SUPRASCAPULAR NERVE BLOCK RESULTS IN A COMPENSATORY INCREASE IN DELTOID MUSCLE ACTIVITY

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INTRODUCTION

During normal shoulder function, there exists a delicate balance between the forces exerted by the deltoid and rotator cuff muscles. It has been established in cadaver (Sharkey et al., 1994; McMahon et al., 1995) and computer (Magermans et al., 2004) models that reducing the contribution of the rotator cuff muscles places a higher demand on the deltoid. Since the line of action of the deltoid is directed more superiorly, this increase in deltoid force results in a more superiorly directed joint reaction force at the glenoid.

The aim of this study was to examine the in-vivo consequences of rotator cuff dysfunction by studying the effects of a suprascapular nerve block on shoulder muscle activity. We hypothesized that this block would result in a compensatory increase in deltoid activity, similar to what has been observed in cadaver models.

METHODS

Ten subjects with no reported shoulder pathology successfully completed a nerve block protocol (age range 23-33). EMG, kinematic and isometric strength data were collected prior to and immediately after a suprascapular nerve block.

A Myopac Jr. (RUN Technologies, Mission Viejo, CA) unit with dual lead channels was used for collection and processing of EMG recordings from the upper and lower trapezius; anterior, middle, and posterior portions of the deltoid; serratus anterior; and infraspinatus. EMG data were normalized to a maximum voluntary contraction (MVC) for each muscle. The 3Space Fastrak (Polhemus, Colchester, VT) was used to collect humerothoracic motion. A thoracic receiver was placed over T3 with double sided tape and a humeral receiver was mounted on a molded cuff strapped to the distal humerus. Kinematic and EMG data were collected simultaneously during scapular plane elevation. Isometric strength during shoulder external rotation was assessed with the arm at the side with a 50 lb (22.7 kg) capacity load cell (Lebow, Troy, MI).

The suprascapular nerve block was performed by an anesthesiologist (PK) who administered lidocaine 100 mg after motor stimulation confirmed needle placement by the nerve.

RESULTS AND DISCUSSION

The nerve block resulted in a mean external rotation force level that was 25% of the original baseline measurement. All three heads of the deltoid demonstrated an increase in activation following the nerve block (p < 0.002). Follow-up t-tests indicated that there was an increase in muscle activation at all angles, except for 120 degrees of elevation for the anterior deltoid and 20 degrees of elevation for the
posterior deltoid (figure 1). There was no significant effect of the nerve block on activity of the upper and lower trapezius, serratus anterior and infraspinatus.

A comparison was made with two cadaver models that simulated paralysis of cuff muscles (Sharkey et al., 1994; McMahon et al., 1995) and a computation based on moment arm data (Liu et al., 1997). Despite the disparity between the models (cadaver, computational and in-vivo), they all show the same general trend of a large percent increase from baseline at low elevation angles that decreased as the arm was elevated (figure 2).

**Figure 1**: Deltoid EMG activity as a function of humerothoracic elevation. *p < 0.05

**Figure 2**: Percent increase in middle deltoid activity as a function of humerothoracic elevation

**SUMMARY/CONCLUSIONS**

Our results provide *in-vivo* evidence that the central nervous system compensates for the loss of rotator cuff function with an increase in deltoid activity. Future studies examining the EMG activity of the deltoid and rotator cuff muscles in patients with rotator cuff pathology is warranted.

**REFERENCES**