SUPRASPINATUS TORQUE CALCULATED FROM DELTOID EMG BEFORE AND AFTER A SUPRASCAPULAR NERVE BLOCK

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INTRODUCTION
The supraspinatus and deltoid muscles are primary shoulder elevators [1]. Determining the exact mechanical behavior of the supraspinatus is difficult due to the large number of muscles crossing the glenohumeral joint. Previous research has demonstrated a compensatory increase in deltoid EMG in response to the loss of the supraspinatus during after a suprascapular nerve block [2]. Since there is a direct relationship between force and EMG amplitude [3], the amount of force the deltoid generates has increased.

An isometric ramp contraction can be used to define the deltoid EMG and externally measured force relationship before and after a nerve block. Less external force will be generated with the same amplitude of deltoid EMG after the block. The difference between pre and post measured external force for a specific amplitude of EMG activation will be the supraspinatus torque contribution. The purpose of the study is to determine the contribution of the supraspinatus muscle at increasing levels of maximal voluntary contraction (MVC). We hypothesize that the supraspinatus contributes 50% of humeral elevation MVC across all angles and loads.

METHODS
Three subjects volunteered for the experiment (2 females, 1 male). Surface EMG data from the dominant side’s middle deltoid and force from the load cell were sampled simultaneously at 2000 Hz.

The maximum deltoid EMG activation was measured during 2 MVCs with the arm abduced 90° in the coronal plane and the elbow flexed to 90°. Two MVCs for external rotation were recorded. To measure maximum external force, 2 MVCs were measured with the arm in the scapula plane with the elbow fully extended at 30°, 60° & 90° humeral elevation. The target for each ramp contraction was set to 60% MVC for each angle.

Subjects performed 3 isometric ramp contractions at 30°, 60° & 90° at 15 N/s. A computer monitor provided biofeedback so the subjects could maintain the specified rate of force application.

After the ramp contraction, an ultrasound guided suprascapular nerve block was performed (1.5% lidocaine, 1: 200,000 epinephrine). After the block, external rotation was measured at 5 and 10 minutes, and then every 2 minutes until 2 consecutive attempts were below 50% external rotation MVC. The pre-block procedure was then repeated.

RESULTS AND DISCUSSION
We observed a 60.5% drop in external rotation after the block (Figure 1). A large drop is observed in the amount of MVC produced given the same middle deltoid EMG amplitude pre-block (Figure 2). The difference between these two curves would be the supraspinatus contribution to the measured level of force. This can then be calculated as a percent contribution at each level of MVC (Figure 3). At lower levels of MVC, the supraspinatus contributes more but decreases as external force increases.

CONCLUSIONS
The supraspinatus contributes significantly to humeral elevation but its contribution decreases and then plateaus with increasing %MVC.

REFERENCES