



Review

Analysis of scapular muscle EMG activity in patients with idiopathic neck pain: A systematic review



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ABSTRACT

It is proposed that altered scapular muscle function can contribute to abnormal loading of the cervical spine. However, it is not clear if patients with idiopathic neck pain show altered activity of the scapular muscles. The aim of this paper was to systematically review the literature regarding the differences or similarities in scapular muscle activity, measured by electromyography (=EMG), between patients with chronic idiopathic neck pain compared to pain-free controls. Case-control (neck pain/healthy) studies investigating scapular muscle EMG activity (amplitude, timing and fatigue parameters) were searched in Pubmed and Web of Science. 25 articles were included in the systematic review. During rest and activities below shoulder height, no clear differences in mean Upper Trapezius (=UT) EMG activity exist between patients with idiopathic neck pain and a healthy control group. During overhead activities, no conclusion for scapular EMG amplitude can be drawn as a large variation of results were reported. Adaptation strategies during overhead tasks are not the same between studies. Only one study investigated timing of the scapular muscles and found a delayed onset and shorter duration of the SA during elevation in patients with idiopathic neck pain. For scapular muscle fatigue, no definite conclusions can be made as a wide variation and conflicting results are reported. Further high quality EMG research on scapular muscles (broader than the UT) is necessary to understand/draw conclusions on how scapular muscles react in the presence of idiopathic neck pain.

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1. Introduction

Neck pain is a common complaint with a 12-month prevalence of 30–50% in the adult population (Hogg-Johnson et al., 2008). It is an important source of disability and several underlying mechanisms have been explored. A number of studies has highlighted the importance of the activity of the muscles around the neck/shoulder region. Most of these studies have focused on the cervical extensors and flexors in patients with neck pain (Cagnie et al., 2010; Falla et al., 2004b; Falla et al., 2004c; Nederhand et al., 2000; O'Leary et al., 2011). These studies have indicated that altered behavior between different muscle layers and between muscles of the upper and lower cervical regions may exist in patients with neck pain compared to healthy controls.

However, there is increasing research indicating that there is a broader involvement than only the cervical musculoskeletal system in mechanical neck pain. One muscle group that has gained specific interest is the scapular muscle group. A growing body of evidence supports the theory that the function of the scapula is important in normal neck function, and might be disturbed in patients with neck pain (Cagnie et al., 2014; Cools et al., 2014). The mobility and stability of the scapula is provided by the surrounding scapular muscular system, including Trapezius Muscle (=Trapezius M) (with the three different parts: Upper Trapezius M (UT), Middle Trapezius M (MT), Lower Trapezius M (LT)), the Serratus anterior M, the Levator Scapulae M, the Rhomboidei Muscles (=Rhomboidei Mm) and the Pectoralis Minor M (Kibler et al., 2013). Scapular muscles have the dual role of orientating the scapula while simultaneously transferring loads between the upper limbs and the vertebral column, including the cervical spine (Cools et al., 2014). Disturbances in the function of the scapular muscles can result in an increase of load on the cervical spine, as both the Trapezius and the Levator Scapulae span the cervical spine (Behrsin and Maguire, 1986). Compressive loading of the cervical spine can consequently increase the intradiscal pressure and zygapophyseal joint surface, which could introduce pain. Although a lot of research has already demonstrated alterations in scapular muscle activity in patients with shoulder pain (Cools et al., 2007, 2004; Diederichsen et al., 2009; Lin et al., 2011; Ludewig and Cook, 2000; Roy et al., 2008; Struyf et al., 2014), it is not clear if consistent alterations in muscle function can be identified in the scapular region in patients with neck pain. Moreover, the current body of studies does not enable to delineate if the altered muscle function is a source or a consequence of neck pain.

Different methods exist in order to evaluate muscle function. The most commonly used method by researchers and clinicians is surface electromyography (sEMG). Parameters that can be studied by EMG are amplitude, timing, conduction velocity, fatigability and characteristic frequencies/patterns (Schulte et al., 2006).

As an overview of possible differences or similarities in scapular muscle recruitment between patients with neck pain and healthy control subjects is currently lacking, the aim of this study is to systematically review and summarize the results of scapular muscle EMG activity in patients with chronic mechanical neck pain in comparison with healthy controls without neck pain.

2. Methods

2.1. Eligibility criteria

The search strategy was based on a combination of key words derived from the PICOS question (patients, intervention, comparison, outcome, study design). These were converted to possible Mesh-terms (between brackets) if available. The articles had to report the results of studies evaluating EMG activity of the scapular muscles (O) in patients with neck pain (P) compared to healthy controls (C). EMG outcome variables concerning amplitude, timing and fatigue were included in this review.

2.2. Information sources and search strategy

Two databases were consulted: Web of Science (WOS) and MEDLINE database (PubMed). The search strategy was based on a combination of the following Mesh-terms or free-text words: ("Neck Pain"[Mesh] OR "Neck Injuries"[Mesh]) AND ("Electromyography"[Mesh] OR EMG) AND (Trapezius OR "Serratus anterior" OR "Pectoralis Minor" OR "Levator Scapulae" OR Rhomboid OR "Scapular muscles"). The search was developed by the first author. The last search was run on 26/5/2014. In addition, hand-searching was performed by looking to relevant studies that were cited in other studies.

2.3. Study selection

Selection criteria had to be fulfilled to be included in the review (see Table 1).

Eligibility assessment was performed independently in a blinded standardized manner by 2 assessors. In the first phase

Table 1

Inclusion and exclusion criteria.

Inclusion criteria
(1) Concerning patients with neck pain
(2) Concerning following parameters measured by EMG:
Analysis in time domain:
• Amplitude analysis: mean amplitude (Root Mean Square (RMS), Average Rectified Value (ARV))
• Timing analysis: onset of muscle activity, duration of muscle activity
Analysis in frequency domain:
• Spectral analysis: Mean Power Frequency (MPF), Median Power Frequency (MDF)
(3) Concerning at least one of the following scapular muscles: Trapezius (Upper, Middle or Lower Part), Serratus Anterior, Levator Scapulae, Rhomboids, Pectoralis Minor
(4) Comparison between cases and controls
(5) Full text available
Exclusion criteria
(1) Specific pathology (fibromyalgia, cancer, whiplash associated disorders)
(2) Studies concerning treatment outcome
(3) Reviews, systematic reviews or meta-analyses
(4) Articles with high risk of bias (methodological quality below 50%)

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