that a complete lesion of the inferior cerebellar peduncles suppress other afferent pathways to the cerebellar cortex. Our midline sections were not specifically limited to olivo-cerebellar fibres (see Figure 1), but extended to the neighbouring reticular formation which also projects to the cerebellar cortex[6]. Therefore, it is possible that the interruption of the olivo-cerebellar pathway is only in part responsible for the suppression of Purkinje neuron responses to climbing fibre activation.

Résumé. Les décharges évoquées dans les cellules de Purkinje lors de l'activation des fibres grimpantes ont été testées par stimulation afférente dans un groupe d'animaux intact et dans un groupe d'animaux avec lésion chronique totale et bilatérale de la voie olivo-cerebelleuse. On a démontré qu'une partie seulement des fibres qui atteignent la région vermienne du lobe postérieur du cervelet ont leur origine dans l'olive inférieure.

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Histochemical Changes in Upper Motor Lesions, Parkinsonism and Disuse. Differential Effect on White and Red Muscle Fibres

Histochemical methods for indication of the enzyme activity in striated muscle have permitted a differentiation of the fibres into groups with different metabolic prerequisites. Thus, in vertebrates, a largely reciprocal relation exists between the phosphorylase activity and the oxidative enzyme activity in the individual muscle fibres[1]. The white fibre has a high phosphorylase activity, whereas the myoglobinrich red fibre has a high activity of oxidative enzymes, such as cytochrome oxidase, DPN diaphorase and succinate dehydrogenase.

On the basis of a method for morphological indication of muscle activity[2], it has recently been shown in preliminary experiments that the motor unit is, to a high degree, uniform with respect to its enzyme pattern[3].

In man, the order of recruitment of the motor units is largely fixed, and is thus independent of the type of activation[4]. This implies that some muscle fibres are in a state of more or less continuous activity, whereas others are utilized only under special conditions, such as strong or rapid contraction. Against this background, it is of interest to ascertain how motor disturbances, associated with some inactivity and change in tone, respectively react on the functional anatomy of the skeletal muscle.

Three groups of patients were studied by means of muscle biopsy. (A) Central hemiparesis due to vascular cerebral lesion or cerebral tumour (9 cases), (B) parkinsonism (4 cases), (C) injury to the anterior cruciate ligament of the knee (11 cases).

Staining for myofibrillar A-band ATPase[5] allows a grouping into 2 distinct types of fibre, in which the activity level is largely reciprocal to the oxidative. The distinct differences in activity were maintained under the existing pathological conditions (Figures 1 and 2). This makes the method well suited for classification of the fibres in measurement of the 2 main types separately.

In the group of central paresis, the unaffected side served as a control. The other groups of patients were compared with a control material[6].

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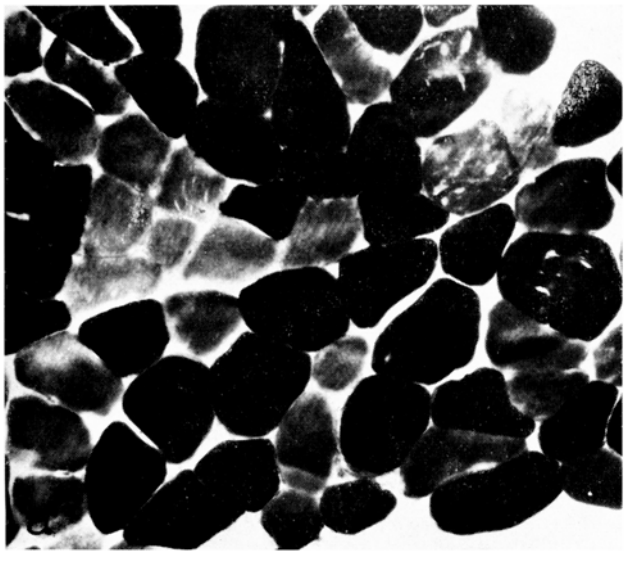

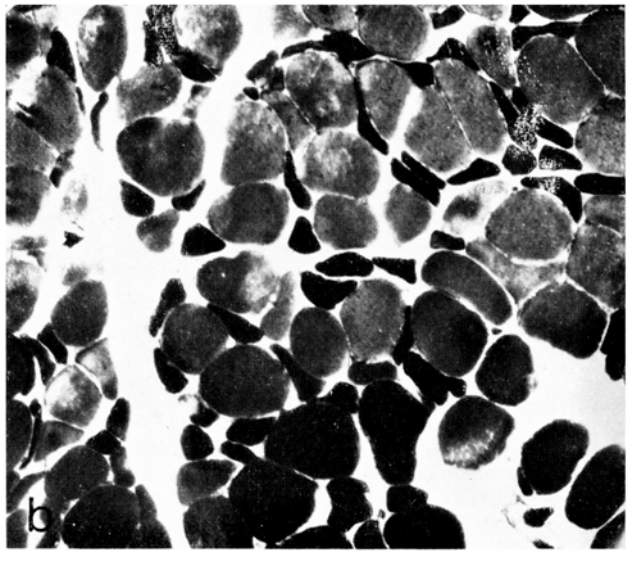

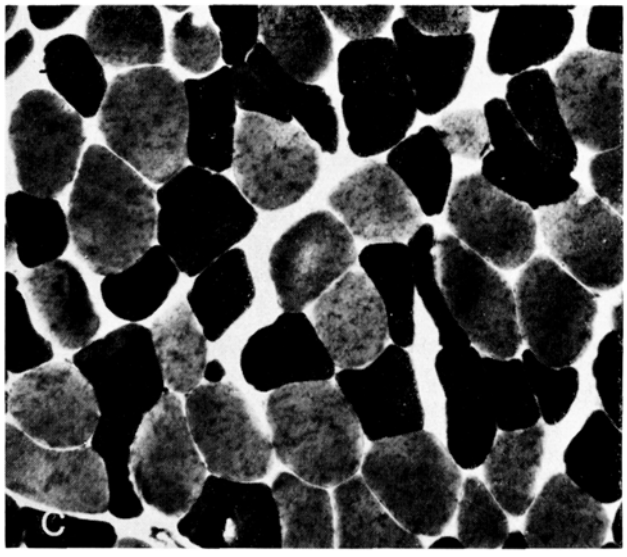

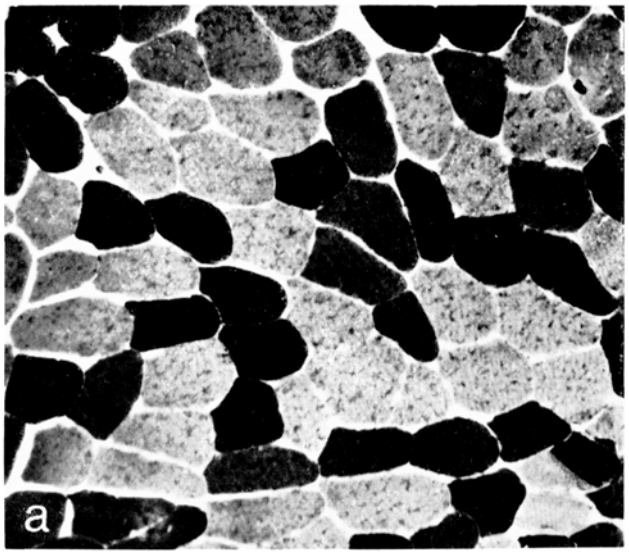

Fig. 1. Biceps brachii muscle. Myofibrillar A-band ATPase. (a) Normal muscle. Large, strongly reacting white fibres and smaller weakly reacting red fibres. (b) 6-months' total paresis (damage to pyramidal tract). Extreme atrophy of white fibres (stained black). (c) Parkinsonism with a long history of akinesia and rigidity. Moderate atrophy of white fibres (stained black) and hypertrophy of red fibres (stained light). × 130.

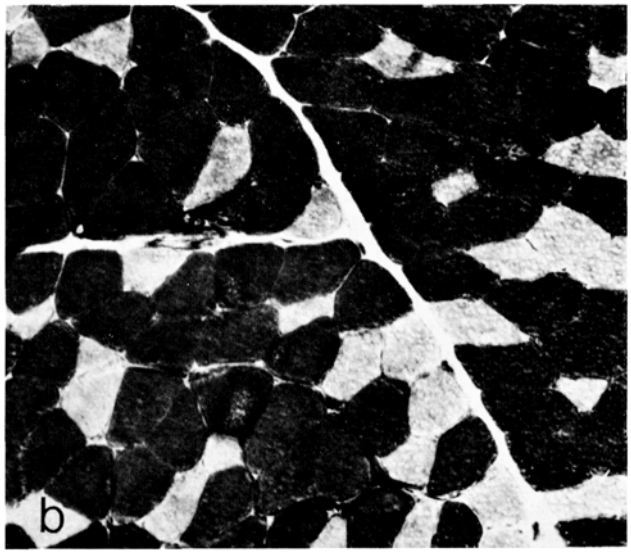

Fig. 2. Quadriceps femoris muscle. Myofibrillar A-band ATPase. (a) Normal muscle. Strongly and weakly reacting fibres of largely uniform size. (b) Damage to anterior cruciate ligament with 2-year history. Atrophy of red fibres (stained light). × 130.

The results can be summarized as follows:

(a) Selective atrophy of the white fibres which was related to the grade of paresis and the duration of functional loss (Figure 1b). After 5–6 weeks total paresis, distinct atrophy was present. 1 patient with a long history of spasticity showed hypertrophy of red fibres.

In addition to a generalized decrease in stainability for DPN diaphorase and succinate dehydrogenase, cytological changes were observed that have been described elsewhere[7].

(b) In cases of lengthy akinesia and rigidity, both atrophy in the white fibre group and hypertrophy in the red fibre group were demonstrable (Figure 1c). No definite increase or decrease was observed in the reaction for DPN diaphorase, succinate dehydrogenase or phosphorylase.

(c) Half of the cases showed changes in the red fibre group, chiefly in the form of atrophy[8] (Figure 2b). The activity pattern of the enzyme reactions used was retained.

One case of pseudoarthrosis of the tibia was also examined, and showed atrophy of the same type as in damage to the cruciate ligament, but of more advanced degree.

The tone dependence of the red fibres can be discussed against the background of these investigations. The effect of a reduction in tone has been studied experimentally in tenotomized animals[9,10], and the results are in good agreement with those in patient group C. Analogously, one could expect the red fibres to react to an increase in tone by hypertrophy. Judging by the results in patient groups A and B, this seems, in fact, to be the case.

Experimental findings indicate that the white fibres are adapted to shorter contributions of activity than the red ones are[2]. If they are organized in motor units with a high threshold, the atrophy in central paresis and in Parkinsonism could be associated with the inability to carry out maximal voluntary muscle contraction in these diseases.

Zusammenfassung. Muskelbiopsiematerial aus Patienten mit motorischen Störungen bei Verletzung der Pyramidenbahn, Parkinsonismus und Kreuzbandverletzung wurde mit histochemischer Technik analysiert. Eine Atrophie der weissen Fasern wurde bei Pyramidenbahnverletzung und Parkinsonismus beobachtet. Kreuzbandverletzung ergab hauptsächlich Atrophie der roten Fasern, während diese bei dauernder Spastizität und Rigidität Hypertrophietendenzen zeigen.

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