

The Relationship Between the Thoracic Spine and Shoulder Impingement Syndrome



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Acknowledgement of Authorship

I hereby certify that the work embodied in this thesis contains published papers/scholarly work of which I am a joint author. I have included as part of the thesis a written declaration endorsed in writing by my supervisor, attesting to my contribution to the joint publication/scholarly work.

By signing below, I confirm that Donald Hunter contributed to the concept and research design, acquisition of data, analysis and interpretation of data, as well as writing, reviewing and editing of the publications entitled:

- **Hunter DJ**, Rivett DA, McKiernan S, Weerasekara I, Snodgrass SJ. Is the inclinometer a valid measure of thoracic kyphosis? A cross-sectional study. *Brazilian Journal of Physical Therapy*. 2018; 22(4): 310-317. Doi: 10.1016/j.bjpt.2018.02.005
- **Hunter DJ**, Rivett DA, McKeirnan S, Smith L, Snodgrass SJ. Relationship between shoulder impingement syndrome and thoracic posture. *Physical Therapy* 2020; 100(4): 677-686. Doi: 10.1093/ptj/pzz182
- **Hunter DJ**, Rivett DA, McKiernan S, Snodgrass SJ. Acromiohumeral distance and supraspinatus tendon thickness in people with shoulder impingement syndrome compared to asymptomatic age and gender-matched participants: a case control study. *BMC Musculoskeletal Disorders*. 2021 22(1): 1004. Doi: 10.1186/s12891-021-04885-3

- **Hunter DJ**, Rivett DA, McKiernan S, Luton R, Snodgrass SJ. Thoracic manual therapy improves pain and disability in individuals with shoulder impingement syndrome compared to placebo: a randomised controlled trial with one year follow-up. *Archives of Physical Medicine and Rehabilitation*, 103(8), 1533-1543. Doi: 10.1016/j.apmr.2022.03.003

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Publications, Presentations and Coursework Included as Part of this Thesis

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- **Hunter DJ**, Rivett DA, McKiernan S, Weerasekara I, Snodgrass SJ. Is the inclinometer a valid measure of thoracic kyphosis? A cross-sectional study. *Brazilian Journal of Physical Therapy*. 2018; 22(4): 310-317. Doi: 10.1016/j.bjpt.2018.02.005
- **Hunter DJ**, Rivett DA, McKeirnan S, Smith L, Snodgrass SJ. Relationship between shoulder impingement syndrome and thoracic posture. *Physical Therapy* 2020; 100(4): 677-686. Doi: 10.1093/ptj/pzz182
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- **Hunter DJ**, Rivett DA, McKiernan S, Luton R, Snodgrass SJ. Thoracic manual therapy improves pain and disability in individuals with shoulder impingement syndrome compared to placebo: a randomised controlled trial with one year follow-up. *Archives of Physical Medicine and Rehabilitation*, 103(8), 1533-1543. Doi: 10.1016/j.apmr.2022.03.003

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- **Hunter D**, Rivett DA, McKiernan S, Snodgrass S. Relationship between shoulder impingement syndrome and the thoracic posture. 30 minute presentation at Osteopathy Australia Conference, Cairns, October 2018.
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- **Hunter D**, Snodgrass S, Rivett DA, McKiernan S. Shoulder impingement syndrome: Is there a relationship with subacromial space? Australasian Sonography Association. Sydney 2018. *Awarded Best ePoster prize.*
- **Hunter D**, Rivett D, Snodgrass S, McKiernan S. Reliability of modified Cobb angle measurements. 22nd Asia-Australasia Conference of Radiological Technologists (AACRT 2019) and 14th Annual Scientific Meeting of Medical Imaging and Radiation Therapy (ASMMIRT), Adelaide, 28-31 March 2019.
- **Hunter D**, Snodgrass S, Weerasekara I, Rivett DA, McKiernan S. Thoracic Kyphosis: The Modified Cobb Angle and Inclinator Measurement. Australian Society of Medical Imaging and Radiation Therapy. Canberra 2018.
- **Hunter D**, Snodgrass S, Buxton A, Rivett DA, McKiernan S. Shoulder impingement syndrome and acromio-humeral distance; is there a relationship? Australasian Sonography Association. Brisbane 2017.
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Abstract

Background

Shoulder pain is a common and costly problem. Shoulder impingement syndrome (SIS) is the most common form of shoulder pain and becomes more prevalent with age. Conservative and invasive treatments, aimed at the shoulder joint, offer limited benefit. Research suggests shoulder function is related to thoracic posture. However, it is unknown if thoracic posture is associated with SIS or if manual therapy interventions to the thoracic spine would reduce the symptoms of SIS.

Purpose

To investigate a) if there is an association between thoracic posture and SIS (case-control study), b) whether there are anatomical and/or structural differences between individuals with SIS compared to individuals with no shoulder symptoms (case-control study), c) the validity of a clinical measure for thoracic posture using an inclinometer, d) whether a manual therapy intervention (muscle energy technique) applied to the thoracic spine improves the pain and disability associated with SIS (randomised controlled trial).

Methods

The case-control study measured the thoracic posture and range of motion (ROM) of 39 participants with SIS (age \geq 40 years) and 39 age, sex and dominant arm matched controls using the modified Cobb angle from a standing lateral radiograph and an

inclinometer. Between-group differences for the acromiohumeral distance (AHD) and supraspinatus tendon thickness (STT), measured using ultrasound, were obtained from SIS participants and matched controls. To determine validity of the clinical measure of thoracic kyphosis using a gravity-dependent inclinometer, it was compared with the modified Cobb angle results from standing lateral radiographs (the gold standard). A randomised controlled trial with placebo investigated the effectiveness of muscle energy technique (MET) applied to the thoracic spine and MET + soft tissue massage to the shoulder in participants with SIS aged ≥ 40 years. Outcome measures were disability (Disabilities of the Arm, Shoulder and Hand (DASH /100) questionnaire), pain (visual analogue scale (VAS mm/100)) and thoracic posture and ROM. Pain and disability outcome measures were recorded at baseline, discharge, 4-weeks, 6-months and 12-months follow-up. Thoracic posture and ROM measurements using an inclinometer were recorded at baseline and discharge.

Results

Individuals with SIS had a significantly greater thoracic kyphosis (mean difference = 6.2° , 95% CI 2.0, 10.4) and decreased thoracic spine extension ROM (mean difference = 7.8° , 95% CI 2.2, 13.4) as compared to matched asymptomatic controls. Linear regression modelling indicated that as thoracic kyphosis increased, thoracic spine extension ROM decreased. Compared to controls, individuals with SIS had a significantly larger AHD (mean difference = 2.14mm, 95% CI 1.21, 3.07) and STT (mean difference = 1.25mm, 95% CI 0.60, 1.90). Linear regression indicated an association between AHD and STT, suggesting that as the STT increased in size, so did the AHD.

The thoracic kyphosis angle obtained from inclinometer measurements was linearly related to, and had good agreement with, the modified Cobb angle measured from a lateral radiograph.

MET to the thoracic spine demonstrated significantly greater improvement in pain and disability (DASH, VAS 7-day average) compared to placebo at discharge (mean difference DASH = -8.4; 95% CI -14.0, -2.8; VAS = -15.5; 95% CI -24.5, -6.5), 6 - months (DASH = -11.1; 95% CI -18.6, -3.7; VAS = -14.1; 95% CI -26.0, -2.2) and 12 - months (DASH = -13.4; 95% CI -23.9, -2.9; VAS = -17.3; 95% CI -30.9, -3.8). There was no additional benefit from adding soft tissue massage and no differences between groups in thoracic posture or ROM at discharge.

Conclusions

Individuals with SIS had a greater thoracic kyphosis, less extension ROM, a larger AHD and greater STT than age and sex-matched asymptomatic controls. MET to the thoracic spine significantly reduced the pain and disability associated with SIS for up to one year after treatment. Therefore, management of SIS in patients aged 40 years and older should consider including manual therapy to the thoracic spine. These findings provide evidence that there is an association between the thoracic spine and SIS, and that treatments to the thoracic spine are effective in reducing the pain and disability associated with SIS.