Elektronenmikroskopie des zentralen und peripheren Nervensystems

Electronmicroscopy of the Central and Peripheral Nervous System

Zellbiologie und Zellkultur des Nervengewebes

Biology and Culture of the Nervous Tissue

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Structural Differences of Fast and Slow Extrafusal Muscle Fibers and their Nerve Endings

By A. Hess, Salt Lake City

Muscle fibers were fixed in *Susa* or *Dalton's* fluid, embedded in plastic, and longitudinal and cross sections were studied in the phase contrast and electron microscopes. Other muscle fibers were fixed in glyoxal, teased and stained for cholinesterase. Some of the teased muscle fibers stained for cholinesterase were refixed in *Dalton's* fluid, embedded in plastic, and viewed in the electron microscope.

Fibrillenstruktur muscle fibers have regular fibrils, each surrounded by sarcoplasm and granules. The Z-disk runs straight across the width of the fibril. These are the twitch or "fast" fibers. Felderstruktur muscle fibers have irregular fibrils apparently joining each other at certain points along the length of the fibrils, the fibrils are not regularly surrounded by sarcoplasm and granules, and the Z-disk appears zigzag across the width of the fibril.

End plate or "en plaque" nerve endings are the ordinary kind of ending and usually occur one per muscle fiber on Fibrillenstruktur muscle fibers only. Several "en grappe" terminations occur on each muscle fiber and only on fibers of Felderstruktur.

Frogs. Fibrillenstruktur and Felderstruktur muscle fibers occur in the tonus bundle of the iliofibularis muscle; only fibers of Fibrillenstruktur are found in portions of the iliofibularis muscle without the tonus bundle. The "en plaque" endings in the tonus bundle are most frequently relatively short, branched and variable in structure, while those in other portions of the iliofibularis muscle are generally long and are the typical "Endbüschel" of frog muscle. "En grappe" endings are found only in the tonus bundle. The distance between the multiple "en grappe" endings on a single Felderstruktur muscle fiber is very irregular and can vary from 60 μ to more than 1 millimeter.

Chickens. The posterior latissimus dorsi of the chicken from hatching to one week of age, from 2 to 3 months of age, and adult, consists almost entirely of muscle fibers of Fibrillenstruktur type which have one ordinary end plate on each fiber. There are, however, a few fibers which receive several "en grappe" terminations in the posterior latissimus dorsi and are probably of Felderstruktur type. The anterior latissimus dorsi of such chickens consists entirely of muscle fibers of Felderstruktur. Several "en grappe" terminations are found on each of these muscle fibres, occurring regularly along the length of the muscle fiber and separated by distances of about 250 μ—350 μ in 1- to 7-day-old chickens, and by about 1,000 μ in adults. The biventer cervicis consists of mixed Fibrillenstruktur and Felderstruktur muscle fibers, the former with one end plate type ending per muscle fiber and the latter with several "en grappe" terminations on each muscle fiber.

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Mammals. Fibrillenstruktur and Felderstruktur muscle fibers occur in the extraocular muscles of the guinea pig. In addition, thin muscle fibers with concentrations of mitochondria on the borders of the fiber are found on the periphery of extraocular muscles. Most of these latter fibers are Felderstruktur, some are Fibrillenstruktur. "En plaque" endings occur only on fibers of Fibrillenstruktur and have interlacing fingerlike processes on a compact portion of the muscle fiber. "En grappe" endings occur only on fibers of Felderstruktur and are seen as clusters or collections of droplets of stained material and are indeed "grape-like" or can appear simply as a darkly stained spot of material on the muscle fiber. The spots of stained material occur irregularly spaced from each other; the more delicate clusters of droplets cover extensive lengths of muscle fibers and appear on some stretches of muscle to be practically continuous from one ending to the next. It is suggested that the "en grappe" endings appearing as irregularly spaced spots occur on the thin Felderstruktur muscle fibers which have concentrations of mitochondria in their borders and which are located on the periphery of the extraocular muscles, while the more delicate and extensive "en grappe" endings occur on the other larger Felderstruktur fibers in the interior of the muscle.

References

Hess, A.: The structure of extrafusal muscle fibers in the frog and their innervation studied by the cholinesterase technique. Amer. J. Anat. *107*, 129—152 (1960); Structural differences of fast and slow extrafusal muscle fibres and their nerve endings in chickens. J. Physiol. London *157*, 221—231 (1961). The structure of slow and fast extrafusal muscle fibers in the extraocular muscles and their nerve endings in guinea pigs. J. Cellul. Comp. Physiol. *58*, 63—80 (1961).

Electron Microscope Studies of Pathological Changes in Human Cutaneous Nerve

By J. B. Finean and A. L. Woolf, Birmingham

Dr. *Finean* and I are reporting here the results of what we believe to be the first systematic study of the ultrastructure of normal and abnormal cutaneous nerves. That such a study has not previously been conducted is surprising in view of the ease with which small branches of cutaneous nerves may be sampled in the course of muscle biopsies which today are being carried out with increasing frequency. We have taken specimens from over 100 patients, the nerve used being most commonly a branch of the antebrachial cutaneous nerve of the forearm removed in the course of a biopsy of palmaris longus or flexor carpi radialis. A 2 cm. length of nerve was divided into 4 pieces placed in saline, osmic acid, potassium permanganate and formol saline for haematoxylin and eosin staining, respectively. The specimen in

saline was examined by low-angle X-ray diffraction. This appears to be a valuable technique for early determination of the amount of myelin present. In 15 cases we encountered abnormal diffraction patterns (*Finean* and *Woolf*, 1961a). The abnormal patterns were seen in patients with histologically normal nerves, but we have also encountered an abnormal pattern in three cases in which paraffin and electron microscope sections showed marked degenerative changes.

Electron microscopy was carried out on the specimens fixed in osmic acid and potassium permanganate. So far about 50 preparations have yielded useful electron microscopic data and 15 have been studied in detail (*Finean* and *Woolf*, 1961a and b). We have particularly carefully studied the myelin layering and have found no difference in cases where the nerve was thought on clinical grounds to be normal, from that encountered in other mammalian peripheral nerves (*Fernández-Morán*, 1957; *Fernández-Morán* and *Finean*, 1957; *Finean* and *Robertson*, 1958; *Robertson*, 1959, 1960; *Sjöstrand*, 1960). In some cases suspected clinically of sensory denervation, striking changes in the myelin layering were observed (*Finean* and *Woolf*, 1961a and b). There was a tendency for the myelin layers to roll up and form droplets. In some fibres the axon was shrunken or had actually disappeared suggesting that the changes in the myelin might be secondary to axonal degeneration. In another case the axons had apparently been more resistant, since axons larger than those normally found unmyelinated, could be seen devoid of myelin cover or with only a few laminae which were thought to represent abortive attempts at myelin regeneration.

The unmyelinated nerve fibres were particularly interesting especially in view of the impossibility — apart from the crude demonstrations of silver impregnation — of studying them without the electron microscope. We were particularly impressed by the remarkable variation in diameter of the non-myelinated axons some of them being only 0.1 μ in diameter and almost certainly invisible with the light microscope even when impregnated with silver. The axons also varied markedly in outline and electron density. The interpretation of these variations in terms of function — sensation conducted, autonomic fibres, etc., — has still to be made.

The number of axons in an individual Schwann cell also varied considerably and was particularly high in infancy. Where myelinated nerve fibres were markedly reduced in number or were completely absent, as in a case of sensory neuropathy, the unmyelinated fibres appeared correspondingly more numerous suggesting that a degree of axonal sprouting had occurred. However, such a conclusion cannot be considered proven until quantitative studies of the normal and abnormal nerves have been carried out. Another feature suggesting regenerative sprouting was the finding of myelinated sheaths of normal thickness around axons of unusually small calibre in a case of Guillain-Barré syndrome with evidence in other fibres of axonal degeneration. Here again, however, statistical studies are required.

These investigations are only in a very preliminary stage but it is already obvious, that electron microscopy will be of the greatest value in extending the meagre information provided by the light microscopy of pathological specimens of human cutaneous nerves.