Introduction: Mini-open and arthroscopic rotator cuff repairs both demonstrate good clinical results, however, have high re-tear rates by MRI and ultrasound. In one recent study, 31% of mini-open rotator cuff repairs and 47% of arthroscopic tears had failed to heal, or had re-torn at follow-up, with the non-intact cuffs having decreased strength of forward elevation and external rotation compared to those that healed. Clinical results may be improved if we can achieve a lower re-tear rate of the repaired cuff. A potential method to decrease the strain on the healing tendon-bone interface would be to temporarily paralyze the rotator cuff muscle for the duration of tendon to bone healing. This inability to activate the muscle would also allow patients to begin early active motion using the other rotator cuff muscles, deltoid and periscapular muscles, decreasing the likelihood of post operative stiffness and disuse atrophy and allowing patients to continue activities of daily living.

We hypothesized that using botulinum toxin to temporarily paralyze the supraspinatus muscle would not adversely effect tendon-to-bone healing, and would result in a stronger tendon attachment.

Methods: 132 Sprague Dawley rats underwent division and repair of the supraspinatus tendon. 66 rats underwent repair alone and 66 rats received injection of botulinum toxin of 6 units/kg into the supraspinatus muscle, prior to detachment and repair. Rats were sacrificed at 4, 8 and 24 weeks and underwent histologic, biomechanical, volumetric, and micro CT analysis.

Results: Grossly there were no failures in either group. The weight of the supraspinatus muscle was significantly less at 4 and 8 weeks in the Botox group, but had equalized by 24 weeks with weights of 0.534 and 0.497 grams in the control and Botox groups, respectively. At 4 and 24 weeks there was no significant difference in the load to failure between the Botox group and the controls. However, at 8 weeks the Botox group had a significantly lower load to failure (27.7 N versus 46.7N, p< .01). These can be seen in Figure 1. MicroCT analysis showed that the Botox group had less bone volume, total mineral content and total mineral density at all time points, although these differences were only significant at 8 weeks. Histologically, at 4 weeks the control specimens had less fibrocartilage and were less organized than the Botox specimens, which all had a tidemark. At 8 weeks the differences between the control and Botox specimens was much less pronounced with the tendons becoming less cellular in both groups. At 24 weeks both groups had well aligned cells with a well organized interface between the tendon and the bone. The H&E and safranin-O images can be seen in Figures 2-4.

Conclusion: We demonstrated an ability to alter tensile loading of the bone tendon interface using botulinum toxin in a rat model. While there was no significant difference in the tendon attachment strength at 4 and 24 weeks, there was a significantly decreased load to failure at 8 weeks. This observed difference may be due to the negative effects of decreased load in the Botox group. While the rat is an excellent animal model for rotator cuff repair anatomically, they demonstrate better tendon healing than humans as they do not fail even though they are loading their repairs post-operatively (unlike humans who are immobilized), and thus, the potential benefit from the reduction in strain on the healing tendon may not be well demonstrated. Modulation of the mechanical environment may have a more pronounced positive effect on tendon to bone healing in a large animal or human model where rotator cuff tendon healing has a higher failure rate.