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Systematic review

Is thoracic spine posture associated with shoulder pain, range of motion and function? A systematic review

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ABSTRACT

Introduction: Excessive thoracic kyphosis is considered a predisposing factor for shoulder pain, though there is uncertainty about the nature of the relationship between shoulder pain and thoracic spine posture. The aim of this systematic review was to investigate the relationship between thoracic kyphosis and shoulder pain, shoulder range of motion (ROM) and function.
Methods: Two reviewers independently searched eight electronic databases and identified relevant studies by applying eligibility criteria. Sources of bias were assessed independently by two reviewers using a previously validated tool (Ijaz et al., 2013). Data were synthesised using a level of evidence approach (van Tulder et al., 2003).
Results: Ten studies were included. Four studies were rated as low risk of bias, three at moderate risk of bias and three at high risk of bias. There is a moderate level of evidence of no significant difference in thoracic kyphosis between groups with and without shoulder pain. One study at high risk of bias demonstrated significantly greater thoracic kyphosis in people with shoulder pain ($p < 0.05$). There is a strong level of evidence that maximum shoulder ROM is greater in erect postures compared to slouched postures ($p < 0.001$), in people with and without shoulder pain.
Conclusions: Thoracic kyphosis may not be an important contributor to the development of shoulder pain. While there is evidence that reducing thoracic kyphosis facilitates greater shoulder ROM, this is based on single-session studies whose long-term clinical relevance is unclear. Higher quality research is warranted to fully explore the role of thoracic posture in shoulder pain.

1. Introduction

Shoulder pain is a common musculoskeletal condition and is often associated with substantial morbidity, with a third of patients demonstrating persisting restriction of movement, loss of function and/or pain after one year (Reilingh et al., 2008; Greving et al., 2012). The most common source of shoulder pain reported in clinical practice is subacromial pain (van der Windt et al., 1995). Subacromial pain syndrome (SAPS) has been described as non-traumatic shoulder pain, localised around the acromion, which worsens during or subsequent to lifting the arm (Lewis, 2011). Due to the limited diagnostic accuracy of clinical tests (Lewis, 2009), SAPS has been adopted as an overarching term encompassing subacromial impingement, bursitis and rotator cuff (RC) tendinopathy (Lewis, 2011; Diercks et al., 2014; Engebretsen et al., 2009). The pain and limitation of shoulder movement associated with shoulder pain may reduce shoulder function and health-related quality of life (Duckworth et al., 1999; Smith et al., 2000; MacDermid et al., 2004).

The role of the thoracic spine in shoulder mechanics has been investigated. Previous studies have demonstrated that approximately 15° of thoracic extension mobility is required for full bilateral shoulder flexion, in both younger and older populations (Crawford and Jull, 1993). Other research suggests that full unilateral arm elevation requires approximately 9° of thoracic extension (Stewart et al., 1995). Thoracic hyperkyphosis, an angulation of the thoracic spine of greater than 40° (Greendale et al., 2011) or 50° (Willner, 1981; Teixeira and Carvalho, 2007), has been implicated as a contributing factor to shoulder pain (Grimsby and Gray, 1997).

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Crawford and Jull demonstrated that older adults with a large thoracic kyphosis had reduced arm elevation (Crawford and Jull, 1993). A recent cross sectional study involving 525 volunteers compared the prevalence of rotator cuff tears across four postural classifications; ideal alignment, kyphotic-lordotic posture, flat-back posture and sway-back posture (Yamamoto et al., 2015). This study reported that the prevalence of rotator cuff tears, diagnosed using ultrasound, was lowest in the ideal posture at 2.9% and highest in the kyphotic-lordotic posture at 65.8%, which points towards a posture-impairment model.

Several hypotheses have been proposed to describe the mechanisms by which thoracic hyperkyphosis effects the shoulder. Firstly, it has been postulated that a small increase in thoracic kyphosis is associated with a more elevated and anteriorly tilted resting position of the scapula in pain-free participants (Culham and Peat, 1993; Kebaetse et al., 1999). As a result, the acromion may be in a more inferior and anterior position, hypothetically reducing the subacromial space (Solem-Bertoft et al., 1993; Borstad, 2006). An additional hypothesis suggests that thoracic spine curvature may influence the shoulder girdle through muscular attachments (Michener et al., 2003) and by altering the length-tension relationship of the muscles attached to the scapula (Grimsby and Gray, 1997). The evidence to support these hypotheses is scant and investigations of the relationship of thoracic kyphosis with the shoulder girdle have been largely conducted in pain-free populations.

The impingement model of the shoulder has been widely challenged in recent research with a variety of other mechanisms such as mechanical overload or lifestyle factors purported to be important in the development of shoulder pain (Lewis, 2011; Lewis et al., 2015). In addition, a recent systematic review concluded that there is insufficient evidence for the role of scapula orientation in SAPS (Ratcliffe et al., 2014). This leaves considerable uncertainty concerning the relationship between spinal posture and shoulder pain. The aim of this systematic review is to establish the current level of evidence regarding the relationship between thoracic kyphosis and shoulder pain, function and range of motion (ROM). The specific research questions are:

1. Is there a difference in thoracic kyphosis between groups with and without shoulder pain?
2. What is the effect of changing thoracic kyphosis on shoulder pain, function and ROM in people with or without shoulder pain?

2. Methods

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Liberati et al., 2009) and was registered with PROSPERO (ID: CRD42015024834).

2.1. Identification and selection of studies

An electronic search was conducted by two reviewers (EB, MOK) in July 2015 using the following databases: Medline, CINAHL, AMED, SPORTDiscus, PsycINFO, PsycARTICLES, General Science and Biomedical Reference Collection. A combination of three search lines was used;

("shoulder" OR "glenohumeral") [Title/Abstract] AND ("range" OR "movement" OR "motion" OR "pain" OR "function*" OR "disability" OR "symptom*" OR "dyskinesi*") [Title/Abstract] AND ("spin*" OR "alignment" OR "hyperkypho*" OR "kypho*" OR "postur*" OR "orientation" OR "biomechanic*" OR "curv*" OR "thora*") [Title/Abstract].

Two reviewers (EB, MOK) independently screened the title and abstract of each article, followed by the full texts of those deemed potentially relevant, applying the eligibility criteria. Inclusion and exclusion criteria are displayed in Table 1. Both observational and experimental studies were eligible for inclusion. The reference lists of the included studies were manually searched for other relevant studies.

2.2. Assessment of risk of bias

Sources of bias were assessed independently by two reviewers (EB, MOK) using a standardised checklist of 10 criteria (Ijaz et al., 2013) which was validated for use in observational studies (Shamliyan et al., 2010). Each item was rated as a low, high or unclear risk of bias. The 10 items were divided into two hierarchical groups (Ijaz et al., 2013). The group with the major items of bias included exposure definition, exposure assessment, reliability of exposure assessment, analysis bias and confounding factors. The remaining five items were considered as minor domains: attrition, blinding of assessors, selective reporting, funding and conflict of interest. Studies were considered as low risk of bias if they had low risk in all major domains and $\geq$2 of the minor domains, moderate risk of bias if they had low risk of bias in $\geq$4 major and 2 minor domains, or high risk of bias if they had low risk of bias in <4 major domains (Ijaz et al., 2013).

For the purpose of this review, the exposure was considered to be thoracic kyphosis. Therefore, to be scored as a low risk of bias in the domain of exposure definition, the level of spinous processes where measurement was taken was required to be stated. To be scored as low risk of bias in the domain of exposure assessment, the study must have used an objective measurement of thoracic kyphosis, thereby providing a thoracic kyphosis angle. To be scored as low risk of bias in the domain of reliability exposure assessment, the reliability of the measurement tool must have been stated, either by measuring the tool's reliability in a pilot study or providing reference to its previously established level of reliability. To be scored as low risk of bias in the domain of confounders, between group comparisons of thoracic kyphosis must contain samples of similar gender and age, as these variables influence thoracic kyphosis angle (Fon et al., 1980). The remaining six domains were rated as previously recommended (Ijaz et al., 2013).

2.3. Data analysis

One reviewer (EB) extracted data relating to the study design, study population, postures used and outcome measures related to shoulder pain, range of motion and/or function. Variation in the study designs, study population and outcome measures used did not permit the pooling of data in a meta-analysis. Data were synthesized using a level of evidence approach (van Tulder et al., 2003), taking into account the risk of bias, the design of the study and the outcomes of the included studies. Definitions for levels of evidence are outlined in Table 2.

3. Results

3.1. Flow of trials through the review

Fig. 1 details the flow of studies through the review process. A total of ten studies involving 2794 participants were included in the review.