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بعض الملاحظات على النهايات الحسية والحركية فى عضلات  
العين والقرنية

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تمسك المفازل العضلية بعصب حسى واحد أو اثنين يتراوح سمك هذا العصب من ٣٠ - ٦٠ ميكرومتر . كذلك لوحظت النهايات الحركية فى عضلات العين . كما شوهدت فى مستقبلات الألم داخل النسيج الطلائى المركب العرشفى فى القرنية خاصة عند اتصال القرنية بالصلبة .



SOME OBSERVATION ON SENSORY AND MOTOR NERVE ENDINGS  
IN EXTRINSIC EYE MUSCLES AND CORNEA IN ONE HUMPED CAMEL  
(With 4 Figures)

By

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SUMMARY

The sensory nerve endings demonstrated themselves either around the extrafusal muscle fibers or arborized with special patterns within the muscle spindles. The muscle spindles are supplied either by one or two sensory nerves which range from 30-60  $\mu$ m. in thickness. The motor nerve endings demonstrated within the extraocular muscles, are mainly demonstrated near the extrafusal muscle fibers.

Pain receptors were demonstrated within the stratified squamous epithelium of cornea as naked nerve ending between the epithelial cells especially in the vicinity of corneoscleral junction

INTRDODUCTION

The histomorphological observation on the sensory and motor nerve endings in the striated extrinsic eye muscles, moreover, in the stratified squamous epithelium of the cornea, are of great importance.

The motor innervation of the spindle was studied by COERS and DURAND, (1956); HESS, (1961); BOYD, (1962); GRANIT, (1966), and BARKER, (1967). In addition COOPER and FILIENZ, (1955) COPENHARE (1964), FOSTER, (164) HAM, (1974) described the pain receptors within the stratified squamous epithelium.

The lack of study of peculiar histomorphological features of the sensory and motor innervation of the extraocular muscles as well as the patterns of nerve endings of the single humped camel necessitates the carrying out of this investigation

MATERIAL AND METHODS

For studying the sensory and motor nerve endings of the extraocular muscles in single humped camel, specimens were collected from ten camels of different sexes and ages.

The extraocular muscle liberated separately from the globe.

Each ocular muscle was fixed in 10% formalin and was divided into 3 portions, near the origin, the middle and near the insertion

Each portion of muscle was turned on its proximal cut edge and was transversely and longitudinally sectioned at 40  $\mu$ m. thickness after embedding in paraffin. The sections were taken serially. Many serial frozen sections were cut from the eye muscles mainly transverse at thicknesses varying from 40-50  $\mu$ m. For studying the nerve endings within the cornea, paraffin sections at 30  $\mu$ m. thick were taken.

The following stains were used

- 1 Harris's Haematoxylin and Eosin stain for general histological examination (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) (BENECROFT and STEVENS, 1977)
  - 4 Sudan black stain for demonstration of lipids (LISON and DAGENLIE, 1935)
- Measurements were made with a dye-piece micrometer disc calibrated on a stage micrometer to the nearest 0.1  $\mu$ m.

RESULTS

The nerves supplying the extraocular muscles of the camel are peculiarly thick. Each nerve trunk penetrates the corresponding muscle at its distal third or may enter at a point between the distal and the middle thirds of



the ocular muscles.

The nerve courses between the muscle fibers towards the globe and divides successively into thinner branches which were directed caudally towards the origin of the muscle. As the nerve reaches a diameter of 30-60  $\mu$ m. It starts to end around the muscle fibers into various patterns, namely sensory and motor nerve endings.

The sensory nerve endings demonstrated themselves either around the extrafusal muscle fibers or arborized the special patterns within the muscle spindles. The first patterns of ending was frequently observed and represented as fine spiral nerve fibers which turn several times around the extrafusal muscle fibers. The second pattern of sensory nerve ending was manifested within the muscle spindles.

The muscle spindles are supplied either by one or two sensory nerve which range from 30-60  $\mu$ m. in thickness (Fig. 1 and 2). The sensory nerves retains its myelin sheath for variable distances before its penetration to the muscle spindle. The nerves loses its myelin and enters the capsule in a spiral course, where it divides into fine branches which either encircle each intrafusal muscle fiber in a spiral form or runs in a linear manner parallel to the surface of the intrafusal muscle fibers (Fig. 2).

The motor nerve endings which are found within the extraocular muscles, are mainly demonstrated near the extrafusal muscle fibers. They are mainly represented by the plate ending (Fig. 3). The latter variety of nerve ending was predominately found at the middle third of each extraocular muscle. In addition some gap endings were sporadically demonstrated within all extraocular muscles.

The thick sensory nerves supplying the different types of muscle spindle within the extraocular muscles of the camel were sometimes accompanied by thin motor nerve fibers which terminates around the intrafusal muscle fibers.

Pain receptors were demonstrated within the stratified squamous epithelium of the cornea as naked nerve ending between the epithelial cells especially in the vicinity of the cornioscleral junction (Fig. 4).

## DISCUSSION

The present study demonstrated that the nerves supplying the extraocular muscles of the camel are peculiarly thick.

Each nerve trunk penetrates the corresponding muscle at its distal third or may enter at a point between the distal and middle third of the ocular muscles, the serving nerve courses between the muscle fibers toward the globe and divides successively into thinner branches which may directed caudally towards the origin of the muscle. As the nerve reaches a diameter of 30-60  $\mu$ m., it starts to end around the muscle fibers into various pattern namely sensory and motor nerve ending.

The present investigation, inadditions, postulated that the sensory nerve ending were frequently represented as fine spiral nerve fibers which take many turns around the extrafusal muscle fibers, a matter which was demonstrated in man by DANIEL (1946).

The second pattern of sensory nerve ending was manifested in the present study within the muscle spindles.

There has been in the past much confusion over the nature of the proprioceptive supply of the extrinsic eye muscles and even over the excistance of such afferent system in these muscles ( COOPER, DANIEL and WHITTERIDYE, 1955 ). HELMHOLTZ (1867) considered that, the voluntary effort which is needed to move the eye, together, with, the messages received from the retina, makes any from of muscle sense unnecessary. MATTHEWS (1972) mentioned that, with exception of a few muscles innervated by cranial nerves, the muscle spindles have been found in every striated muscle of every species of mammals. Conterary to what was described by SALEH (1978), in the dorsal rectus muscle of the camel, the present study demonstrated that the muscle spindles are supplied either by one or two sensory nerves which range from 30-60  $\mu$ m. in thickness. The spindle, after lossing its myelin sheath, and divides successively into fine branches which either encircle each intrafusal muscle fiber in a spiral form or runs in a linear manner parallel to the surface of the intrafusal muscle fibers.

In addition the present study showed that the motor nerve ending in the extrinsic muscles of the eye of the camel are mainly represented by plate ending which predominates at the middle third of each extraocular muscle. However some gap endings were sporadically demonstrated within the extraocular muscles.



## SENSORY AND MOTOR NERVE ENDINGS

Similar to what described in the human eye by COPENHAVER, (1964); FOSTER, (1964) and HAM, (1974), the present investigation showed the excitement of pain receptors within the stratified squamous epithelium of the cornea represented by naked nerve endings extending between the epithelial cells of the cornea specially in the vicinity of the corneoscleral junction.

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## LEGENDS

- Fig. 1: Transverse section of the ventral rectus muscle showing a muscle spindle. Note the sensory nerve fiber which serves the muscle spindle (arrow) coursing in a circular manner within the thick capsule (Haematoxylin and cosin stain. A= oc. 10x ob. 16 B= oc. 10x ob. 40).
- Fig. 2: Transverse thick section of the medial rectus muscle showing a muscle spindle and the supplying nerve trunk (N). Note that the nerve fiber either encircling or runs parallel to the intrafusal muscle fibers (arrows) (Silver imprignation. oc. 10x ob. 16).
- Fig. 3: Transverse thick section of the ventral muscle showing, a motor end plate (arrow) (Silver imprignation. oc. 10x ob. 40).
- Fig. 4: Naked nerve endings extend between the epithelial cells of the cornea (pain receptors) (Silver imprignation, oc. 10x ob.).





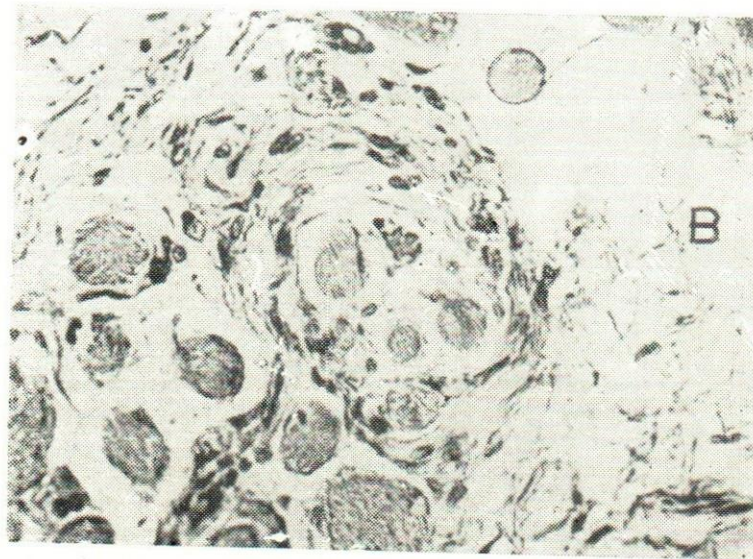
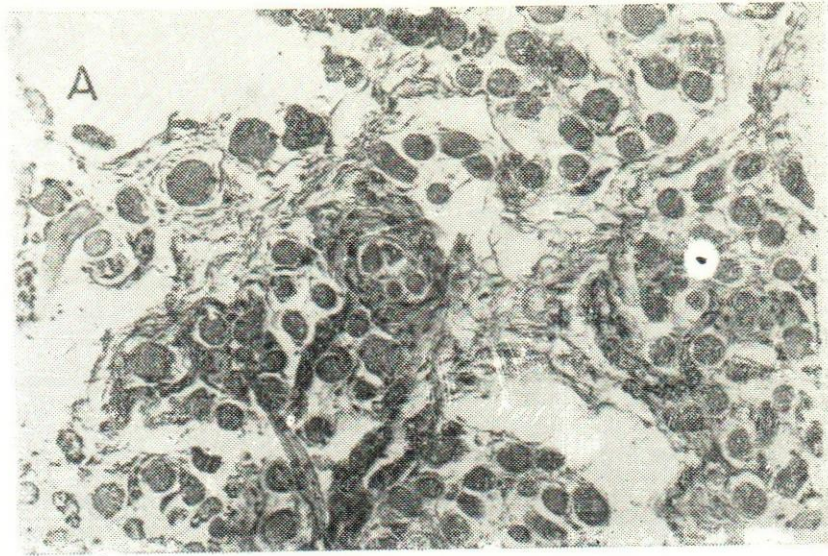


Fig. 1 : Transverse section of the ventral rectus muscle showing a muscle spindle. Note the sensory nerve fiber which serves the muscle spindle (arrow) coursing in a circular manner within the thick capsule (Haematoxylin and eosin stain.

A = oc. 10x ob. 16 B = oc. 10x ob. 40)





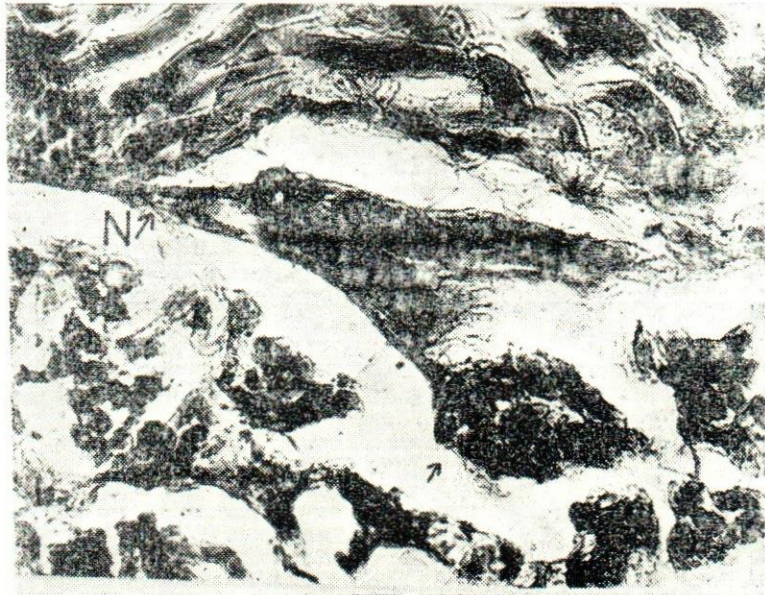


Fig. 2 : Transverse thick section of the medial rectus muscle showing, a muscle spindle and the supplying nerve trunk (N). Note that the nerve fiber either encircling or runs parallel to the intrafusal muscle fibers (arrows) (Silver imprignation. oc. 10x ob. 16).





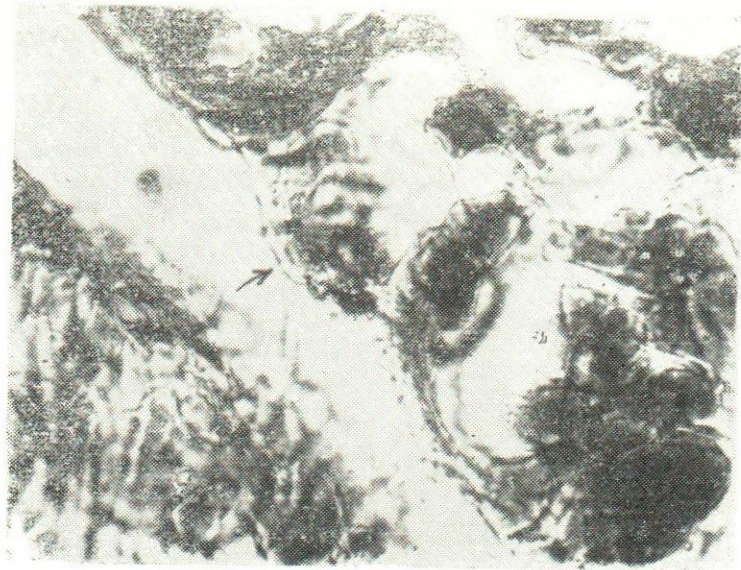


Fig. 3 : Transverse thick section of the ventral muscle showing, a motor and plate (arrow) (Silver impregnation, oc. 10x ob. 40).

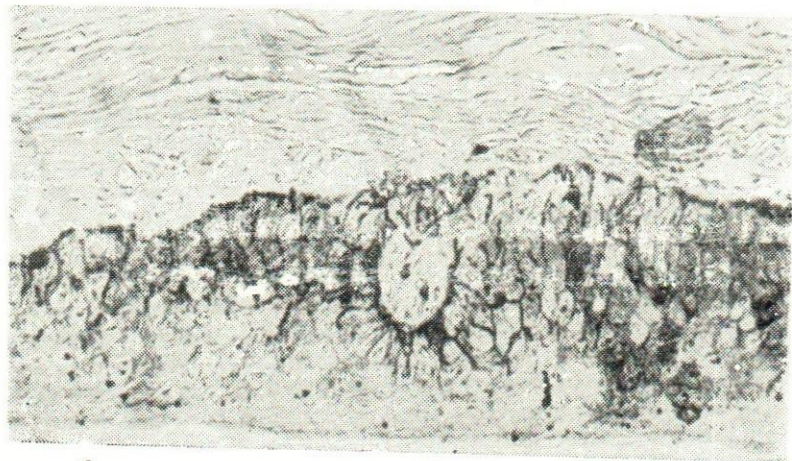


Fig. 4 : Naked nerve endings extend between the epithelial cells of the cornea (pain receptors) (Silver impregnation, oc. 10x ob. ).

