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The role of the serratus posterior inferior muscle evaluated with surface and wire electromyography and ultrasonography

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Introduction

"Chest gripping" represents a narrow lower thorax due to an abnormal trunk muscle activation pattern limiting lateral expansion of the lower thorax[1], which may reduce thoracic extension or even cause low back pain. Hypertonic upper abdominal muscles may be a cause. Though the serratus posterior inferior (SPI) is, in anatomy, considered an only antagonist to the chest gripping, the role of the SPI has not been well understood[2-3].

Roles of the SPI have been studied in the context of respiratory function. Loukas et al.[4] suggested no respiratory function be attributed to either the serratus posterior superior (SPS) or SPI, because no morphometric differences in the SPS and SPI exist between specimens with a history of chronic obstructive pulmonary disorder and normal specimens. Vilensky et al.[5] stated, in their review paper, either SPS or SPI demonstrated no respiratory function. Any other biomechanical roles of the SPI have not been proposed.

The study hypothesis was that the primary role of the SPI is unilateral protraction of the lower thorax, which further contribute to trunk rotation. The secondary hypothesis was that surface-electromyography (SEMG) is able to identify an isolated SPI activity from the latissimus dorsi (LD) activity.

Materials & Method

Participants: Ten male college students signed an IRB-approved consent form. Those with a history of a respiratory disorder or fracture in the thorax or spine, or with BMI greater than 25 were excluded.

Methods: Activity of the five trunk muscles during 8 maximal exertion tasks repeated for 5 times were recorded using surface EMG, from which maximum voluntary isometric construction (MVIC) for each muscle was identified. Changes in the thickness of the SPI were measured using ultrasonography. A comparison of activation patterns detected by wire and surface EMG was conducted in one subject for 3 submaximal thoracic activities. Wire EMG data during the same activities were obtained by personal communication.

Analysis: An average of three median values for each task was used. Normalized surface EMG values were obtained. Thickness of the SPI was measured using ImageJ software (Fig.1). Statistical analyses using the PASW Statistics 18 involved descriptive statistics and intraclass correlation coefficients (ICC) for %MVC and muscle thickness values of the SPI.

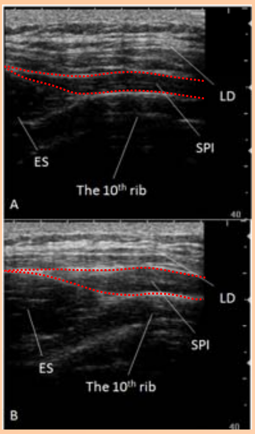

Fig.1 Muscle thickness of the SPI meaasyred by ultrasonography

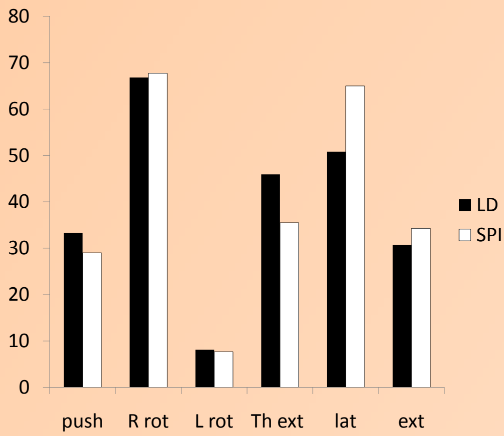

Fig.2 %MVC of the SPI and LD by surface EMG

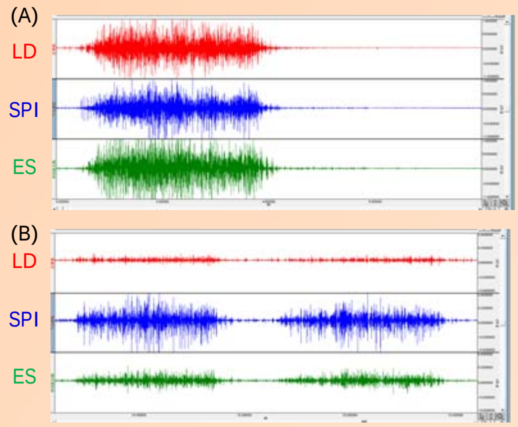

Fig.3 An example of surface EMG muscle activity of the SPI and LD. (A):trunk rotation (B): ipsilateral shoulder hyper-flexion compensated with trunk rotation from the all-four's position

Result

EMG activity and thickness of the SPI were increased during resisted ipsilateral trunk rotation, during which the SPI and LD activities were almost identical.(Fig.2) Thickness of the SPI during resisted ipsilateral trunk rotation was 5.00 ± 1.36 mm.(Fig.1) %MVC of the SPI during the same tasks was 75.1 ± 27.1 %. ICC (1,3) for %MVC and muscle thickness of the SPI were 0.99 and 0.95, respectively.

A wire-EMG study revealed the SPI was active while the LD was silent during active trunk rotation at side lying, ipsilateral shoulder hyper-flexion compensated with trunk rotation from the all-four's position, and resisted back extension using the ATM®2 (Backproject corp.). Wire and surface EMG studies agreed on the activation of the SPI in the first 2 thoracic activities. (Fig.3)

Discussion

This study was suggest that the SPI were effectively recruited during the 3 submaximal thoracic activities. SPI has effect to pull ipsilateral lower ribs to backward, and the one side activity for the rotation of the lower thoracic vertebra and the bilateral activity antagonist for chest gripping, and it may contribute to the lateral expansion of the lower rib cage and thoracic vertebra extension.

Conclusion: The SPI and LD works synergistically during maximal exertion tasks of the trunk. The SPI were effectively recruited during the 3 submaximal thoracic activities. Surface EMG was effective in detecting the activity of the SPI in 2 out of 3 submaximal thoracic activities.

Implications: The SPI is activated by the 3 specific thoracic activities, and they can be expectedly used in treating chest gripping and other trunk disorders involving reduced mobility of the thorax.

Reference

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