Imprimé avec le périodique *journal de Physiologie*, extrait du Tome **65**, 1972, no 1; 149 A. Association des Physiologistes, Réunion de Homburg, 18-19 février 1972.

Effet de l'immobilisation sur la force et la vitesse du soléaire de Rat,

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Translated from French

Effect of immobilization on the strength and velocity of the rat soleus,

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Twenty-one rats of similar weight and age are divided into three groups of 7 animals. Those of the first group receive a plaster covering the posterior left leg, from the toes to the knee. The left soleus is thus immobilized. The rats of the second group receive an identical plaster, but on the right leg. The rats of the third group serve as controls.

After 20 days, the rats are anesthetized to the ether and both soleus are rapidly dissected and weighed. The 21 right soleus are plunged into Bouin-Hollande for morphometric analyses. The 21 left soleus are mounted immediately on an ergometer, for the study of the force-velocity relation.

The average weight of the 14 plastered soleus is 44% lower than that of the controls. This atrophy is attributed to immobilization but also has a decrease in the body growth of the treated animals. By eliminating the "body weight" factor by an analysis of variance, the atrophy is 24% ($P < 0.001$). The weights of the contralateral soleus of the plastered limbs follow the fluctuations of the body weights.

The morphometric analysis of the 21 right-handed soleus indicates the effect of immobilization. The average cross sections of the fibers are 667 μ^2 (SD ± 116, n = 7) in atrophied muscles, 1.155 μ^2 (SD ± 188, n = 7) in contralateral

muscles, and 1,234 μ² (SD + 170, n = 6) in control muscles,. The mean cross - sections of the muscles in each group varied similarly. The number of fibers counted in a section of the central part of the muscle did not differ significantly from that of the contralateral, except in three contralateral muscles which exhibit obvious signs of multiplication of their fibers.

The left handed soleus (in Krebs-0_2 glucose, 28° C) are stimulated by 14 tetani of 2 s (alternating capacitor discharge, 50 / s), at intervals of 3 minutes. The first three or four tetani are isometric with increasing lengths and allow to determine the maximum tetanic tension (P_0). During the following tetani, the muscles are initially stimulated isometrically for 0.5 s: the force then measured is called (P_m), then they are shortened at a velocity V that is constant during the movement. The force maintained during the shortening at a constant velocity is extrapolated back to the beginning of the movement and called (P_r). The P_r / P_m ratios obtained by 8 different speeds are ordered according to the exponential law force- velocity of AUBERT (1956):

$$\ln (P_r / P_m) = - V / B.$$

The mean isometric force (*Po*) was 85 g (SD + 30) in atrophied muscles, 109 g (SD ± 15) in the contralateral muscles and 136 g (SD ± 33) in control muscles (F=6.2; P <0.01). Normalized to the mean transverse cross-section of the muscle they are respectively 3.38 kg / cm2, 3.47 kg / cm2 and 3.66 kg / cm2, and no longer significantly different from each other. The mean value of the velocity constant *B* was 9.5 mm / s (SD ± 2.0) in atrophied muscles, 9.8 mm / s (SD ± 1.2) in the contralateral muscles and 10.6 mm / s (SD ± 2.1) in control muscles (F = 0.5, NS).

CONCLUSIONS: Atrophy of the soleus by immobilization of the ankle joint although verified by the loss of muscle weight and the decrease in the diameter of its fibers does not significantly alter the strength of the muscle, expressed in relation to the cross-section, nor the force-velocity relationship. Everything happens as if the atrophy consists in a disappearance of a certain number of contractile units, with conservation of the mechanical properties of the remaining units.

AUBERT, X. (1956). *Le couplage énergétique de la contraction musculaire*, Arscia, ed. Bruxelles.