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Original research

Comparison of electromyographic activity of the lower trapezius and serratus anterior muscle in different arm-lifting scapular posterior tilt exercises

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ABSTRACT

Objective: To determine the most effective exercise to specifically activate the scapular posterior tilting muscles by comparing muscle activity generated by different exercises (wall facing arm lift, prone arm lift, backward rocking arm lift, backward rocking diagonal arm lift).
Design: Repeated-measure within-subject intervention.
Participants: The subjects were 20 healthy young men and women.
Main outcome measures: Lower trapezius (LT) and serratus anterior (SA) muscle activity was measured when subjects performed the four exercises.
Results: Muscle activity was significantly different among the four exercise positions ($p < 0.05$). The backward rocking diagonal arm lift elicited significantly greater activity in the LT muscle than did the other exercises ($p < 0.05$). The backward rocking arm lift showed significantly more activity in the SA muscle than did the other exercises ($p < 0.05$).
Conclusions: Clinicians can use these results to develop scapular posterior tilting exercises that specifically activate the target muscle.

1. Introduction

When elevating the arm overhead, the normal scapula undergoes a pattern of upward rotation (45–60°), external rotation (15–35°), and posterior tilting (20–40°) (Escamilla, Yamashiro, Paulos, & Andrews, 2009; Ludewig, Cook, & Nawoczenski, 1996). To complete, 180° of humeral elevation, the scapula should depress, slightly adduct, and tilt posteriorly at the end-range of scapular upward rotation (Sahrmann, 2002). Scapular posterior tilt (SPT) is the movement of the coracoid process in a posterior and cranial direction while the inferior angle of the scapula moves in an anterior and caudal direction (Clarkson, 2005). During arm elevation, SPT occurs about a medial-lateral axis of the scapula, with the inferior angle moving anteriorly (Michener, McClure, & Karduna, 2003), which occurs primarily after 90° and increases sharply at the end-range (Hammer, 2006). SPT may be important in allowing the humeral head and rotator cuff tendons to clear the anterior aspect of the acromion during arm elevation (Escamilla et al., 2009).

In particular, athletes or workers involved in overhead activity with abnormal scapular movement at the extremes of humeral elevation are likely to develop shoulder conditions such as subacromial impingement (SI) and glenohumeral instability (Ludewig et al., 1996; McQuade, Dawson, & Smidt, 1998; Warner, Micheli, Arslanian, Kennedy, & Kennedy, 1992). Subjects with SI have approximately 10° less posterior tilt than asymptomatic subjects (Lukasiewicz, McClure, & Michener, 1999). Coordination of SPT muscles is important to prevent abnormal scapular movement and pain during elevation of the arm overhead (Solem-Bertoft, Thuomas, & Westerberg, 1993).

The main muscles thought to facilitate SPT are the LT (lower trapezius) and SA (Serratus anterior) (Ebaugh, McClure, & Karduna,

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