

MORPHOLOGY AND PATHOMORPHOLOGY

THE PROPRIOCEPTORS OF THE OCULAR MUSCLES OF MAMMALS

M. A. Kalugina

From the Chair of Histology (Head — Honored Scientist Prof. A. N. Mislavsky) of the Kazan Medical Institute and the Chair of Histology (Head — Prof. M. Ya. Subbotin) of the Novosibirsk Medical Institute

(Received July 12, 1956. Presented by Active Member of the Academy of Medical Sciences of the USSR V. N. Ternovsky)

The problem of the existence of neuromuscular fibers in the rectus oculi muscles has remained unclear until the present. Data are lacking in the literature to characterize the interrelation between the process of the development of proprioceptors and the functioning of the organ, in particular with the development of vision.

The most detailed description of the sensory apparatuses of the ocular muscles was made by A. S. Dogel [1]. A. Cilimbaris [4] and A. S. Dogel described typical neuromuscular fibers in the ocular muscles. Other authors sought the fibers in the ocular muscles unsuccessfully [5]. S. Mikhailov [2] stated that the sensory neural apparatuses of the heart and ocular muscles should be of one type, since they accomplish the very "complex and active play of contractions." In recent investigations [3] also no indications exist of the neuromuscular fibers in the ocular muscles.

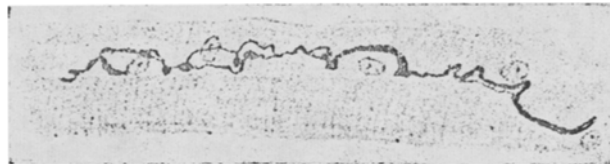


Fig. 1. Sensory nerve ending in the ocular muscles of a cat. Treated according to Gross-Bielschowsky. Ocular 10x, objective 90.

The present investigation represents an attempt to discover whether the neuromuscular fibers exist in the ocular muscles of animals and to establish a connection between the stage of development of the sensory apparatuses and the functioning of the eye (visual development).

EXPERIMENTAL METHOD

We studied the rectus oculi muscles of some mammals of various age groups: cats (newborn, four-day old, two-week old, adult); dogs (four-day old, two-week old, two-month old); guinea pigs (newborn, two-week old, two-month old). The animals chosen were born blind (cat and dog), as well as with sight (guinea pig). The material was treated by the Gross-Bielschowsky method.

EXPERIMENTAL RESULTS

In many investigations of the ocular muscles of adult animals, the neuromuscular fibers were not found. Sometimes a spiral arrangement of the nerve fibers could be observed in cats, but this was not an ending and

there was no connective tissue capsule around these formations. All the sensory nerve endings which were found were of the free type.

The sensory nerve endings in the ocular muscles of various animals differed considerably.

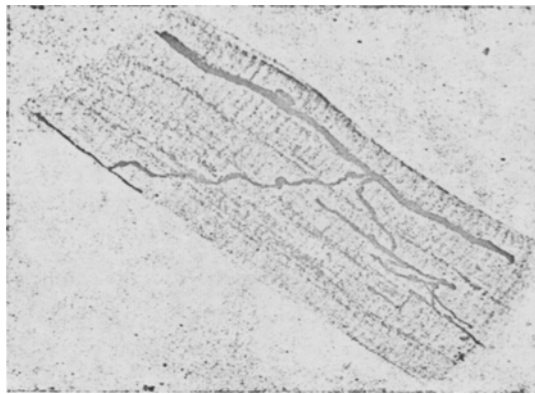


Fig. 2. Sensory nerve endings of the ocular muscles of an adult dog. Gross-Bielschowsky stain. Ocular 10x, objective 90.

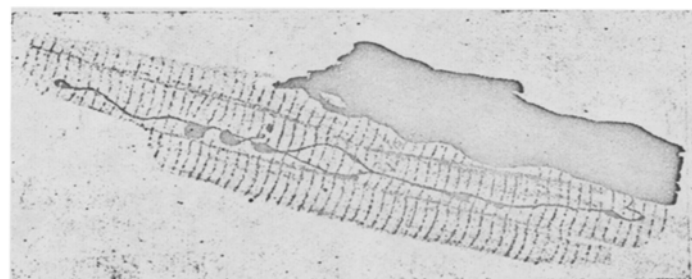
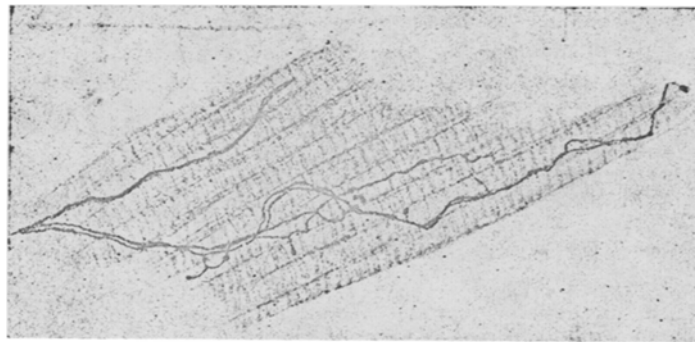


Fig. 3. Sensory nerve endings of the ocular muscles of the guinea pig. Newborn (above); two-week old (below). Treated according to Gross-Bielschowsky. Ocular 10x, objective 40.

In the adult cat, the endings on the muscle fibers were in the form of branching fibrils, extending along the muscle fibers, with many varicose thickenings and areas of ramification (Fig. 1). In addition to such endings, less complex ones were found which represented a fine thread with varicose thickenings.

The proprioceptors in the rectus oculi muscles of an adult dog had the appearance of branching bushes with many varicose thickenings. The branches of the bushes were directed along the muscular fibers (Fig. 2).

In studying the rectus oculi muscles of adult animals (the cat, guinea pig, dog) some zoning was established in the location of nerve endings. The motor endings were located in a more or less limited zone. The sensory endings could be found in various areas of the muscle. They were found in the zone of the motor endfeet as well as in areas poor in motor endings. As observations showed, in the process of the development of the proprioceptors of the ocular muscles, a gradual complication of the nerve endings occurs — with age they become less diffuse and occupy lesser areas of innervated tissue.

On comparing the stage of differentiation of the sensory nerve apparatuses of animals born blind and of animals born with sight, a certain difference can be found. Thus, the nerve endings of a newborn cat are very fine threads with many varicose thickenings which extend a considerable distance. The sensory nerve endings of the two-week old cat are just as simple. The complication of the endings occurs very slowly.

The differentiation of the endings occurs considerably more rapidly in animals which are born with sight (guinea pig). The sensory nerve ending of a newborn guinea pig are very delicate sprays with numerous terminal structures (Fig. 3a). The endings of two-week old guinea pigs are already more differentiated: more complex than in the newborn and more limited (Fig. 3b).

Thus, the differentiation of the nerve endings proceeds more rapidly among animals born with vision than among those born blind.

SUMMARY

The authors found no neuromuscular fibers in the ocular muscles of the investigated animals (cats, dogs, guinea pigs). The sensory nerve endings which were found were of the free type. They were found in the zone of the motor end-feet as well as in areas poor in motor endings. In animals born blind differentiation of the proprioceptors proceeded somewhat more slowly than in animals with sight.

LITERATURE CITED

- [1] A. S. Dogel, *Zapiski Akad. Nauk*, Vol. 20, No. 11, St. Petersburg, 1907.
- [2] S. Mikhailov, *Nevrologichesky vestnik*, Vol. 19, issue 3, pp. 603-658.
- [3] V. N. Ternovsky and V. N. Murat, in the book: *Problems in Morphology*, Moscow, 1953, pp. 5-42.
- [4] A. Cilimbaris, *Arch. f. mikroskop. Anat.*, 1910, Bd. 75, S. 692-747.
- [5] C. Regand and M. Favre, *Les Terminaisons Nerveuses et les Organes Nerveux Sensitifs de l'Appareil Locomoteur*, Lyon — Paris, 1904.

• In Russian.