ALTERED SCAPULAR MUSCLE ACTIVITIES AND IMPAIRED SHOULDER JOINT POSITION SENSE IN SUBJECTS WITH SUBACROMIAL IMPINGEMENT SYNDROME

[1]Cheng-Ju Hung , [1]Shing-Yu Chen , [3]Jing-lan Yang and [1,2,3]Jiu-Jenq Lin

[1]School and Graduate Institute of Physical Therapy, National Taiwan University, Taipei, Taiwan

[2]Physical Therapy Center, National Taiwan University Hospital, Taipei, Taiwan

[3]Department of Physical Medicine & Rehabilitation, National Taiwan University Hospital, Taipei, Taiwan;

E-mail: jiujlin@ntu.edu.tw

INTRODUCTION

Subjects with subacromial impingement syndrome (SAIS) have abnormal scapula motion and altered scapular muscle activities during arm elevation [1], thus impaired proprioception may be expected. Additionally, we expected that control of scapular muscle activity may be related to impaired proprioception. The purposes of this study were twofold: to examine whether proprioception in subjects with SAIS differs from proprioception in controls; and to examine the effect of muscular contraction on joint reposition error (JRE) in subjects with SAIS.

METHODS

Seven subjects with unilateral SAIS (age=22.4±1.6) and seven healthy controls were analyzed (age=21.4±1.2). They performed abduction in the scapular plane 6 times by self-selecting shoulder 90-degree abduction position. The electromagnetic motion-capturing system collected kinematic data while surface electromyography (sEMG) collected muscle activities (upper trapezius, UT; lower trapezius, LT; serratus anterior muscles, SA).

The sEMG data were evaluated by voluntary response index (VRI) including voluntary motor task (magnitude) and EMG distribution across the recorded muscles (similarity index, SI) during movements [2,3]. A vector was generated as RMS values from UT, LT, and SA as response vector (RV). Additionally, normalization of RV

$$\left(R_{norm} = \frac{[R_1\ R_2\ R_3]}{\sqrt{\sum_i R_i^2}} \text{ Where } R_1 = \text{UT},\ R_2 = \text{LT},\ R_3 = \text{SA} \right)$$

was conducted to represent muscle contraction pattern among 3 muscles during the task. The objective of the movements was to move the upper limb to the target position as accurately and similarly as possible without visual guidance.

To determine if a significant proprioception difference existed between groups, t-test was calculated on the JRE. To determine the effect of muscular activity on JRE, Pearson product-moment coefficients of correlations were used to correlate the JRE with the VRI, and three muscle activities.

RESULTS AND DISCUSSION

The measurement values for JRE, SI, EMG magnitude and 3 normalized muscle activities in involved shoulders and controls were demonstrated in Table 1.

There was an increased JRE in subjects with SAIS compared to control (2.7 degrees, $p<0.05$). The replication accuracy was also enhanced by coordination (SI) among muscle activation ($R=0.80$, $p<0.05$), by increased muscle activation level (magnitude) ($R=0.81$, $p<0.05$). Although SI in SAIS group was high, it may demonstrate that JRE was sensitive to SI. A little altered muscle activation may result in increased JRE. Specifically, JRE was increased by higher upper trapezius muscle activation ($R=0.79$, $p<0.05$) and decreased by higher lower trapizius muscle activity. ($R=0.82$, $p<0.05$).

	SAIS group (SD)	Control group (SD)
JRE (degrees)	5.4(2.7) *	2.7(1.6)
SI	0.98(0.01) +	NA
EMG Magnitude (mv)	191.9(48.9)* +	178.1(79.2)
$\mathbf{R_{UT}}$	96.7(1.3) * +	84.6(11.6)
$\mathbf{R_{LT}}$	18.6(5.4) * +	37.6(13.3)
$\mathbf{R_{SA}}$	15.4(5.9) *	31.8(13.4)

Table 1: Measurement values for JRE, SI, EMG magnitude and 3 normalized muscle activities.
*: There was a significant difference between subjects with SAIS and control.
+ : There was a high correlation between JRE and VRI, normalized muscle activities. (R values > 0.75)

CONCLUSIONS

We used an unconstrained shoulder model to investigate the existence of proprioception deficit in subjects with SAIS and the relationships between shoulder repositioning accuracy and scapular muscle activities. The replication accuracy was enhanced by increased scapular muscle activation level and by coordination among scapular muscle activation (SI). The impaired proprioception and unbalanced scapular muscle control such as higher UT and lower LT muscle activities are important to consider in the rehabilitation of patients with SAIS. Reducing UT and facilitating LT muscle activities may improve the shoulder joint position sense in these subjects.

REFERENCES

1. Ludewig PM, et al., *Phys Ther.* **80**:276-291, 2000.
2. Lee DC, et al., *J Electromyogr Kinesiol.* **14**:379-388, 2004.
3. Lin JJ, et al., *J Electromyogr Kinesiol.***16**:458-468, 2006.