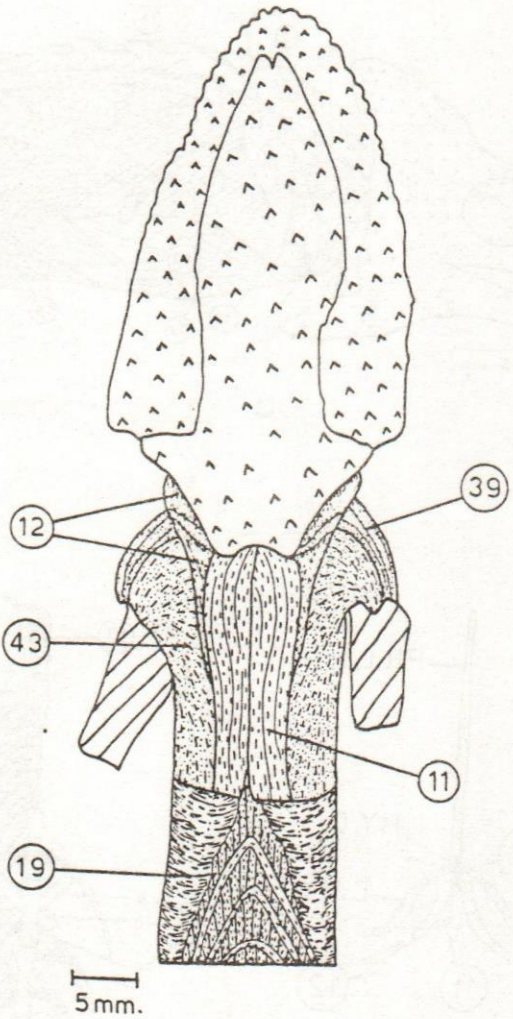

Fig.(4)