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Research Paper Review

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The Effects of Thoracic Spine Manipulation in Subjects with Signs of Rotator Cuff Tendinopathy

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ABSTRACT

STUDY DESIGN: Controlled laboratory study.

OBJECTIVES: To assess scapular kinematics and electromyographic signal amplitude of the shoulder musculature, before and after thoracic spine manipulation (TSM) in subjects with rotator cuff tendinopathy (RCT). Changes in range of motion, pain, and function were also assessed.

BACKGROUND: There are various treatment techniques for RCT. Recent studies suggest that TSM may be a useful component in the management of pain and dysfunction associated with RCT.

METHODS: Thirty subjects between 18 and 45 years of age, who showed signs of RCT, participated in this study. Changes in scapular kinematics and muscle activity, as well as changes in shoulder pain and function, were assessed pre-TSM and post-TSM using paired t tests and repeated-measures analyses of variance.

RESULTS: TSM did not lead to changes in range of motion or scapular kinematics, with the exception of a small decrease in scapular upward rotation ($P = .05$). The only change in muscle activity was a small but significant increase in middle trapezius activity ($P = .03$). After TSM, subjects demonstrated decreased pain during performance of the Jobe empty-can (mean ± SD change, 2.6 ± 1.1), Neer (2.6 ± 1.3), and Hawkins-Kennedy (2.8 ± 1.3) tests (all, $P<.001$). Subjects also reported decreased pain with shoulder flexion (mean ± SD change, 2.0 ± 1.5; $P<.001$) and improved shoulder function (force production, 2.5 ± 1.4 kg; Penn Shoulder Score, 7.7 ± 9.4; sports/performing arts module of the Disabilities of the Arm, Shoulder and Hand questionnaire, 16.4 ± 13.2) (all, $P<.001$).

CONCLUSION: Immediate improvements in shoulder pain and function post-TSM are not likely explained by alterations in scapular kinematics or shoulder muscle activity. For people with pain associated with RCT, TSM may be an effective component of their treatment plan to improve pain and function. However, further randomized controlled studies are necessary to better validate this treatment approach.

LEVEL OF EVIDENCE: Therapy, level 4.

ANALYSIS

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Background Information

Rotator cuff tendinopathy (RCT) is a common cause of shoulder pain that frequently occurs together with symptoms of shoulder impingement. Several possible underlying pathologies may lead to shoulder impingement, including altered scapular kinematics, faulty posture, glenohumeral posterior shoulder tightness, acromial arch abnormalities, shoulder instability, rotator cuff weakness, and motor control deficits.

Owing to the multiple possible causes of RCT, a variety of treatment approaches are utilized, including thoracic spine manipulation (TSM). Studies by Boyles et al. (1) and Strunce et al. (2) showed that TSM produced immediate decreases in pain and improved function in persons with shoulder impingement. However, these studies were not entirely convincing because no control groups were included for comparison.

While it appears that TSM may be beneficial in the treatment of RCT, the mechanisms that bring about these changes are not well understood. It has been suggested that manipulative forces may give rise to biomechanical along with neurophysiologic changes that result in reduced shoulder symptoms, though little or no research is available to back up these statements. On the other hand, it has been shown that scapular kinematics frequently play a role in shoulder dysfunction and that altered scapular mechanics are commonly seen in RCT patients.

Because of the abnormalities in posture, kinematics and muscle activation that are commonly seen in RCT patients, the authors hypothesized that TSM may improve the pain and dysfunction associated with RCT via changes in:

- Thoracic spine posture,
- shoulder motion,
- scapular kinematics, and
- shoulder muscle activation.

The purpose of this study was to explore biomechanical and neurophysiologic mechanisms that occur subsequent to TSM that might result in changes in RCT patients' pain and function by assessing changes in scapular kinematics and muscle activity.

PERTINENT RESULTS

- Fifty-eight percent of the subjects (38 out of 65) had radicular pain.
- Following TSM, there were significant improvements in pain with performance of all provocative tests for rotator cuff pathology, as well as with loaded arm elevation in all 3 planes.
- Significant improvements were also observed in force production with elevation in the scapular plane following TSM, as well as scores on the Penn Shoulder Score (PSS) and the sports/performing arts module of the Disabilities of the Arm, Shoulder and Hand (SPAM-DASH) that were observed 7 to 10 days following TSM (improved by 7.6 points and 22.0 points, respectively).
- There was a small but significant decrease in scapular upward rotation with humerothoracic elevation following TSM. Also, there was a significant interaction between condition and elevation angle for clavicular elevation, although post hoc t-tests revealed no significant difference in clavicular elevation at any of the tested angles of humerothoracic elevation.
- A statistically significant, albeit small, increase in middle trapezius surface EMG activity was detected following TSM. However, no changes were detected for the upper/lower trapezius, infraspinatus, or serratus anterior muscles.
- No differences were observed for scapular posterior tilt, scapular external rotation, clavicular protraction, cervical rotation ROM, thoracic spine ROM, or humerothoracic elevation ROM.

CLINICAL APPLICATION & CONCLUSIONS

While this study showed that TSM may improve pain and abnormal function associated with RCT, the improvements are not likely explained by changes in scapular kinematics or shoulder muscle activity.

The authors suggested that the observed improvements in pain and function were probably explained by other yet to be determined neurophysiologic processes. They suggest that future studies on TSM for RCT should focus on assessing altered neuromotor control and segmental spine kinematics, in addition to changes in pain perception.

Because of various limitations, this study represents a low level of evidence for using TSM in patients with RCT, although it does lend support for the use of the procedure in conjunction with other evidence-based modalities.

An interesting finding of this study that was discovered during post-hoc analysis is that decreases in pain were not dependent on cavitation. Average decreases in subjects' pain with provocative testing ranged from 2.4 to 3.0, regardless of whether cavitation occurred.

STUDY METHODS

Subjects with symptoms of RCT were recruited from local universities, rowing clubs, and master's swim clubs. Sixteen men and 14 women that averaged 30.6 years-of-age participated in the study.

The subjects were included in the study if they showed signs of rotator cuff pathology on screening by means of the Hawkins-Kennedy, Neer, or Jobe empty-can tests for shoulder impingement. Also, they had to have at least 3 out of 10 on the numeric pain rating scale (NPRS).

The exclusion criteria were as follows:

- Previous shoulder surgery
- Signs of complete rotator cuff tear
- History of spinal trauma or surgery
- Signs of neurologic impairment
- Degenerative bone disease
- Rheumatic disease
- Allergies to adhesives
- Those at risk for osteopenia or osteoporosis

Scapular motion was measured before and immediately after TSM using an electromagnetic tracking device.

Surface EMG data were collected for the infraspinatus, upper trapezius, middle trapezius, lower trapezius, and serratus anterior muscles.

Pain before and immediately after TSM was assessed using an 11-point NPRS, where 0 represents no pain and 10 represents the worst pain ever. The patients rated their pain while performing the Jobe empty-can, Hawkins-Kennedy, and Neer tests, as well as during loaded humeral elevation in the frontal, scapular, and sagittal planes.

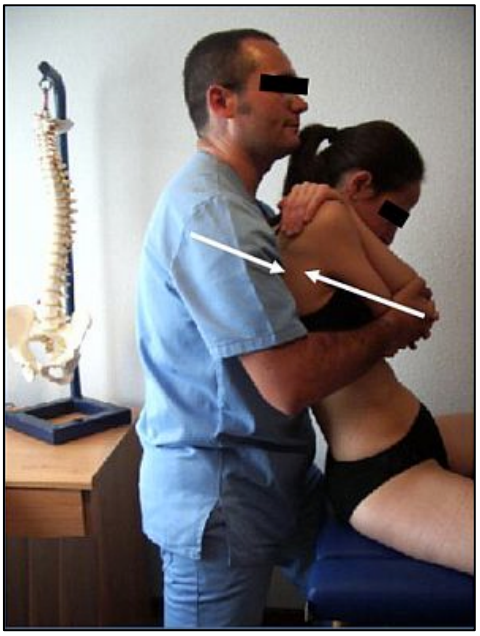
Peak shoulder elevation force was assessed by means of a "break test" before and immediately after TSM using an ergoFET handheld dynamometer.

Shoulder pain and function were measured pre-manipulation and 7 to 10 days post-manipulation using 2 different self-report scales:

1. The Penn Shoulder Score (PSS); and
2. the Sports/Performing Arts Module of the Disabilities of the Arm, Shoulder and Hand (SPAM-DASH).

Before and after TSM range of motion assessments included cervical rotation, thoracic spine flexion/extension, and humeral elevation.

Mid- and upper- thoracic spine thrust-type manipulations were delivered with the therapist standing behind the seated patients (see picture below). The therapist pressed her sternum against the area to be mobilized, then wrapped her arms around the subject and instructed him or her to take a deep breath and then exhale. The therapist then squeezed the subject's upper body and at the same time lifted the subject slightly. The upper-thoracic manipulation was performed similarly, but with the patient's fingers interlocked behind the neck and the therapist's arms threaded through the subject's arms to enable a sternal contact that was higher in the thoracic spine. If no cavitation was detected, one more attempt was made before moving on to the next step.



The data analyses comprised of t-tests which compared before and after ROM, pain during provocation testing and ROM, force production, as well as scores on the PSS and SPAM-DASH scales. In addition, 2-factor repeated-measures analysis of variance was used to determine interactions between the effects of condition (pre-TSM and post-TSM) and degree of humerothoracic elevation for each of the 5 dependent kinematic variables and the 5 dependent EMG variables.

STUDY STRENGTHS/WEAKNESSES

This was a well-conducted study that sheds some light on the relationship between thoracic spine function and RCT. However, there are some limitations that prevent drawing firm conclusions. These include the fact that it was not a randomized trial, there was no control or comparison group, and incomplete blinding was employed.

The main problem with the way blinding was carried out is that the examiner also performed the TSM, so ROM assessment may have produced biased results. However, ROM measurements were obtained via an electromagnetic tracking device, which likely prevented the examiner from influencing the results.

There were also limitations to the way spinal ROM was assessed, as outlined below:

- Thoracic rotation was not restricted during performance of cervical rotation, even though cervical ROM was assessed in relation to the thorax.
- Segmental thoracic motion was not assessed; rather it was only assessed in relation to the global coordinate system.
- The method of measuring thoracic motion that was used has not been validated.

An additional study limitation is that the subjects were physically active and were on average young. Thus, one should be cautious when comparing the results of this study with other populations.

Additional References:

1. Boyles RE, Ritland BM, Miracle BM et al. The short-term effects of thoracic spine thrust manipulation on patients with shoulder impingement syndrome. Man Ther 2009; 14: 375-380.
2. Strunce JB, Walker MJ, Boyles RE, Young BA. The immediate effects of thoracic spine and rib manipulation on subjects with primary complaints of shoulder pain. J Man Manip Ther 2009; 17: 230-36.
3. Andres BM, Murrell GA. Treatment of tendinopathy: what works, what does not, and what is on the horizon. Clin Orthop Relat Res 2008; 466: 1539-54.

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