Non-paretic Forelimb Training Does Not Interfere with Recovery of Paretic Forelimb Strength After Experimental Middle Cerebral Artery Occlusion

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Background

- Humans often compensate with their unimpaired forelimb after surviving a stroke
- Research in rats suggests that this can be maladaptive after focal motor cortical strokes[2]
- Forelimb weakness is understudied in rodent models of stroke

Purpose

- How behavioral experience with the non-paretic forelimb affects paretic forelimb strength recovery after ischemic injury caused by middle cerebral artery occlusion (MCAo)
- How training with the non-paretic limb influenced corticostriatal projections of neural connections

Methods

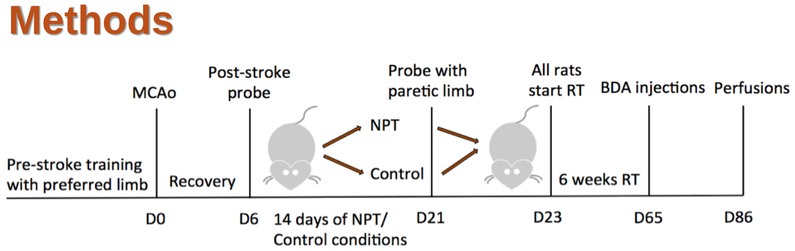
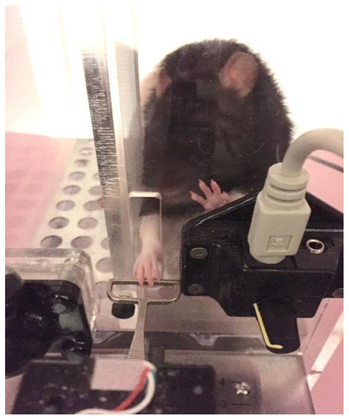


Figure 1. Summary of experimental design. After training the preferred forelimb on the Isometric Pull Task, rats underwent MCAo of the contralateral hemisphere. One week after, rats were probed for initial impairment level and assigned to either **Non-Paretic Limb Training (NPT)** or non-training control conditions for 14 days. Paretic limb performance was probed one day later. All rats then received six weeks of **Rehabilitative Training (RT)**. The anterograde tract tracer BDA was injected into the lesioned hemisphere. Rats were sacrificed three weeks later and brains were processed for histology.



Isometric Pull Task with modified handle

Figure 2. The Isometric Pull Task is a fully automated system that incorporates reach-to-grasp motion and provides quantitative data on forelimb force generation[1]. A modified handle was used that required rats to use more skillful movements than in traditional reach-to-grasp rodent tasks.

Results

Training with the non-paretic limb does not interfere with paretic limb recovery on the Isometric Pull Task

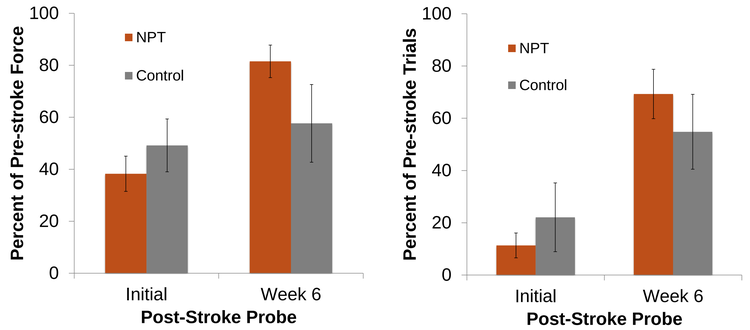


Figure 3. Post-stroke function was measured one week after MCAo. Week 6 function was measured at the completion of rehabilitative training

Training the non-paretic forelimb does not increase reliance on the impaired forelimb

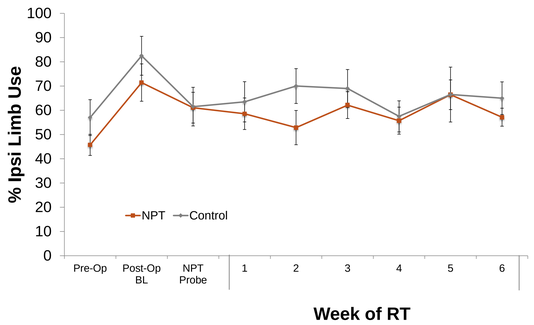


Figure 4. Forelimb asymmetries in postural support behaviors as measured in the Schallert Cylinder Test

Non-paretic limb training does not influence ipsi corticostriatal axon quantities after MCAo

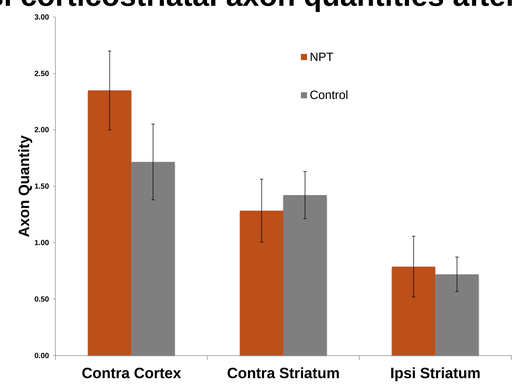


Figure 5. Axon quantities were measured using quantitative microscopy.

Reconstructions of the extent and placement of MCAo lesions

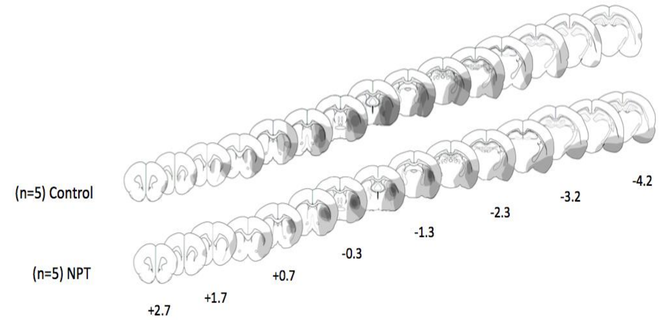


Figure 6. The darkest areas have the greatest extent of lesion overlap between subjects. Numbers under the figure approximate coordinates in mm relative to bregma. There was no significant difference in cortical or striatal volume between the groups.

Conclusions

- Compensatory use of the non-paretic forelimb after strokes involving subcortical or cortical damage primarily in the somatosensory region may not be maladaptive for strength.
- Axonal plasticity may not be adversely effected by non-paretic limb training
- Understanding how behavioral recovery varies with lesion locus could influence clinical management of patients.

References

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2. Allred, R., Cappellini, C., & Jones, T. (2010). The “good” limb makes the “bad” limb” worse: Experience-dependent interhemispheric disruption of functional outcome after cortical infarcts in rats. *Behavioral Neuroscience, 124*(1), 124-132.
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