

COMPLETE UNILATERAL SECTION OF THE PYRAMIDAL TRACT AT THE MEDULLARY LEVEL IN *MACACA MULATTA*

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A short movie was shown to illustrate the motor deficits in hand usage which result in the adult monkey after complete unilateral section of the medullary pyramid at the level of the trapezoid body. The animal (68-70) was one of 8 in which unilateral or bilateral pyramidal section was undertaken for the primary purpose of studying the effects of pyramidal tract section on movements elicited by electrical stimulation of the rolandic region of the cerebral cortex. The results obtained in these 8 animals formed the subject of the J. Hughlings Jackson Memorial Lecture given at the Montreal Neurological Institute on May 11, 1971.

Fig. 1 is a cross-section through the medulla at the level of the inferior olive showing, 465 days after section, complete disappearance of the left pyramidal tract. with essential preservation of the right pyramid. However, histological examination at



Fig. 1. Cross-section through the medulla of monkey 68-70 at the level of the inferior olive showing complete degeneration of the left pyramid. Heidenhain stain.

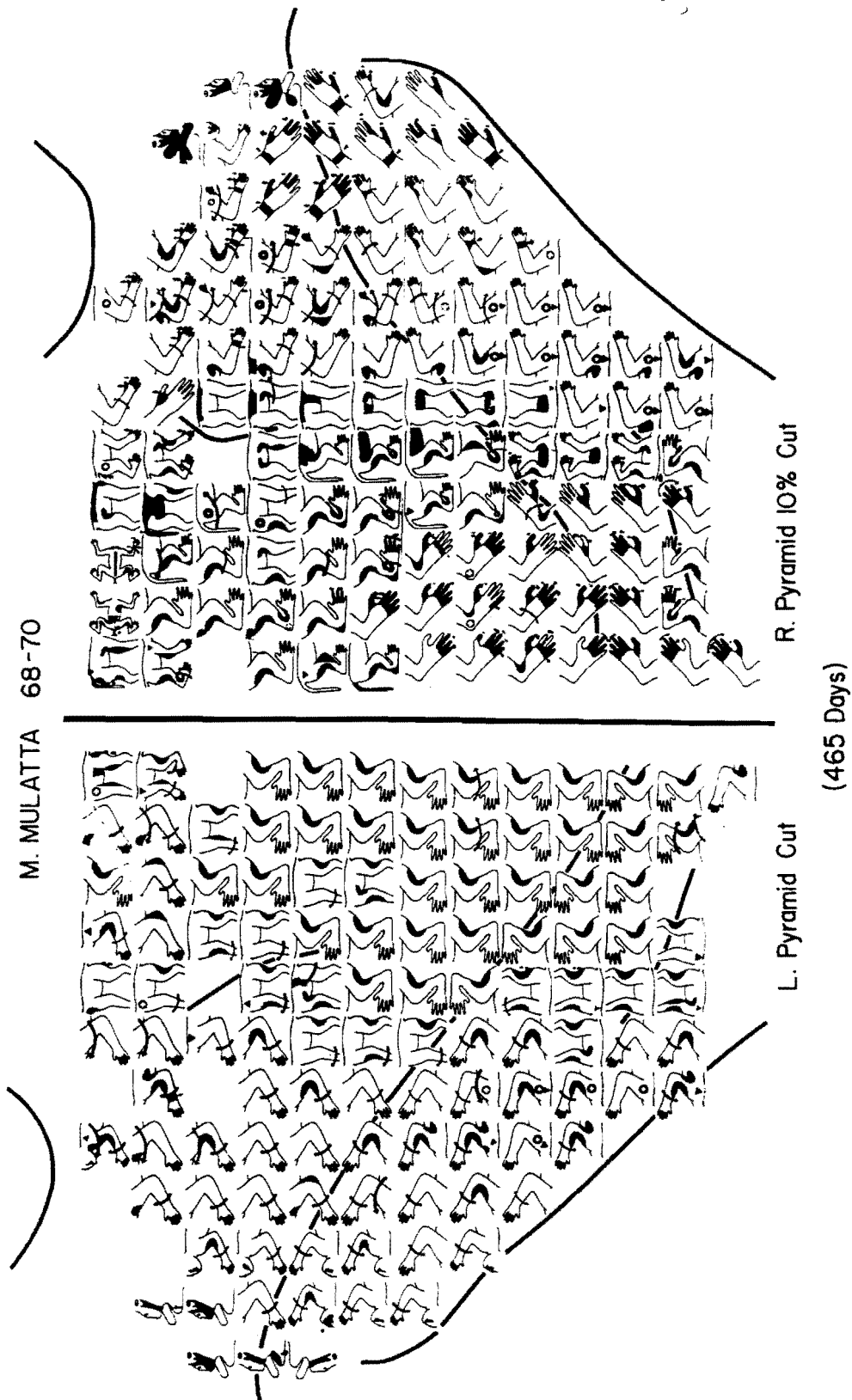
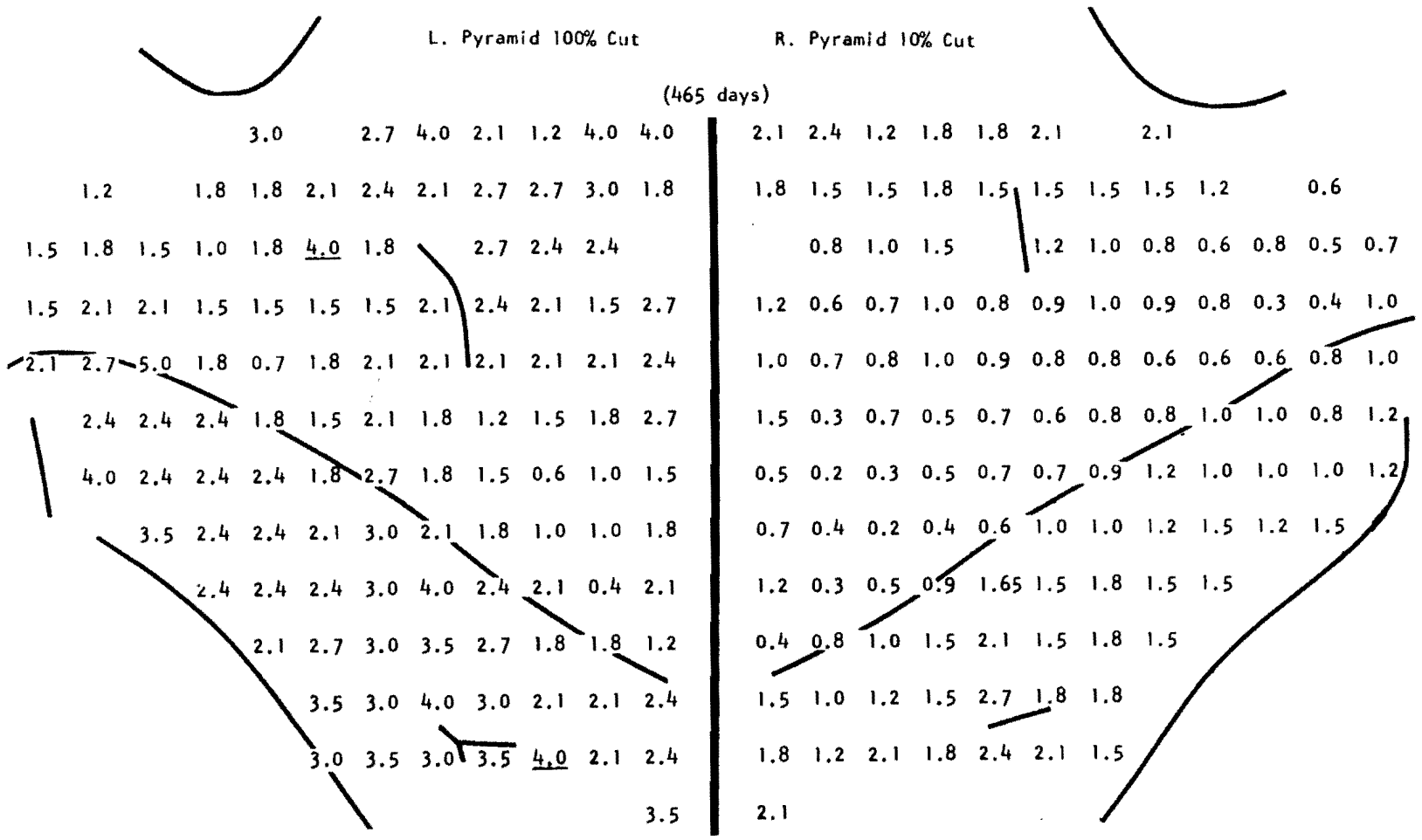


Fig. 2. Figurine map to illustrate the movements elicited by electrical stimulation of pre- and post-central cortex of both hemispheres 465 days after complete section of the left pyramid at the level of the trapezoid body and some involvement of the medial border of the right pyramid, probably less than 10%.

Fig. 3. Threshold values of stimulating currents used to elicit movements illustrated in Fig. 2.



M. MULATTA 68-70
 STIMULATION THRESHOLDS (mA, RMS, 60 cycles)

the level of the transection revealed that perhaps 10% of the fibers of the right pyramid at the midline had also been severed.

Fig. 2 is a figurine map of the movements obtained from the right and left hemispheres of this animal when pre- and postcentral areas of cortex were stimulated with 60-cycle alternating currents whose threshold values are shown in Fig. 3. The 10% loss of pyramidal fibers on the right had no detectable effect upon the pattern of movements elicited by stimulation of the right hemisphere either pre- or postcentrally and little if any effect upon threshold of stimulation. The results illustrated on the right in Fig. 2 are quite similar to those reported for normal animals by Woolsey *et al.*³. For an explanation of the figurine markings the reader may wish to consult Fig. 2 of Hardin *et al.*¹. A rich variety of movements was obtained pre- and postcentrally from the leg and the arm areas. In contrast, the movements elicited by much stronger stimuli applied to the left hemisphere were very much simpler and limited mainly to



Fig. 4. Use of hand to extract small cubes of apple from 'food wells' before operation (above) and 9 months after section of the left pyramid at the level of the trapezoid body.

flexions of the knee, flexion of the elbow and pronation of the forearm. The arm-leg boundary remained unchanged in spite of the stronger stimuli. No digital movements were elicited from this hemisphere in either the arm or the leg except at one point near the midline rostrally from which extension of the hallux was obtained. The results in this animal were quite similar to those obtained in the other animals prepared, although in some instances weak actions of fingers and wrist were seen in which all digits flexed together.

In general the neurological status of our animals did not differ in any significant respect from the description of the effects of pyramidal lesion in the monkey given by Tower² in 1940.

Behaviorally monkey 68-70 showed marked impairment in use of the right hand in actions requiring use of the fingers in picking up small items of food from a table top or in extracting them from 'food wells'. Normal animals will use the index finger and thumb of each hand in rapid alternation to pick up small round candies 1.5 mm in diameter even when these are rolling along the surface. Animals with unilateral pyramidal tract section are unable to pick up such small objects under any circumstance. By flexing all fingers together they may after several attempts succeed in picking up stationary candy (or apple) cubes 0.5 cm on a side. Normal hand use in extracting pieces of apple from food wells 2 cm deep and 2 cm in diameter are shown in the upper half of Fig. 4. In the lower half of the figure, the left hand is extracting food in a normal manner from the food well; the right hand has been placed above the well and flexor movements of all digits together are being made, but thumb and index finger are not apposed and the food is not extracted. This was the status of hand action 9 months after pyramidal section. There was no significant improvement up to the time of sacrifice at 465 days. We did not attempt to force use of the right hand by constantly restraining use of the left.

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