Subacute effects of cervicothoracic spinal thrust/non-thrust in addition to shoulder manual therapy plus exercise intervention in individuals with subacromial impingement syndrome: a prospective, randomized controlled clinical trial pilot study

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ABSTRACT

Objectives: To determine the subacute effects of cervicothoracic spinal thrust/non-thrust in addition to shoulder non-thrust plus exercise in patients with subacromial pathology.

Methods: This was a randomized, single blinded controlled trial pilot study. This trial was registered at ClinicalTrials.gov (NCT01753271) and reported according to Consolidated Standards of Reporting Trials requirements. Patients were randomly assigned to either shoulder treatment plus cervicothoracic spinal thrust/non-thrust or shoulder treatment-only group. Primary outcomes were average pain intensity (Numeric Pain Rating Scale) and physical function (Shoulder Pain and Disability Index) at 2 weeks, 4 weeks, and patient discharge.

Results: 18 patients, mean age 43.1 (15.8) years satisfied the eligibility criteria and were analyzed for follow-up data. Both groups showed statistically significant improvements in both pain and function at 2 weeks, 4 weeks, and discharge. The between-group differences for changes in pain or physical function were not significant at any time point.

Discussion: The addition of cervicothoracic spinal thrust/non-thrust to the shoulder treatment-only group did not significantly alter improvement in pain or function in patients with subacromial pathology. Both approaches appeared to provide an equally notable benefit. Both groups improved on all outcomes and met the criteria for clinical relevance for both pain and function.

Level of Evidence: 2b.

KEYWORDS

Manual therapy; subacromial impingement syndrome; randomized controlled trial

Introduction

Shoulder pain accounts for nearly one-third of primary care office visits for musculoskeletal pain in the United States [1] with an annual prevalence greater than 50% in the general population [2]. Subacromial impingement and/or rotator cuff tendinopathy, henceforth referred to as subacromial pathology, is the most common shoulder condition in orthopaedic medicine [1,3–5]. Subacromial pathology is a complex disorder with a multifactorial etiology including intrinsic degenerative changes in the bones and soft tissues surrounding the glenohumeral joint, decreased anatomical suprahumeral space, and/or altered scapular or humeral position [6–9]. Individuals with subacromial pathology often exhibit deficiencies in rotator cuff strength, limited flexibility of the posterior shoulder structures and other soft tissue restriction, [10] scapular muscle strength disparities, [11–14] and altered scapular kinematics [3,15–20] all of which may contribute to activity restrictions. Given the complex nature of

subacromial pathology multimodal intervention programs including therapeutic exercise, manual therapy, and home exercise has been advocated [10,21–23] with treatments matched to individual impairments and functional limitations. Recently, a staged approach to shoulder rehabilitation has been advocated based on patient symptom irritability combined with pathoanatomic considerations as means to diagnose and approach treatment [24]. This approach may provide additional guidance in treating this challenging shoulder condition, however, specific details regarding the optimal timing, inclusion and dosing of interventions to most effectively treat subacromial pathology have yet to be defined.

Two recent systematic reviews evaluating treatments for subacromial pathology have indicated that manual therapy (generally defined for treatments targeting both spinal joints and the shoulder girdle), alone or combined with other treatments, may improve pain yet functional improvements were not apparent [25]. Exercise therapies

alone were demonstrated to improve both pain and functional disability across trials [26]. Despite these reviews, there are few studies which have evaluated the influence of spinal manual therapies in addition to targeted shoulder girdle treatment (usual care) compared to usual care alone in patients presenting with subacromial pathology. Bergman et al. [27] have reported that patients with subacromial pathology who received manipulative therapy (thrust/non-thrust) of the cervicothoracic spine and ribs in addition to exercise demonstrated statistically significantly greater reported full recovery rates than patients in the control group at 26 weeks. However, in this study manipulative therapies were only 16% of all treatment sessions and included techniques applied to shoulder girdle or vertebral joints [27]. In a large pragmatic trial, Cook and colleagues [23] evaluated the role of cervical spine non-thrust only (grade III) and exercise on patients with subacromial pathology compared to treatments directed to the shoulder alone. Both groups improved in pain and disability over the course of treatment yet no between-group differences were noted. These equivalent outcomes were reported acutely and at discharge from physical therapy. This equivalence may have been due to the lack of cervical spine symptoms of shoulder patients in this study. Rhon et al. [28] have also evaluated long-term outcomes of pain and disability in a large group of patients with subacromial pathology when comparing the role of manual physical therapy to the shoulder girdle or cervicothoracic spine compared to subacromial corticosteroid injection. No difference in one-year outcomes existed between groups, however, the manual physical therapy group received less follow-up care over that time than the injection group [28].

The theory that dysfunction of one body part imparts dysfunction on another, or regional interdependence, has been suggested as the clinical rationale for the use of cervicothoracic spinal manipulation in patients with upper extremity disorders [29,30]. Immediate effect studies support the theory of regional interdependence between the cervicothoracic spine and shoulder pain and function [31–33]. However, these studies are limited in their ability to determine a cause and effect relationship between manual therapy interventions and outcomes. This may be due to the role of both biomechanical and neurophysiologic mechanisms impacting shoulder pain and function [30,34]. The roles and potential benefits of manual therapy to the cervicothoracic spine in the treatment of subacromial pathology remains to be determined despite what is already known about this topic, especially in terms of benefits beyond immediate effects. The purpose of this pilot study was to investigate whether treatment directed at the cervicothoracic spine (including thrust and non-thrust techniques) and shoulder is more beneficial than treatment directed solely at the shoulder for patients with clinical diagnosis of subacromial impingement syndrome (SIS).

It was hypothesized that patients receiving spinal manual therapy in addition to shoulder-specific treatments would exhibit greater improvements than shoulder interventions alone.

Methods

This was a randomized, single blinded, controlled pilot study. The study was approved by the High Point University Institutional Review Board (#201208-122) and complies with the Declaration of Helsinki. All patients provided written informed consent prior to their enrollment in the study. This trial was registered at ClinicalTrials.gov (NCT01753271) reported according to Consolidated Standards of Reporting Trials (CONSORT) requirements.

Consecutive patients, aged 18 and older, with a referral for subacromial pathology, who attended care at a physiotherapy outpatient or academic physiotherapy setting, were scheduled and screened for eligibility during their initial visit by treating physiotherapists. For patients to meet inclusion criteria, each was required to meet two of three positive tests for the diagnosis of SIS which included: (1) Hawkins–Kennedy Impingement sign; (2) painful arc sign; and (3) weakness in external rotation with the arm at the side. Park et al. [14] has shown a post-test probability of >90% for SIS when two of three tests were positive. Exclusion criteria included the presence of any red flags; previous shoulder surgery; fracture; current oral steroid use; steroid or analgesic injection in the past 3 months; cervicothoracic joint referral; neurological symptoms and/or sinister pathology; and misdiagnosed shoulder pathology. All patients underwent a cervical spine screen and if shoulder pain was reproduced with the cervical screen, they were excluded as we felt this was not indicative of isolated SIS. Chronicity of symptoms was not specified as inclusion or exclusion criteria.

After signing informed consent, all patients provided a history, underwent a physical examination, and completed a number of self-report measures at baseline. The historical items included questions pertaining to age, gender, height and weight, duration of symptoms, mechanism of injury, educational level, and employment status. The physical examination consisted of items routinely used in the physical therapy examination and included functional assessment, range of motion (ROM), strength testing, passive accessory motions, and provocation tests of the shoulder joint. The physical examination items were used to further determine the level of irritability and tolerance to manual therapy techniques and to identify specific strength deficits. Details regarding treatment frequency, prognosis, duration, and discharge planning were not standardized for this study but were chosen by the treating physiotherapist in line with the pragmatic nature of the trial.

Outcome measures

Patients completed all outcome measures at baseline, 2 weeks, 4 weeks, and at patient discharge. Primary outcomes included the Shoulder Pain and Disability Index (SPADI) for function, and the Numeric Pain Rating Scale (NPRS) for pain. The SPADI tool consists of five statements related to pain and eight statements related to shoulder function [35]. Participants score their ability to perform these tasks using a Likert scale with choices ranging from 0 (no pain or disability) to 10 (worst pain imaginable or so difficult it requires help). Scoring consists of creating a percentage of pain and disability with higher scores indicating more severe limitation. Patient data from the SPADI has been reported as reliable and valid [36]. The minimal detectable change of the SPADI has been reported as 18 points with the minimal clinically important difference (MCID) ranging between 8 and 13 points [37]. Pain intensity was measured by asking patients regarding their pain levels over the past 24 h using an 11-point NPRS, for which 0 represented no pain and 10, the worst imaginable pain. Numeric pain scales have been shown to be reliable and valid [38]. Minimal detectable change has been reported as 2.5 points with a MCID of 1.1 points [39].

Secondary outcomes included self-reported Fear Avoidance Beliefs Questionnaire (FABQ); shoulder active ROM (flexion, abduction, internal rotation, external rotation); and the test of resistance. The FABQ consists of two subscales including the physical activity subscale (items 1–5) and the work subscale (items 6–16). Each subscale is graded separately by summing the responses respective scale items (0–6 for each item); for scoring purposes only 4 of the physical activity scale items are scored (24 possible points) and only 7 of the work items (42 possible points) with increasing scores indicating greater levels of fear-avoidance behavior. The FABQ has been shown to be reliable and valid among shoulder injured participants [40]. Fear-avoidance behaviors in the shoulder are not as well understood, with research finding both no influence [41] and influence [42] on self-report outcome measures. Active ROM of the glenohumeral joint was performed to the patient's tolerance (via Acumar single digital inclinometer). Shoulder flexion and abduction were performed in standing; shoulder internal and external rotations were performed in the supine position. Given the pragmatic nature of the study, ROM was measured and recorded by the treating clinician. A physical performance test measure of shoulder function was quantified using the test of resistance. There is a lack of validated upper extremity performance measures for use in the described patient population. The test of resistance is performed in the standing position with the involved arm in 90° abduction, 20–30° anteposition, and in external rotation. The patient is then asked to follow the way of a spiral drawn on a drawing sheet for 20 turns; 1 turn = from the center to the end of the spiral and vice versa (spiral width = 20 cm). The patient is allowed

to rest for 1 min after 10 turns. The test is considered positive when the patient is not able to conclude it due to strength decrease or to shoulder pain. The number of turns performed is counted and scored. Results are compared to the unaffected shoulder. The resistance test has been documented as a highly specific test for the diagnosis of subacromial impingement but lacks strong sensitivity. In essence, we modified the use of the test of resistance as a physical performance test of function rather than a test of diagnostic accuracy [43].

Randomization and interventions

Randomization was performed prior to study initiation by roll of die. Randomization codes were sealed in consecutively numbered opaque envelopes that were opened following baseline assessment. Patients and treating clinicians were not blind to the intervention; however, initial explanation of the study attempted to minimize patient bias of group selection as patients were informed that current research supported use of both intervention types in the treatment of shoulder pain. Both groups received evidence-based treatment for SIS, with a pragmatic approach based on patient response and tolerance.

This pilot study was designed as a pragmatic study to evaluate the subacute effects of cervicothoracic spinal thrust/non-thrust manipulation in addition to shoulder manual therapy and exercise in patients with subacromial pathology. Interventions were provided at three separate sites (University of Illinois Hospital & Health Sciences System, Walsh University Department of Physical Therapy, and Carolina Physical Therapy Specialists) in the USA by one of eight physical therapists. Each research site consisted of a research team, which included a team leader and treating therapists. Each team leader contained clinical specialties in Orthopedics and is a named Fellow of the American Academy of Orthopaedic Manual Physical Therapists. Seven of eight treating clinicians had earned doctorate degrees (DPT). Six of eight physical therapists were named Fellows of the American Academy of Orthopaedic Manual Physical Therapists. Prior to study commencement, treating therapists underwent a training module with assigned team leaders for assessing ROM with digital inclinometers, standardization of manual therapy techniques utilized, and standardization of interventions permissible in each group. Patients were typically scheduled for 45-min sessions, two times per week, progressed as tolerated, until discharge. Patient discharge, treatment length, and frequency of treatment were determined by the physiotherapists, although some patients terminated treatment themselves.

All patients received shoulder manual therapy techniques (Appendix A in Supplementary material) in addition to exercise. Some participants were randomly allocated to receive cervicothoracic spinal thrust/non-thrust manipulation in addition to shoulder manual therapy plus exercise.

Table 1. Demographic and clinical characteristics of participants at study entry.

	Shoulder only (<i>n</i> = 8)	CT (<i>n</i> = 10)	<i>P</i> value
<i>Demographics</i>			
Age, mean (SD), years	39.1 (15.8)	46.3 (15.9)	0.35
Sex			1.0
Men, <i>n</i> , % of group	4 (50)	5 (50)	
Women, <i>n</i> , % of group	4 (50)	5 (50)	
Height, mean (SD), cm	167.0 (14.9)	171.6 (12.7)	0.49
Body mass, mean (SD), kg	77.4 (18.2)	90.6 (18.9)	0.15
Body mass index, mean (SD), (kg/m ²)	27.4 (3.8)	31.1 (8.0)	0.22
Symptom duration			0.21
Less than 4 weeks	0	1	
4 weeks to 3 months	4	1	
3 months to 6 months	1	4	
6 months to 1 year	0	0	
More than 1 year	3	3	
Highest level of education, <i>n</i> , %			0.82
Grade school	0 (0)	1(10)	
High school	3(38)	4(40)	
College degree	4(50)	4(40)	
Graduate school	1(12)	1(10)	
Employment status, <i>n</i> , (%)			0.70
Currently employed, full-time	3(38)	5(50)	
Currently employed, part-time	1(13)	1(10)	
Unable to work due to shoulder	0(0)	0(0)	
Unable to work (not due to shoulder)	1(12)	0(0)	
Unemployed	0(0)	1(10)	
Retired	1(12)	2(20)	
Student	2(25)	1(10)	

Note: CT, cervicothoracic plus shoulder manual therapy group.

To reflect actual clinical practice, treatment selection and dosage of the interventions was specific to the examination findings. At least one manual therapy technique and one exercise technique was required at each visit for a minimum of 15 min. This included both a spinal and shoulder manual therapy technique for cervicothoracic spinal thrust/non-thrust group and at least one shoulder manual therapy technique for the shoulder treatment-only group. A description of the thrust manual therapy techniques utilized in this study can be found in Appendices A and B in Supplementary material.

Manual therapy techniques were intended to improve overall joint function and decrease any restrictions in movement of the glenohumeral joint, scapula, cervicothoracic spine if so assigned, and associated soft tissue structures. Patient feedback following the selected technique was used to modify position, angle, force, or rate based on patient response. The exercise component consisted of a multimodal, supervised program of muscle strengthening, muscle stretch, and neuromuscular/motor control exercise intended to normalize shoulder movement, improve muscle force-generating capacity, decrease pain, and improve functional ability. To reflect actual clinical practice, the treating therapist selected the exercises they felt most beneficial to their patient depending on initial assessment findings. Home exercise programs (HEP) were updated as the clinician determined and replicated or supplemented the interventions completed within session. Formal recording of the HEP was not completed as part of the study; however, as typical in patient care, the treating therapist subjectively determined patient adherence to the HEP and adjust the plan of care accordingly.

Statistical analysis

Participants were eligible for analysis if they received at least one additional (beyond baseline) follow-up visit with outcomes measures captured. All data were analyzed using SPSS (IBM SPSS Statistics for Macintosh, Version 23.0. Armonk, NY:IBM Corp). Descriptive statistics describing both groups, including frequency counts for categorical variables and measures of central tendency and dispersion for continuous variables were calculated to summarize the data (Table 1). Baseline demographic data were compared across treatment groups to assess the adequacy of the randomization. Baseline variables were compared between groups using independent *t*-tests or Mann–Whitney *U* tests for continuous data and chi-square tests of independence for categorical data. Between-group differences in mean change from baseline to each time point were compared between groups using repeated measures ANOVA adjusting for baseline levels of the outcome measure. The primary dependent variables were the NPRS for pain and the SPADI for function. Time was the within subjects independent variable and treatment group was the between-subject's independent variable.

Results

Twenty-one patients with SIS satisfied the eligibility criteria and completed the baseline examination yet only 18 of these returned for at least one follow-up visit (Figure 1). Of these 18 patients, 10 were randomized to the cervicothoracic spinal thrust/non-thrust (CT) group plus shoulder manual therapy and exercise and 8 were randomized to the shoulder only manual therapy and

Figure 1. Consolidated Standards of Reporting Trials (CONSORT) flow chart of study enrollment.

exercise only (shoulder) group. Two patients were discharged prior to the four-week assessment; therefore, the discharge data points were carried forward for analysis. Only raw data was used for all other assessment points, thus only 16 patients were analyzed at the four-week assessment point. Baseline descriptive statistics of the study sample are shown in Table 1. There were no statistically significant baseline differences between the two groups in any variable (Table 1). There were no adverse events to any of the manual therapy procedures or treatment provided to any of the patients. On average, patients were seen 8.4 (3.0) times over the course of 33.8 (16.4) days. There were no between-group differences ($p = 0.345$) for total number of visits with the CT group being seen for an average of 7.6 (3.3) visits and the shoulder-only group an average of 9.0 (2.7) visits.

There were no statistically significant between-group differences noted for the primary outcome measures of self-reported pain as measured using the NPRS and physical function as assessed on the SPADI (Table 2). Both groups, however, showed statistically significant improvements in pain and function over the course of

treatment. The shoulder-only group improved a mean (95% confidence interval) of -2.50 ($-4.00, -1.00$) points and the CT group, -3.50 ($-5.25, -1.75$) point on the NPRS. Both groups showed statistically significant improvement in physical function on the SPADI with the shoulder group improving a mean of -38.85 ($-61.32, -16.37$) and the CT group, -36.00 ($-52.01, -19.99$). These within group improvements met criteria for clinical significance for both pain (MCID: 1.1) and function (MCID: range 8–13). In general improvements in pain tended to favor the CT group with effect sizes ranging from 0.46 to 0.93, although not statistically significant.

Similar to our primary outcomes, both groups showed statistically significant improvements in ROM at all time points with the exception of internal rotation at week two for the CT group (Table 3). In general, ROM improvements tended to favor the shoulder treatment-only group with effect sizes ranging from 0.14 to 0.50, although not statistically significant. The test of resistance also showed statistically significant improvements within groups at all time points with the exception of week two for the shoulder-only group (Table 2). We found no significant

Table 3. Change within groups and difference in change between groups for shoulder range of motion.

		Mean (95% CI)																				
		Scores by week, mean (SD)					Score change within groups					Difference in change between groups ^a										
		0		2		4		Discharge		Week 2		Week 4		Discharge		Week 2		Week 4		Discharge		
Shoulder (n = 8)	CT (n = 10)	Shoulder (n=8)	CT (n = 10)	Shoulder (n = 7)	CT (n = 7)	Shoulder (n = 9)	CT (n = 10)	Shoulder (n = 8)	CT (n = 10)	Shoulder (n = 8)	CT (n = 10)	Shoulder (n = 7)	CT (n = 7)	Shoulder (n = 8)	CT (n = 9)	Shoulder (n = 8)	CT (n = 10)	Shoulder (n = 8)	CT (n = 10)	Shoulder (n = 8)	CT (n = 10)	
Outcome																						
Shoulder range ^{ab}																						
Flexion	134.0 (27.6)	141.3 (15.7)	167.1 (6.1)	165.8 (7.5)	167.6 (3.8)	168.3 (6.7)	170.8 (5.7)	168.8 (5.7)	33.1 (11.0, 55.2)	24.5 (14.7, 34.3)	35.9 (7.7, 64.0)	24.7 (13.5, 35.9)	36.8 (12.2, 61.3)	27.5 (16.5, 38.5)	-8.6 (-29.0, 11.8) ES: -0.43	-11.2 (-35.8, 13.4) ES: -0.49	-9.3 (-32.0, 13.5) ES: -0.41					
Abduction	117.8 (32.4)	124.3 (16.0)	156.9 (24.7)	155.4 (15.2)	165.3 (10.7)	170.1 (5.7)	172.5 (5.1)	165.7 (12.8)	39.1 (17.1, 61.2)	31.1 (19.1, 43.1)	49.6 (22.0, 77.1)	46.2 (31.9, 60.6)	54.8 (28.1, 81.4)	41.4 (25.6, 57.2)	-8.0 (-29.6, 13.6) ES: -0.37	-3.3 (-29.4, 22.7) ES: -0.14	-13.4 (-40.3, 13.6) ES: -0.50					
Internal rotation	58.1 (67.0)	67.0 (28.7)	76.0 (15.6)	75.6 (18.9)	76.4 (17.9)	82.9 (12.8)	78.0 (15.8)	81.1 (14.4)	17.8 (3.4, 32.4)	8.6 (-5.2, 22.4)	20.0 (2.7, 37.3)	12.6 (0.2, 24.9)	19.9 (4.8, 34.9)	14.1 (3.1, 25.1)	-9.3 (-27.8, 9.3) ES: -0.50	-7.4 (-26.1, 11.2) ES: -0.43	-5.8 (-22.4, 10.9) ES: -0.35					
External rotation	70.8 (21.4)	76.9 (16.5)	88.0 (7.5)	87.1 (11.0)	93.7 (9.8)	93.3 (7.7)	92.1 (12.8)	91.8 (9.0)	17.3 (0.3, 34.2)	10.2 (1.1, 19.3)	21.4 (1.5, 41.3)	16.2 (5.9, 26.6)	21.4 (4.5, 38.2)	14.9 (4.9, 24.9)	-7.1 (-23.6, 9.5) ES: -0.43	-5.2 (-24.0, 13.6) ES: -0.30	-6.5 (-23.5, 10.6) ES: -0.38					

^aAdjusted for baseline scores and calculated as change in cervicothoracic group minus change in shoulder group.^bPositive change within groups means improvement; negative difference in change between groups favors the shoulder group.

between-group differences or within group changes in either subscale of the FABQ with the exception of the physical activity subscale at discharge for the shoulder-only group -6.00 (-9.46 , -2.54).

Discussion

Our randomized controlled trial investigated the subacute effects of cervicothoracic spinal thrust/non-thrust in addition to shoulder non-thrust plus exercise (usual care) compared to shoulder non-thrust plus exercise only in patients with subacromial pathology at several time points during the plan of care. The results from this study demonstrated no statistically significant difference between the treatment groups. Both groups improved on all outcomes and met the criteria for clinical relevance for both pain and function. The greatest improvement for both groups for changes in pain and improved functional reports occurred within the first two weeks with smaller improvements occurring throughout discharge. Our findings suggest that manual therapy, in combination with therapeutic exercise, may have positive effects beyond the immediate within session change.

Our results are consistent with Cook et al. [23] which also demonstrated no between-group differences when comparing combined cervical and shoulder non-thrust to shoulder treatment alone. Similar to Cook, our sample population excluded the likelihood that patient with concomitant cervicothoracic conditions were enrolled in the study. While Cook's study reported 41.2% of patients identified as an acute episode, 33% of our patients reported symptoms greater than one year. Interestingly, the total number of visits was similar in both studies, though the average treatment duration was less in our study, 33.8 days compared to 56.1 days. While further research is warranted, these results suggest that manual therapy and therapeutic exercise in the context of tissue healing may influence the duration of an episode of care.

We believe the lack of significant difference between groups may be due to several factors. First, the complex etiology of subacromial pathology likely resulted in a heterogeneous patient selection [44]. One of the exclusion criteria was reproduction of shoulder symptoms with neck motions. This would, therefore, exclude patients with neck and shoulder involvement who may have benefitted from cervicothoracic manual therapy. This study, however, aimed to address isolated subacromial pathology. It is possible that patients with both cervical spine and shoulder symptoms would benefit from spinal manual therapies. These patients would not be captured in this study. Secondly, there may have been patients in the shoulder treatment-only group who may have benefitted from spinal manual therapy but did not receive it. However, as these are underreported findings in the systematic reviews, [25,26,45] both number of

visits and duration of days could be further examined in the context of chronicity.

In a recent systematic review, manual therapy interventions consisting of shoulder girdle and cervical spine mobilization and manipulations in SIS demonstrated favorable efficacy with regards to pain reduction, with the response monitored from same day to 13 weeks [25]. These studies were mixed regarding their exclusion of cervical spine involvement. However, high-quality studies with low risk of bias examining the effectiveness of manual therapy in SIS are lacking. The lack of significant difference between groups at each time point in our study suggests that the addition of cervicothoracic spinal thrust/non-thrust to evidence based shoulder care does not result in better outcomes in patients with SIS who do not present with concomitant neck and/or thoracic spine problems. Both groups received a combined manual therapy and exercise approach and achieved significant improvement in their pain and functional outcomes with the approaches utilized in our study. While both approaches appeared to provide an equally notable benefit, these findings, along with Cook's study, [23] suggest that a shoulder-specific strategy may be sufficient in those patients without subjective symptoms suggesting proximal involvement. Manual therapy in conjunction with exercise therapy, appears to be fundamental in the management of SIS. Previous systematic reviews support the use of exercise therapy for this management of this condition. [26,45] Long-term effectiveness of manual therapy must be placed in the context of both of these topics and further research is required.

Limitations

This was an effectiveness trial comparing two competing interventions, without a true control group. This makes it impossible to determine what if any of the effect noted may be attributed to placebo, natural course of the illness, alternative factors unforeseen, or any other potential bias that may have been introduced during the study. Additionally, there were only 18 subjects within this study, which significantly limits the interpretation and generalizability of the results. Results of this study should be interpreted with caution, as the sample size is underpowered. The small sample size could be responsible for the lack of significant differences between groups, particularly with regards to pain reduction as reported effect sizes, while insignificant strongly favored the CT-only group. In contrast, functional improvements as reported by the SPADI showed little to no effect in favor of one group over the other. Improvements in ROM were largely in favor of the shoulder-only group. These findings suggest that perhaps with a larger sample size, significant differences may have surfaced.

The chronicity of symptoms may have played a role in this study as well. The shoulder treatment-only group was split between chronic (>3 months) and sub-acute symptoms duration. Whereas, the shoulder plus spinal treatment group was approximately 70% chronic in nature. While randomly assigned to groups, sub-acute shoulder injuries pragmatically received more shoulder specific manual interventions. Therefore, the differences in the chronicity of symptoms may not have been influential in this study. More interesting would be to examine cervicothoracic interventions in acute injury or shoulder only interventions in a chronic condition. Finally, the pragmatic design of this study has some inherent limitations. A pragmatic approach to exercise therapy may be appropriate, but limits the interpretation for future research and duplication of the exercise approach, dosage, and intensity. Furthermore, the treating physiotherapists collected all impairment measures. This may have introduced bias. Also, multiple clinicians were involved in the data collection at other sites.

While this was a pragmatic study, we did not monitor the therapeutic exercise/ motor control retraining included in this pragmatic study, nor the adherence to the home exercises. In addition, we did not record the use of pain medications. We also openly acknowledge that the physical performance test utilized in this study, the test of resistance, lacks the psychometric properties needed of a performance test in this population. However, literature reports that upper extremity physical performance measures in a general outpatient orthopedic population are in fact lacking [46]. In general, we felt it better to utilize some type of physical performance measure to full capture the construct of function alongside the self-report measures than nothing at all. Lastly, while our initial results continue to support the notion that conservative management of subacromial pathology is effective, it is unknown whether the benefits of either physical therapy treatment would be effective over a longer time period. Larger, randomized controlled trials with a follow-up period of 1 year or greater are needed to generate valid and informative results.

Conclusion

This pragmatic randomized clinical trial investigated the effects of the addition of cervicothoracic spinal thrust/non-thrust to shoulder non-thrust plus exercise (usual care) compared to usual care alone in patients with subacromial pathology. The results indicated that in this study the addition of cervicothoracic spinal thrust/non-thrust to the shoulder-only treatment did not significantly improve pain or function in those patients with a clinical diagnosis of SIS when the cervical spine was cleared for involvement. Both approaches appeared to provide an equally notable benefit. Both groups

improved on all outcomes and met the criteria for clinical relevance for both pain and function. The results of this pilot study should be confirmed in a larger trial.

Ethical approval

This study was approved by the High Point University Institutional Review Board (Protocol #201208-122).

Conflict of interest

I affirm that I have no financial affiliation (including research funding) or involvement with any commercial organization that has a direct financial interest in any matter included in this manuscript.

Contributorship statement

We declare all named authors made substantial contributions to the conception or design of the work; drafting and revising the work, final approval of the manuscript to be published, and are in agreement to be accountable for all aspects of the work.

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