A LONGITUDINAL STUDY OF SKELETAL MUSCLE FOLLOWING SPINAL CORD INJURY AND LOCOMOTOR TRAINING

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Introduction

Spinal cord injury (SCI) results in loss of muscle mass and motor function. Recently, novel intervention therapies, focusing on repetitive locomotor training, have shown great promise in promoting spinal plasticity and recovery in motor function following SCI. Recovery of motor function after spinal cord injury likely requires both neural and muscular adaptations. The objective of this study was to implement magnetic resonance imaging to characterize the longitudinal changes in rat lower hindlimb muscle morphology following contusion SCI and to determine the therapeutic potential of two modes of locomotor training.

Experimental

Spinal cord contusion injuries were produced using a NYU (New York University) impactor device. Twenty-four Sprague Dawley rats were assigned to either treadmill training, cycle training or an untrained group. Both training protocols were started at 1-week post injury and were performed continuously for 3 months, 5 days/week, 2 trials/day, 20 minutes/trial. Magnetic resonance images were collected prior to injury as well as at 1-, 2-, 4-, 8-, and 12-weeks post injury. The maximal cross-sectional area of the tibialis anterior, triceps surae, extensor digitorums and flexor digitorums was measured.

Results and Discussion

Following midthoracic spinal cord contusion injury, we observed significant atrophy in the rat hindlimb muscles. The degree of atrophy appeared to be muscle-specific, with the anti-gravity extensor muscles showing greater atrophy than the flexor muscles. In the non-trained animals, the greatest amount of atrophy was measured at two weeks post-injury and spontaneous recovery in muscle size was observed by 4 weeks post SCI. Both cycling and treadmill training halted the atrophic process and significantly accelerated the rate of recovery. The therapeutic influence of both treadmill and bicycle training was observed within 1 week of training. Finally, a significant positive correlation was found between locomotor functional scores and hindlimb muscle size following SCI.

Conclusions

This study demonstrates that rats following SCI show a significant decrease in hindlimb muscle size followed by a spontaneous recovery and early intervention strategies can effectively accelerate the rate of recovery.

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