Real-time visual feedback can be used to activate scapular upward rotators in people with scapular winging: an experimental study

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Question: Can real-time visual feedback facilitate the activity of serratus anterior in individuals with scapular winging during shoulder flexion? **Design:** Comparative, repeated-measures experimental study. **Participants:** Nineteen subjects with scapular winging. **Intervention:** Participants performed isometric shoulder flexion at 60° and 90° with and without real-time visual feedback using a video camera to monitor scapular winging. **Outcome measures:** Activity in the upper trapezius, lower trapezius, and serratus anterior muscles was measured using surface electromyography. A video motion analysis system measured the displacement of a marker attached to the acromion in the frontal and sagittal planes. **Results:** Visual feedback significantly increased activity in the upper trapezius at 60° of shoulder flexion by 2.3% of maximum voluntary isometric contraction (95% CI 0.7 to 4.0). Visual feedback also significantly increased activity in the serratus anterior at 60° and 90° of shoulder flexion, by 3.0% (95% CI 2.3 to 3.6) and 5.9% (95% CI 3.3 to 8.5) of maximum voluntary isometric contraction respectively. These effects equated to effect sizes from 0.29 to 0.46. Visual feedback also significantly improved movement of the acromion superiorly at 60° of shoulder flexion and anteriorly at 60° and 90° of shoulder flexion. **Conclusion:** Real-time visual feedback can be used to activate the upper trapezius and serratus anterior muscles and to improve movement of the scapula during shoulder flexion in people with scapular winging. **[Weon J-H, Kwon O-Y, Cynn H-S, Lee W-H, Kim T-H, Yi C-H (2011) Real-time visual feedback can be used to activate scapular upward rotators in people with scapular winging: an experimental study. *Journal of Physiotherapy* 57: 101–107]**

Key words: Electromyography, Scapular winging, Serratus anterior, Visual feedback

Introduction

Shoulder pain is a common problem. The incidence is 11.6 per 1000 person-years in Dutch general practice (Bot et al 2005), with reports of the prevalence in various populations ranging from 7% to 67% (Adebajo and Hazleman 1992, Cunningham and Kelsey 1984, Meyers et al 1982, Reyes Llerena et al 2000). Abnormal scapular position and movement are associated with shoulder pain and glenohumeral joint impingement syndrome (Cools et al 2003, Kibler 1998). Scapular dysfunction may arise from musculoskeletal factors – including sustained abnormal posture (Rempel et al 2007), repetitive movements that deviate from normal movement patterns (Madeleine et al 2008), or glenohumeral and scapulothoracic muscle imbalance (Cools et al 2004, Hallstrom and Karrholm 2006) – or from neurological abnormalities. Co-ordinated activation of the scapular upward rotators is essential for normal scapulohumeral rhythm.

and winging of the scapula (Ludewig and Cook 2000, Lukasiewicz et al 1999). In particular, over-activation of the upper trapezius and reduced activity in the lower trapezius and serratus anterior muscles during shoulder flexion may contribute to abnormal scapulohumeral rhythm and scapular winging (Cools et al 2004, Cools et al 2007, Ludewig and Cook 2000). Kendall and colleagues (1993) and Sahrmann (2002) also emphasise weakness of serratus anterior as an etiological factor for aberrant scapular mechanics.

Several pushup and wall sliding exercises have been developed for rehabilitation and in the sports field to activate serratus anterior (Hardwick et al 2006, Ludewig et al 2004). However, because the scapula is located behind the rib cage, it is not possible for the patient to monitor scapular movement visually during these exercises. Thus, for effective training of serratus anterior, the exercise must be supervised to ensure that the load applied to the upper limb is appropriate and does not cause scapular winging.