

## Muscle Atrophy Following Spinal Cord Contusion Injury

M. Liu (UF, Physical Therapy); Y. Fan (UF, Physical Therapy); R. Vohra (UF, Physical Therapy); A. Jayaraman (UF, Physical Therapy); P. Shah (UF, Physical Therapy); G.A. Walter (UF, Physiology); K. Vandendorpe (UF, Physical Therapy)

### Introduction

Spinal cord injury (SCI) results in loss of muscle mass and motor function. The amount of atrophy is dependent on the severity of injury and the muscle of investigation. The objective of this study was to implement magnetic resonance imaging to quantify the degree of muscle atrophy following two levels of mid-thoracic contusion injury: a moderate and severe injury.

### Experimental

Both spinal cord contusion injuries were produced using a NYU (New York University) impactor device. 3D proton MR images were obtained prior to injury and at 1, 2, 4, 8, and 12 weeks post injury. The 3D data were acquired with an encoding matrix of 516 x 256 x 64, field of view of 2.5 x 2.5 x 4 cm, slice thickness of 1 mm, pulse repetition time of 100 ms, and an echo time of 6.4 ms.

### Results and Discussion

Animals with a moderate contusion SCI demonstrated ~25% atrophy in the soleus and 20.5% atrophy in the tibialis anterior muscle. However, significant spontaneous recovery in muscle size was noted and by 12 weeks post-SCI, the CSA of all muscles studied had recovered to pre-injury values. In comparison, rats with a severe SCI showed more profound atrophy in all the hindlimb muscles studied. A longitudinal MR study showed some restoration of muscle size in the severed injured rats (Fig. 1). We found the largest amount of atrophy in the posterior compartment muscles, with 38-45% atrophy in posterior muscles and 27-29% atrophy in anterior muscles. As a consequence the total triceps CSA, assessed by MRI, decreased from  $91.6 \pm 2.7 \text{ mm}^2$  in controls to  $59.7 \pm 8.2 \text{ mm}^2$  in SCI animals (Fig. 2). Immunohistochemical analysis showed similar decreases in fiber CSA. At 2 weeks post-SCI the soleus fiber CSA was  $1,531 \pm 407 \mu\text{m}^2$  in severe SCI (cSCI-10%) rats, compared to  $2,722 \pm 417 \mu\text{m}^2$  in age- and gender matched controls (Fig. 3).

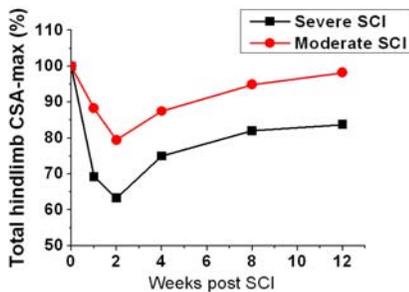


Fig 1: Total hindlimb muscle CSA in moderate and severe SCI rats.

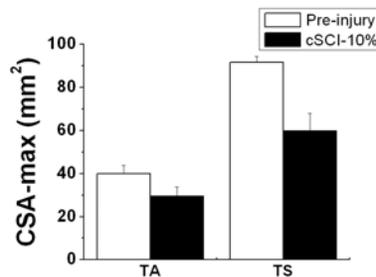


Fig 2: Muscle CSA in severe SCI (cSCI-10%) rats.

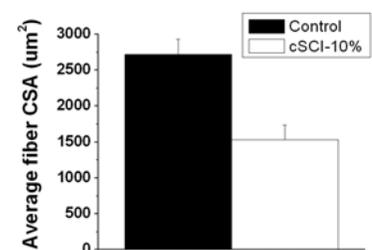


Fig 3: Muscle fiber CSA in severe SCI (cSCI-10%) rats.

### Conclusions

This study demonstrates that rats following severe SCI show a greater degree of muscle atrophy and a slow rate of spontaneous recovery.

### Acknowledgements

This work was supported by grants RO1HD37645 and RO1HD40850 from the NIH. MR data were obtained at the Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS) facility in the Evelyn F. and William L. McKnight Brain Institute of the University of Florida.