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دراسات هستومورفولوجية عن المغازل العضلية لعضلات العين في الجمل وحيد السنام

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أمكن مشاهدة المغازل العضلية فى كل عضلات العين فى الجمل . توجد هذه المغازل بشكل واضح عند منشأ العضلات وكذلك فى الثلث الأوسط ولكن تندر عند اندغام العضلات فى مقلة العين .

وتوجد ثلاث أنواع من المغازل :

- فرادى
- ترادفى
- جهازى

ولم يكن بالامكان تمييز ليفات عضلية متنوعة بداخل المغازل الا ان بعض الليفات وجد بها أنوية مركزية .

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A HISTOMORPHOLOGICAL STUDY OF THE MUSCLE SPINDLES OF THE EXTRA-OCULAR MUSCLES IN ONE HUMPED CAMEL

(With 7 Figures)

By

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SUMMARY

The muscle spindles could be demonstrated within all the extrinsic eye muscles of the camel.

Three different types of muscle spindles were observed in all the extrinsic eye muscles, namely; the single, the tadem and the system varieties. The muscle spindles in the camel are abundantly demonstrated at the origin and middle third of all extra-ocular muscles. They are scarcely demonstrated towards the insertion of each muscle into the globe of the eye.

INTRODUCTION

The proprioceptors are mainly represented by the muscle spindles in the extrinsic eye muscles. These structures are necessary for fine adjustements and activities of the ocular muscles. Such eye movements are in response to the movements of the head and body, and are postural.

Those animals that have been shown to have muscle spindles in their extrinsic eye muscles like ungulates are mainly with a high center gravity needing for good balance which will be aided by impulses from the eye muscles.

The available data on the histomorphological features of the proprioceptors and their distribution within the extrinsic eye muscles are greatly different in the domestic animals. The early studies by (CILIMBARIS, 1910) and Cooper, (DANIEL and WHITTERIDGE 1955) revealed that muscle spindles are found in the extraocular muscles of sheep, goat, dear, fox, ox, wild pig, but they are not found in horse, dog, cat, domestic pig, bear, cheetah, rabbit and macaque monkey.

MATERIAL AND METHODS

For the histomorphological study of the muscle spindles of the extraocular muscles in the one humped camel, specimens were collected from ten camels of both sexes, ranging from 4 - 6 years old.

The extraocular muscles were liberated separately from the globe and each muscle was fixed in 10% formalin and was then divided with a sharp knife into three portions:

a- One near the origin.
b- The second is the middle third.
c- The third near the insertion.

Each portion was turned on to its proximal cut edge and was transversaly and longitudinally sectioned at 40 microns thickness after embeding in paraffin. The latter sections were in series with and interval of 400 microns.

Numerous serial frozen sections were cut from the eye muscles mainly transverse at thicknesses varing from 40-50 microns with an interval of 400 microns.

The following stains were employed:

1- Harris's Haematoxylin and Eosin stain for general Histological observation (HARRIS, 1898).
2- Heidenhain's Azan modification for demonstration of collagenous fibers and muscle cells (HEIDENHAIN, 1915).
3- Gros-Bielschowsky's silver stain for axons in frozen and paraffin sections (Modified) (BENCROFT and STEVENS, 1935).
4- Sudan blach stain for demonstration of lipids (LISON and DANGENLIE, 1935).

RESULTS

The muscle spindle could be demonstrated within all the extraocular muscles of the camel.

Three different types of muscle spindles were observed in all the muscles, namely, the single, the tandem and the system varieties.

The distribution of the muscle spindles within the extraocular muscles of the camel is subjected to great variance, however they are demonstrated with abundance at the origin and the middle third of all extraocular muscles. They are scarcely demonstrated towards the insertion of the muscles into the globe of the eye.

The muscle spindles are mostly abundant at the peripheral part of the seven extraocular muscles of the camel. No defenit numerical ratio could be obtained for the different three types of muscle spindles within all the extraocular muscles of the camel, however, the single spinle variety exceded the ether two types in number. The total number of muscle spindles within the extraocular muscles of the camel ranged from 20-28 muscle spindles at the middle of each muscle.

The muscle spindles were found to be surrounded by a relatively well defined thick irregularly wavy connective tissue capsule which consists of three to seven fibrous laminae with flattened cells (Fig. 3 b). The connective tissue fibers of the capsule frequently extended to include several neigbouring extrafusal muscle fibers. Small blood vessels were demonstrated near or within the spindle and or its capsule (Fig. 1 and 2) and some of them were of special structure (Fig. 3). The capsules in the system spindles were either found disposed side (Fig. 4) or commonly inclose two spindles (Fig. 6). The intrafusal muscle fibers ranged from 5-7 in number but they were found to be up to 12 and as few as one within the muscle spindles (Fig. 2).

The intrafusal muscle fibers though rich in nuclei, they were mainly peripheraly placed and sometimes one or two nuclei might be seen lying together in the center of the intrafusal muscle fibers (Fig. 3,5 and 6). Several muscle spindles were demonstrated harbouring a relatively large periaxial space filled with homogenous amorphous material which was easily recognized in paraffin sections (Fig. 5 and 6).

The muscle spindles are supplied either by one or two sensory nerves which retain their myelin sheath for variable distances before their penetration in to the muscle spindle. Each fiber pierces the capsule at variable sites and losses its myelin sheath and is incorporated within the capsule persuing a spiral course. The nerve enters the muscle spindle, and divides successively into fine branches which either encircle each intrafusal muscle fiber in a spiral form or run in a linear manner parallel to the surface of the intrafusal muscle fibers (Fig. 7).

DISCUSSION

Contrary to what was revealed in the cat, dog, rabbit, domestic pig,fox, hare, rat and horse by (SHERRINGTON, 1897), (CILIMBARIS, 1910); (WOOLARD, 1931); (HINES, 1931); (COOPER and DANIEL, 1949); (COOPER, DANIEL and WHITTERIDGE, 1955), and similar to what was recorded in ox (CREVATIN, 1900); and in sheep, ox, dear, goat and wild pig (CILIMBARIS, 1910); and in calves (WOHLTORT, 1935), the present investigation showed that there are proprioceptors in the eye muscles of the camel which are mainly represented by muscle spindles.

Data on the discription of the muscle spindles and their destribution within the eye muscles were given by several authors (SHERRINGTION, 1897; CILIMBARIS, 1910; VOSS, 1937; DANIEL, 1946; COOPER and DANIEL, 1949; MERRILLEES, SUNDERLAND and HAYHOW, 1950; WOLTER, 1954; 1955, COOPER, DANIEL and WHITTERIDGE, 1955; VOSS, 1957, COOPER, 1960; BARKER, 1967; YELLIN, 1969). Although (SALEH 1978) wrongly assumed that the long neck of the camel is characterized by a very wide range of movement, so she mentioned that the dorsal rectus muscle of the eye contains abundant muscle spindles. The latter are of three types, namely the single, tandem and the system varieties. Conterary to what was found in man (COOPER, DANIEL and WHITTERIDGE, 1955) and similar to the description of SALEH, (1978) of the dorsal rectus muscle of the camel, the present study showed that the muscle spindles were distributed mainly within the middle third and at the insertion of all the extraocular muscles of the camel. Similar to what was found in the goat (CILIMBARIS, 1910; COOPER, DANIEL and WHITTERIDGE,1955), and in the goat and man (COOPER and DANIEL, 1949), the muscle spindles within the eye muscles of the camel were found to be neumerous.

Although the muscle spindles at the middle of the dorsal rectus muscle of the eye of the camel were about 25% of the total number of the muscle spindles in these muscles (SALEH, 1978), the present study revealed that the total number of the muscle spindles within the extraocular muscles of the camel ranged from 20-28 muscle spindles

at the middle of each muscle. Contrary to what was found in man (COOPER and DANIEL, 1949, MERRILLEES et al. 1950). and similar to the description of (SALEH, 1978) in camel, the muscle spindles in the extraocular muscles of the camel are relatively large with thick capsule. In contrast to what was found in man (COOPER, DANIEL and WHITTERIDGE, 1955), that the intrafusal fibers ranged from 2 to 10 in number, and 2-14 in the dorsal rectus muscle of the camel, (SALEH, 1978) the present work showed that the intrafusal fibers in camel were 1 - 12 in number.

Contrary to what was found in man (COOPER, DANIEL and WHITTERIDGE, 1955) the intrafusal muscle fibers in the camel often have peripheral nuclei. Moreover, it could not be demonstrated in the present study that the intrafusal muscle fibers of the camel are of two varieties, a nuclear bag and a nuclear chain type, a matter which is in agreement with the findings of (SALEH 1978).

In addition, the present study revealed the presence of central nuclei within the intrafusal muscle fibers of the camel.

The physiological significance of the excistance of muscle spindles into the extrinsic eye muscles of some mammals and man was discussed by several workers (COOPER and DANIEL, 1949 as well as COOPER, DANIEL and WHITTERIDGE, 1955). The muscle spindles constitute the main proprioceptive ending of the somatic muscles which perform fine adjustments and high activity. The movements of the eye are frequently mentioned as an example of the extremly delicate receprocal innervation. The posture of the eyeballs is adapted to maintain the visual field and all movements of the eyes are carried out with full reflex Co-ordination. As it is the case in man, the voluntary movements of the eyes of the camel is probably far from wide spread in other animals where neck movements largly take the place of extensive eye movements (COOPER and DANIEL, 1949). A matter which was wrongly assumed by (SALEH 1978) and need more eye movements for sight, this necisstates the excistance of well developed proprioceptive system which is proved to be present by the work here in. The animals that have been shown to have muscle spindles in their extrinsic eye muscles as ungulates are mainly with a high center gravity needing for good blance which will be aided by impulses from the eye muscles. A fact which is even more necessary for the camel as an animal which carries heavy leads and lives on sandy or mudy grounds.

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LEGENDS

Fig, 1: Transverse section through a muscle spindle and adjacent nerve trunk (N) the medial rectus muscle. Note the well dofined thick capsule which appears irrigularly wavy. A neighbouring blood vessel (arrow) is shown (Haematoxylin and eosin stain. oc. 10 x ob. 25).

Fig. 2: Transverse section of the lateral rectus muscle showing, a muscle spindle of the system variety with 12 intrafusal muscle fibers. Note the blood vessels within the muscle spindle (arrows) (Haematoxylin and eosin stain. oc. 10 x ob. 40).

Fig. 3: Transverse section of the dorsal rectus muscle showing, a muscle spindle of the system variety and the adjacent nerve trunk (N). Note the central nucleus within the intrafusal muscle fiber (arrow). The well defined capsule which appears irrigularly wavy. A blood vessel of special structure between the muscle spindles (Haematoxylin and eosin stain A-oc. 10 x ob. 16 B-àc. 10 x ac. 40).

Fig. 4: Transverse section showing a muscle spindle of the system type and the adjacent nerve trunk (Left within the M. retractor bulbi. Note the well defined capsule, the neclei in which suggest the there is an encircling nerve fiber. (Haematoxylin and eosin oc. 10 x ob. 40).

Fig. 5: Transverse section through a muscle spindle of the single type within the superior oblique muscle. Note the central nucleus within an intrafusal muscle fiber (arrow) the large periaxial space (S) (Haematoxylin and eosin stain. oc. 10 x ob. 25).

Fig. 6: Transverse section through a muscle spindle of the system variety within the ventral obligue muscle. Note the central nucleus within the intrafusal muscle fiber (arrow-inset). The common capsule (C). The large periaxial space (S). (Haematoxylin and eosin stain. oc. 10 x àb. 16 inset: oc. 10 x ob. 40).

Fig. 7: Transverse thick section of the lateral rectus muscle showing muscle spindle of the system variety. Note that each intrafusal muscle fiber is encircled with a nerve fiber. (Silver imprignation oc. 10 x ob. 40).

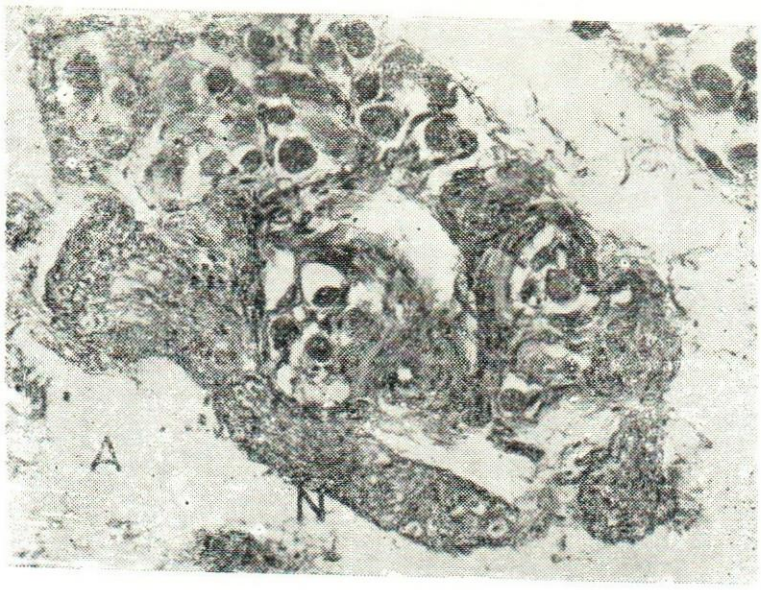

Fig. 1 : Transverse section through a muscle spindle and adjacent nerve trunk (N) the medial rectus muscle Note the well dofined thick capsule which appears. irrigularly wavy. A neighbouring blood vessel (arrow) is shown (Haematoxylin and eosin stain, oc. 10x ob. 25).

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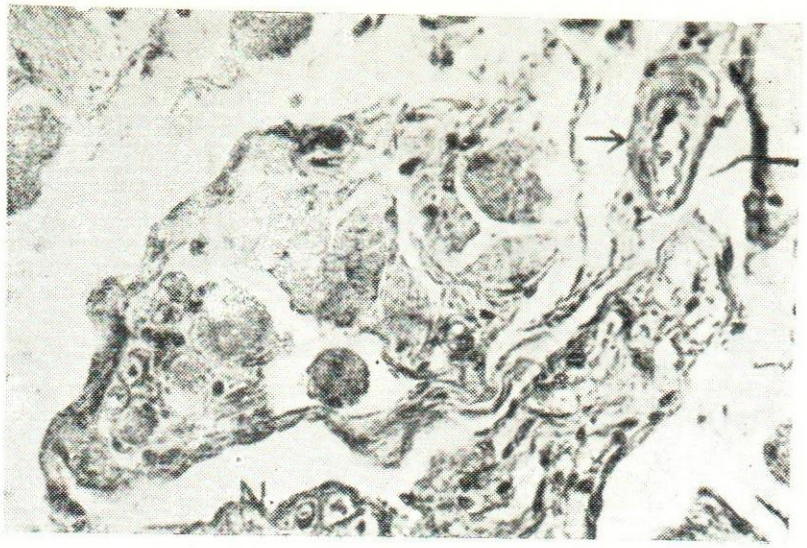


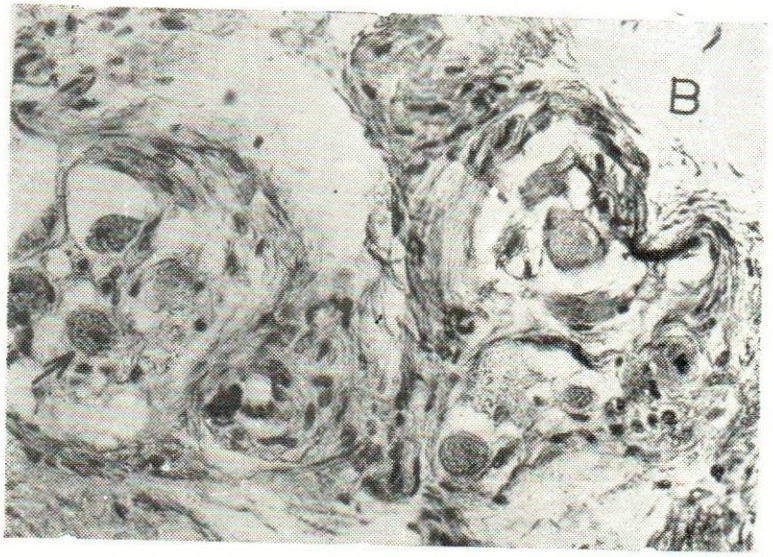
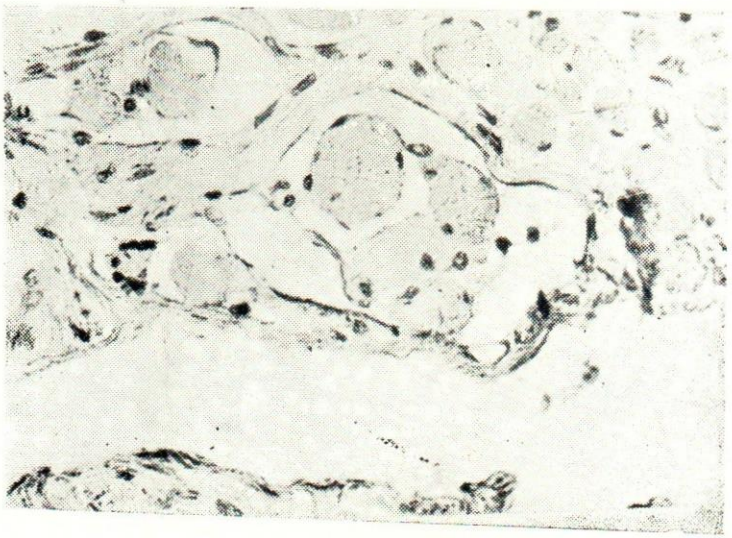


Fig 3 : Transverse section of the dorsal rectus muscle showing, a muscle spindle of the system variety and the adjacent nerve trunk (N). Note the central nucleus within the intrafusal muscle fiber (arrow). The well defined capsule which appears irrigularly wavy. A blood vessel of special structure between the muscle spindles (Haematoxylin and eosin stain A - oc. 10xob, 16 B - oc. 10 x ob. 40).



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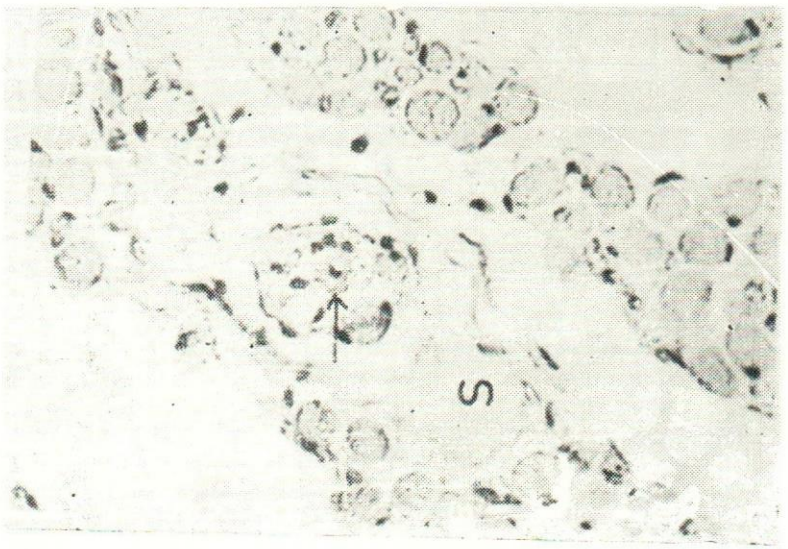

Fig 5 : Transverse section through a muscle spindle of the single type within the superior oblique muscle. Note the central nucleus within an intrafusal muscle fiber (arrow) and the large periaxial space (S) (Haematoxylin and eosin stain. oc. 10 x ob. 25).

Fig. 6 : Transverse section through a muscle spindle of the system variety within the ventral oblique muscle, Note the central nucleus within the intrafusal muscle fiber (arrow-inset). The common capsule (C). The large periaxial space (S). Haematoxylin and eosin stain oc. LO x ob. 16 inset : oc. 10 x ob, 40).

Fig. 7 : Transverse thick section of the lateral rectus muscle showing, muscle spindle of the system variety, Note that each intrafusal muscle fiber is encircled with a nerve fiber. (Silver imprignation oc. 10 x ob. 40).