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COMPENSATION FOR PARTIAL PERIPHERAL NERVE INJURIES

ABSTRACT

When a muscle is partially denervated, the remaining motoneurons sprout and reinnervate neighbouring denervated muscle fibers. This enlargement of the motor unit (MU) by collateral sprouting is an important compensatory mechanism for partial denervation. To study the capability of MU's to enlarge by sprouting, we partially denervated the medial gastrocnemius (MG) muscle of the cat by sectioning one of its two contributing ventral roots. The relative contributions of the two roots to the innervation of the MG was determined by the charge distribution on the roots (Hoffer et al. 1979) and by recording MG tetanic force in response to stimulation of each root. Two to twelve months later, MU's were characterised by isolation and stimulation of dissected ventral root filaments. The size of MU's, as measured by their tetanic force, increased in proportion to the extent of muscle denervation. Normally MU force varies over a 100 fold range (10:1000 mN). When partial denervation was relatively small (25%), this range decreased (50:1000 mN) as the smaller units enlarged relatively more than the large ones. When denervation was extensive (75%) the entire force range shifted (100:5000 mN). These results suggest: 1) that the extent of sprouting is unlimited and proportional to the number of available denervated muscle fibers, and 2) that small, frequently recruited MU's enlarge more readily than large ones, but the final MU force is governed by the size of its motoneuron.