RESTORATION OF THE MOTOR FUNCTION AFTER TOTAL DESTRUCTION AND REGENERATION OF GASTROCNEMIUS MUSCLES OF THE RAT.

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Gastrocnemius muscles of male prepubertal rats (group A, weight ± 50 g, n = 15) and postpubertal (group B, weight ± 150 g, n =15) are minced into fragments of 1 cubic mm and implanted *in situ* after exeresis of the soleus muscle. During the immediate operative follow-up the rat leans on the heel and holds the leg in dorsal flexion. At 15 postoperative days this posture appears partially fixed with a deficit in passive plantar extension 40°. At the 2nd postoperative month, the group A rats recovers a digitigrade march and the deficit in extension is only 15°. In the 3rd month postoperative, walking is normal and the deficit extension is negligible. Group B rats do not improve their march or their deficit which remains at 35° at 120 days.

It is observed that from 5 to 15 days after the operation a new muscle is formed, innervated, vascularized, contractile and connected by tendons with anatomical insertions (Carlson, 1972).

At 15, 30, 60, 90 and 120 days postoperative muscles regenerated are dissected while maintaining their insertions, vascularization's and innervations intact. The length in situ, Lo, is measured between the insertion of the regenerate on the femoral condyle external and distal musculotendinous junction, ankle and the thigh at 90° on the leg. The lower limb is then fixed in an isometric clamp. The distal tendon is released and attached to an isometric lever. Stimulation electrodes are placed on the sciatic nerve after severing the branches collaterals going to the other muscles of the paw. The muscles are subjected to a stretch-shortening cycle ranging from 0.90 Lo to 1.25 Lo in increments of + 0.02 Lo and at intervals of 2 minutes. At each plateau the muscle is stimulated isometrically during 0.25 seconds at 32°C.

In both groups the tension-length relationship of muscle at rest changes little during the postoperative course. At Lo the resting force is negligible and at the end of the joint stroke maximum (1.18 Lo, measured on the knee in total extension and ankle in maximum flexion) it reaches 20 to 90 grams against 250 at 350 g in an adult control rat. The active tension-length relationship is changing differently in both groups. The maximum isometric tension remains at 1.2 Lo; its size increases between 15 and 120 days from 28 ± 6 (SEM, n = 3) to 351 ± 32 g in group A and from 8 ± 0.4 to 171 ± 17 g in group B, although the weight of regenerates is changing similarly in both groups (602 ± 29 g at 120 days). The evolution of the tension according to the articular span (0.88Lo to 1.18 Lo) is also different. The force activated at Lo remains negligible in group B, but it increases in group A such that at 90 days the rats can exert an active tension throughout the joint stroke (active tension at Lo from 1 ± 0.2g to 15 days and 76 ± 24 g at 90 days). In conclusion, the muscle that regenerates after total destruction by mincing does not allow a complete functional recovery if the operation is performed in young adult rats but accompanied by a satisfactory functional recovery if the operation is performed on prepubertal rats because then the regenerate is able to generate an active tension appreciable throughout the joint stroke.