SYSTEMATIC REVIEW

Effects of thoracic spinal thrust manipulation for the management of shoulder impingement syndrome: Systematic review

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Abstract

Objective: To determine the effectiveness of thoracic spinal thrust manipulation for shoulder impingement syndrome in the improvement of pain, range of motion and functional outcomes.

Method: The systematic review was conducted by 2 researchers independently using search strategy developed for different databases, including Cochrane Central register of control trials, PubMed, Pedro and MEDLINE, for relevant articles published between 2008 and 2020. The search strategy was designed for each database by combining the key terms and Boolean operators related to the review's objective.

Results: Of the 312 studies identified, 14(4.5%) were included. Of them, 4(28.6%) were in favour of thoracic thrust manipulation, 8(57.2%) did not support thoracic thrust manipulation as the sole treatment and 2(14.3%) favoured thoracic thrust manipulation along with exercises.

Conclusion: Studies indicated immediate improvement in range of motion as well as pain after thrust manipulation, but others reported no such clinical difference. Manipulation should be combined with other exercise therapy to ensure some clinical improvement.

Keywords: Rotator cuff impingement, Rotator cuff impingement syndrome, Shoulder impingement, Shoulder impingement syndrome, Spinal manipulation. (JPMA 73: 338; 2023)

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Introduction

The scapula, clavicle, and proximal humerus work together as a single biomechanical unit to form the shoulder girdle. Three joints – the glenohumeral (GH), acromioclavicular and sternoclavicular joints – and two gliding planes – the subacromial and the scapulothoracic – allow the shoulder a greater range of motion (ROM) than any other joint in the body, reaching nearly 180 degrees in almost all directions of movement. It's evident that such a large range of shoulder mobility relies on these joints and gliding planes working in harmony to allow the arm and the hand to be positioned as needed in space around the body.[1]

The GH joint, a synovial ball and socket joint, is formed when the humeral head articulates with the glenoid fossa of the scapula.[2] Internal and external rotation, abduction and adduction, flexion and extension are all achievable with this joint, which is chiefly controlled by the rotator cuff muscles (teres minor, subscapularis, supraspinatus, infraspinatus), pectoralis major, and deltoid. The subacromial, subdeltoid, subcoracoid, and coracobrachial bursae were amongst the synovial bursae that allow frictionless motion in the GH joint.[3] The GH joint is stabilised by the coracoacromial and acromioclavicular ligaments, which restrict proximal humerus migration.[4,5]

For more than 2000 years, spinal manipulation has been practiced. The physiology of the varied impacts of spinal manipulation has been explained numerous times, especially of the high-velocity, low-amplitude thrusts (HVLATs) or high-velocity thrusts (HVTs). This type of manipulation, as the name implies, involves a high-velocity "impulse" or "thrust" administered to a diarthrodial synovial joint with a very small amplitude. This form of manipulation is generally accompanied by an audible "crack," which is often seen as a sign of successful manipulation.[6] The cracking sound is created by a phenomenon known as "cavitation," which occurs within the joint's synovial fluid (SF).

Cavitation describes the production and activity of bubbles (or cavities) within a fluid as a result of a local pressure reduction.[7] Acute and chronic low back pain (LBP) have both been benefited by the spinal manipulative therapy. While previously examined for effectiveness, spinal HVLAT manipulation and mobilisation (a light, often oscillatory, passive movement) were grouped together as one intervention due to a lack of basic information.[8] Peculiar outcomes associated with spinal HVLAT manipulation, especially those that appear to occur only in conjunction

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with the cavitation event, have the potential to give sufficient theoretical justification for evaluating mobilisation and manipulation as distinct clinical entities.[9]

The third most frequently reported musculoskeletal condition is shoulder pain, with incidence rates up to 2.5% and prevalence ranging from 6.9% to 26% for point prevalence, which increases to 65.7% for the general population lifetime prevalence.[10,11] About half of all patients with shoulder discomfort heal entirely within Six months of the injury and another 10% recover over a 6-month period.[12] The major proportion of patients, however, report chronic shoulder ache with increase in the frequency of sick leaves which contributes over 80% of the whole cost of shoulder pain.[13] The health, personal and socio-economic impacts of shoulder discomfort are widely observed, but the contributors to chronicity are little known. Rotator cuff disorders, adhesive capsulitis of the shoulder, and GH osteoarthritis are perhaps the most commonly reported clinical pathologies associated with chronic shoulder pain, comprising the majority of all shoulder pain pathologies. Furthermore, one of most frequent causes of chronic shoulder discomfort is rotator cuff disorders, particularly supraspinatus tendinopathies.[14] The rotator cuff is the primary dynamic stabiliser of the shoulder joint, allowing the humeral head to be centered in the glenoid. A trauma or weakening of the rotator cuff can thus produce further instability, causing other muscles to co-activate and stabilise the GH joint, such as the long head of the biceps. Not surprisingly, the effects of the long head of the biceps are often linked to supraspinatus tendinopathies. Furthermore, shoulder adhesive capsulitis is a high prevalence pathology (up to 5.3% in general populations) which is characterised by long-term symptoms, therefore accounting for a substantial number of individuals with chronic shoulder discomfort.[15]

Exercise has been seen to be useful for both short-term recovery in rotator cuff disease and long-term benefits in terms of function. When compared with exercise alone, combination of mobilisation and exercise provided extra benefits for rotator cuff disease. For adhesive capsulitis, laser therapy was found to be more efficacious than placebo, but not for supraspinatus tendonitis. In comparison with placebo, both ultrasound and pulsed electromagnetic field therapy relieved pain in calcific tendonitis. Ultrasound did not appear to have any impact on shoulder pain, adhesive capsulitis, or rotator cuff tendonitis. Compared to workout alone, ultrasound provides no substantial benefit. For rotator cuff dysfunction, there were some reports that corticosteroid injections are favourable to physiotherapy (PT), but no proof that PT alone is beneficial for adhesive capsulitis.[16]

Bursitis, tendinitis, rotator cuff injury, adhesive capsulitis, impingement syndrome, avascular necrosis, GH osteoarthritis (OA), and other forms of degenerative joint diseases, as well as traumatic damage, can all cause persistent shoulder pain, either together or separately. Rotator cuff dysfunction, adhesive capsulitis, and GHOA all seems to be likely reasons of persistent shoulder pain, accounting for around 10%, 6% and 2-5% of all shoulder discomfort, respectively. Although the aetiologies of all three disorders are complicated, the majority of patients can be diagnosed based on their medical history, thorough physical examination, and plain film radiographs.[17]

Heavy workload, stiff postures, repeated movements, quivering and number of years in service are the consequence associated with physical load. Repetitive movements, vibration, and duration of work show consistent results in trials.

Studies obtaining a method score of 60% or higher reported odds ratios (ORs) ranging from 1.3 to 4.0. The statistical pooling of results is hampered by significant variation in the methodologies utilised for exposure assessment and data processing.[18]

Age, excessive physical strain and arm abduction are all interconnected with shoulder pain and rotator cuff syndrome in men. Shoulder pain is strongly associated with an automated work pace and a lack of supervisor assistance, while the rotator cuff syndrome is linked with a high psychological demand and a lack of skill discernment. Age, repetitive nature of jobs, and inadequate supervisor assistance are all interconnected with shoulder pain and rotator cuff syndrome in women. Shoulder pain is linked with perceived increase in physical activity and exposure to cold temperature.[19]

Thrust manipulation is a therapy for shoulder pain commonly used by physiotherapists. In the peer-reviewed literature, spinal or extremity-directed thrust manipulations are known as Grade V mobilisations or HVLA manipulation. Spinal manipulative therapy (SMT) refers to thrust manipulation of the spine. SMT may have a therapeutic effect through a variety of mechanisms, some of which overlap. SMT affects sensory processing in the brain and spinal cord, and is associated with decreased pain sensitivity in the extremities. Fibrous adhesions resulting from disuse, injury, or degenerative diseases are considered to be disrupted by thrust manipulation of the spine, extremities and joints.[20]

A numerical rating scale (NRS) requires the patient to rate their pain on a defined scale. For example, 0–10 where 0 is no pain and 10 is the worst pain imaginable. The commonly used NRSs have 11 points (0-10), 21 points (0-20) and 101 points (0-100).[21,22]

A physical therapist can test ROM. This may begin with a simple physical exam, but can also include the use of a goniometer, an instrument that tests the angle of joints, such as elbow or knee. It measures the degree of movement at a joint with various flexing exercises.

Global rating of change (GRC) scales are very commonly used in clinical research, particularly in the musculoskeletal area. These scales are designed to quantify a patient's improvement or deterioration over time, usually either to determine the effect of an intervention or to chart the clinical course of a condition. GRC scales ask that subjects assess their current health status, recall that status at a previous time-point, and then calculate the difference between the two.[23]

The current systematic review was planned to analyse the efficacy of thoracic thrust manipulation (TTM) on patients with shoulder impingement syndrome.

Materials and Methods

The systematic review was conducted after aapproval from the institutional ethics review board of The University of Lahore, and comprised randomised controlled trials (RCTs) and controlled clinical trials (CCTs) published from 2008 to 2020. The review followed preferred reporting item for systematic review and meta-analysis (PRISMA) guidelines as outlined by EQUATOR network.[24] The review protocol was registered with PROSPERO (CRD 42021272608) or (272608). A detailed search was conducted by 2 authors independently, using a search strategy developed for different databases, including Cochrane Central Register of Controlled Trials (CENTRAL), PubMed, Pedro and MEDLINE. Hand searching was also conducted on different databases to ensure the inclusion of all relavent articles. Search strategy was designed for each database by combining key terms and Boolean operators i.e. 'and', 'or' and 'not'. Full text articles were retrieved for eligibilty. In case of conflict of opinion, the matter was decided with discussion. Indexing terms, synonyms and population, intervention, control and outcome (PICO)[25] format terms were used and filtered applied. These included 'full text', 'clinical trials', 'RCT', 'humans' and 'English'.

Study eligibilty were based on PICO format. Relevant information from the included studies was extracted and reviewed by the authors. Peer-reviewed RCTs and CCTs published in English language were included in which thrust manipulation treatment directed to thoracic spine had been tested on impingement syndrome patients of both genders aged 19-44 years. Studies were excluded if the treatment was other than thrust manpulation or if the manipulation was done under anaesthesia. Also excluded were studies that did not include a detailed description of the methodology, those investigating main diagnoses not related to the shoulder or that resulted in referred shoulder pain. Studies involving people who needed to be evaluated for surgery or those recovering from surgery were also excluded, and so were all forms of editorials, commentaries and case series.

Search records were saved in EndNote X8 software. Duplicate records were removed, followed by screening of the articles on the basis of abstracts and full text articles. In the end final text articles which were included from different databases were used to create tables describing different variables, like methdology, sample size, demographic data, etc. Studies were assessed thoroughly to calculate standard mean difference and effect between intervention and control groups.

Differences between the groups were noted to divide outcome measures and quality scores.

Methdological quality of all studies were assessed using the 11-point Pedro scale.[26] which is a tool for assessing the quality of RCTs. A high score on the scale indicates better quality of the study. The scale does not measure studies' external validity or the treatments' effect size. As a result, although item 1 (eligibility criteria) was assessed, it was not included in the score computation. This explains why a maximum score of 10 points is achieved with 11 components.

Risk of bias was assessed by two independent reseracher using the Risk of bias tool in accordance with Cochrane handbook for systematic review of interventions.[27]

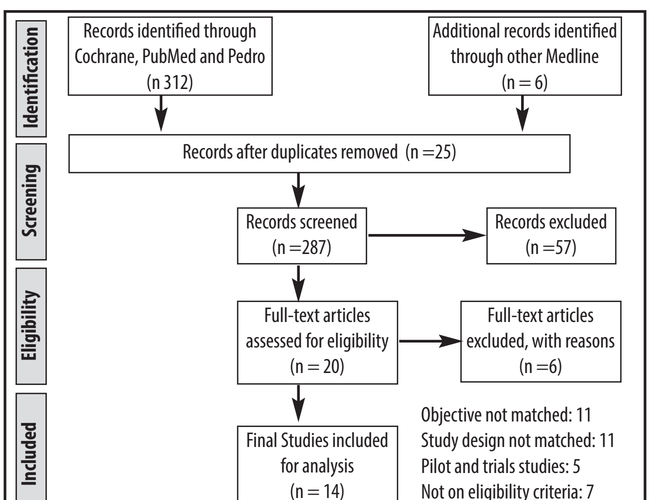

Figure: Preferred Reporting Item for Systematic Review and meta-analysis (PRISMA) flowchart.

Table-1: Demographic data of the studies reviewed.

No.	Study Author Latest to old	Country	Age (years) Mean ±SD	Gender (M/F)	Dropout	Participants	Side (L/R)
1	Park SJ et al., 2020[28]	Korea	G1: 49.20±9.48 G2: 50.90±9.10 G3: 50.20±8.99	M: 9 F: 21	0	30 G1: 10 G2: 10 G3: 10	L: 14 R: 16
2	Land H et al.,2019[29]	Australia	G1: 51±4.4 G2: 51±5.4 G3: 51±6.0	M: 30 F: 30	9	69 G1: 23 G2: 22 G3: 24	L: 7 R: 53
3	Grimes JK et al.,2019[30]	Chicago	G1: 37.6±15.3 G2: 35.6±14.7 G3: 36.5±15.5	M: 37 F: 23	3	60 G1: 20 G2: 20 G3: 20	L: 7 R: 53
4	da Silva AC et al.,2019[31]	Brazil	MG: 46.06±16.11 PG: 44.46±12.14	M: 19 F: 41	0	60 MG: 30 PG: 30	NM
5	Haider R et al.,2018[32]	Pakistan	EG: 49.30±.985 CG: 49.80±9.671	M: 18 F: 22	0	40 EG: 20 CG: 20	L: 17 R: 19 BL: 4
6	Wright AA et al., 2017[33]	UK	G1: 39.1±15.8 G2: 46.3±15.9)	M: 9 F: 9	3	21 G1: 9 G2: 12	NM
7	Vinuesa-Montoya S et al., al.,2017[34]	Spain	G1: 46.85 ± 8.02 G2: 51.21 ± 5.29	M: 28 F: 13	1	41 G1: 21 G2: 20	BL: 40
8	Haik MN,et al.,2017[35]	Brazil	G1: 32.5±12.0 G2: 31.3±11.0	M: 38 F: 23	5	61 G1: 30 G2: 31	L: 21 R: 40
9	Michener LA et al.,2015[36]	USA	G1: 30.9±11.9 G2: 32.5±12.4	M: 30 F: 26	0	56 G1: 28 G2: 28	L: 23 R: 33
10	Kardouni JR et al.,2015[37]	USA	G1: 31.1±12.3 G2: 31.2±12.1	M: 25 F: 23	3	48 G1: 24 G2: 24	NM
11	Kardouni JR et al.,2015[38]	USA	G1: 30.8±11.9 G2: 33.2±12.6	M: 28 F: 24	0	52 G1: 26 G2: 26	L: 22 R: 30
12	Coronado RA et al.,2015[39]	USA	G1: 36.7±16.0 G2: 39.4±13.6 G3: 41.0±14.1	M: 42 F: 36	15	78 G1: 26 G2: 27 G3: 25	NM
13	Haik MN et al.,2014[40]	Brazil	G1: 25.5±0.2 G2: 26.1±5.0 G3: 33.8±12.2 G4: 29.7±9.3	M: 52 F: 45	3	97 Asymptomatic(48) G1: 25 G2: 23 SIS (52) G3: 26 G4: 26	L: 40 R: 57
14	Kachingwe AF et al., 2008[41]	USA	G1: 45.6±13.0 G2: 47.3±20.1 G3: 43.4±14.7 G4: 48.9±13.7	M: 17 F: 16	3	36 G1: 7 G2: 8 G3: 9 G4: 9	L: 2 R: 31

G: Group, MG: Manipulation group, PG: Placebo Group, EG: Experimental group, CG: Control group, SIS: Shoulder impingement syndrome.

Selection bias was assessed by allocation concealment and random sequence generation, and detection bias by blinding of outcome assessment and marked as unclear (?), low risk (+) and high risk (-).

Results

Of the 312 studies found, 14(4.5%) were included (Figure). Demographic characteristics of the studies reviewed were noted (Table 1).22-35 Methodology adopted by each study (Table 2), methodological quality of the studies (Table 3) and the risk of bias of each study reviewed were noted separately (Table 4).

In 2(14.3%) studies, TTM along with exercise resulted in the reduction of symptoms of impingement syndrome and pain, and improved ROM.[22,23]

Also, in 2(14.3%) studies, the TTM alone was not sufficient for improving symptoms like pain, ROM and quality of life (QOL).[24,25]

TTM along with exercise was effective in 1(7.1%) study,[26] cervico-thoracic thrust had no pain reduction or function in patients in 1(7.1%)study,[27] ROM and pain improved by manipulative therapy,[28] thoracic spinal manipulation did not seem to influence the activity of scapular muscles,[29]and sham SMT and SMT had the same beneficial effects.[30]

Further, 1(7.1%) study demonstrated that there was no difference in patients receiving TTM and those who do not receive this treatment.[31] There was no apparent improvement in pain sensations or overall ROM in 1(7.1%) study,[32] while another study showed no improvement in clinical symptoms.[33] In 1(7.1%) study, there was immediate improvement in

Table-2: Characteristics of the studies reviewed.

No.	Study Author (Latest to old)	Method	Interventions	Outcomes	*p*-value	Conclusions
1.	Park SJ et al., 2020[28]	RCT Computer based randomization	G1: Joint Mobilization Group G2: Exercise Group G3: Combination Group	• Thoracic kyphosis angle. • SPADI total point.	p < 0.05	The combination therapy of thoracic mobilization and extension exercise can be regarded as a promising method to improve thoracic alignment and shoulder function in patients with subacromial impingement syndrome.
2.	Land H et al.,2019[29]	RCT Parallel group design Randomization into three groups	G1: Upper thoracic intervention G2: Posterior shoulder intervention G3: Active control group (Ultrasound)	• Thoracic range of motion. • Passive glenohumeral internal rotation range and posterior shoulder range. • Pain rating (NPRS). • SPADI.	NPRS p < 0.05. SPADI p < 0.01. Passive IR p < 0.05. Posterior shoulder p= 0.07	Manual therapy treatment that addresses these extrinsic factors, of thoracic spine or posterior shoulder tightness, decreases the signs and symptoms of SSI.
3.	Grimes JK et al.,2019[30]	Randomized Clinical Trial	G1: Supine TSTM G2: Seated TSTM G3: Sham	• self-reported pain • function • satisfaction • biomechanical impairment	p< 0.017	Two TSTM techniques resulted in no differences in pain, satisfaction, and function when compared to a sham manipulation.
4.	da Silva AC et al., 2019[31]	RCT Sealed envelope method	MG: thoracic spinal manipulation PG: placebo manipulation	• Pain : visual analog scale (VAS)	p< 0.01	Both thoracic vertebral manipulation and a placebo manipulation provided statistically significant but non clinically significant decreases in pain.
5.	Haider R et al.,2018[32]	RCT Sealed envelope method	EG: Thoracic manipulative therapy CG: conservative exercise therapy	• Pain Intensity (NPRS) • Functional Status Score (SPADI)	p< 0.05	Maitland thoracic spinal manipulation with conservative exercise therapy was more effective than conservative exercise therapy alone.
6.	Wright AA et al., 2017[33]	RCT concealed opaque envelops method of randomization	G1: shoulder manual therapy techniques in addition to exercise G2: cervicothoracic spinal thrust/non-thrust manipulation in addition to shoulder manual therapy plus exercise	• Shoulder Pain and Disability Index (SPADI) function • The Numeric Pain Rating Scale (NPRS) for pain. • self-reported Fear Avoidance Beliefs Questionnaire (FABQ)	p = 0.345	Cervicothoracic spinal thrust/non-thrust to the shoulder treatmentonly group did not significantly alter improvement in pain or function in patients with subacromial pathology.
7.	Vinuesa-Montoya S et al., 2017[34]	RCT Computer based randomization	G1: Cervicothoracic Mobilization With and Without Impulse Technique and Exercise Therapy. G2: home exercise program	• visual analog scale (VAS) • the Disabilities of the Arm, Shoulder, and Hand score • Shoulder Disability Questionnaire • subacromial impingement syndrome (Hawkins-Kennedy Test and Neer Test) • shoulder active range of motion	(DASH) p= 0.012 pain intensity p= 0.859 (SDQ) p= 0.061	cervicothoracic manipulative treatment and exercise therapy improve intensity of pain and range of motion compared with home exercise alone.
8.	Haik MN,et al., 2017[35]	RCT Computer based randomization	G1: TSM group G2: Sham-TSM group	• Scapular kinematics • Pain and function • Disability of the Arm, Shoulder and Hand (DASH) questionnaire • Western Ontario Rotator Cuff Index (WORC)	(DASH) p= 0.01 (WORC) p= 0.02 Scapular kinematics p< 0.01 Pain p= 0.04	TSM may increase scapular upward rotation during arm lowering. TSM does not seem to influence activity of the scapular muscles.
9.	Michener LA et al., 2015[36]	RCT Computer based randomization	G1: spinal manual therapy (SMT) G2: Therapist-assisted range of motion (sham-SMT)	• Numeric pain rating scale NPRS • Shoulder active range of motion • Pain • Penn- Pennsylvania shoulder score	p > 0.05 NPRS =0.70 Penn= 0.94	Thoracic sham SMT is comparator with SMT. Sham SMT was active treatment and have equal beneficial effect, it has an inert effect on AROM.

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Table-2: *Continued from previous page ....*

No.	Study Author (Latest to old)	Method	Interventions	Outcomes	*p*-value	Conclusions
10.	Kardouni JR et al., 2015[37]	Randomized Controlled Study	G1: Thoracic manipulation G2: Sham thoracic manipulation	• Pain: Numeric pain rating scale (NPRS) • function: Pennsylvania Shoulder Score (Penn) • global rating of change (GROC)	$p < 0.001$	There were no differences in pressure pain sensitivity between participants receiving thoracic SMT versus sham thoracic SMT.
11.	Michener LA et al., 2015[36]	RCT Computer based randomization	Thoracic SMT Thoracic Sham SMT	• Pain: Numeric pain rating scale (NPRS) • Function: Pennsylvania Shoulder Score (Penn) • global rating of change (GROC)	($p>0.05$) NPRS $p<0.001$ penn $p<0.001$	Patient-reported outcomes improved in both groups without meaningful changes to thoracic or scapular motion.
12.	Coronado RA et al., 2015[39]	Randomized Trial	G1: Cervical thrust manipulation G2: Shoulder thrust Manipulation G3: Home Exercise Programme	• Mechanical Pain Sensitivity • Heat Pain Sensitivity: Heat Pain Threshold • Heat Pain Sensitivity: Temporal Summation of Pain • Shoulder Pain Intensity • Shoulder Function	$p> 0.05$	cervical TM and shoulder-directed intervention (shoulder TM or exercise) result in similar pain-processing and clinical effects.
13.	Haik MN et al., 2014[40]	RCT Computer based randomization	G1: Manipulation G2: Sham G3: Manipulation G4: Sham	• Shoulder pain and function • Disabilities of the Arm, Shoulder and Hand (DASH) • Western Ontario Rotator Cuff (WORC) index • Numeric pain rating scale (NPRS)	$p> 0.05$	Shoulder pain in individuals with SIS immediately decreased after a TSM.
14.	Kachingwe AF et al., 2008[41]	Block randomization method	G1: Exercise only G2: Exercise with glenohumeral mobilizations G3: exercise and MWM G4: A control group receiving only physician advice	• pain (VAS) • pain with the Neer and Hawkins-Kennedy tests • shoulder active range of motion (AROM) • shoulder function (SPADI)	$p> 0.05$	glenohumeral mobilizations and MWM in combination with a supervised exercise programme may result in a greater decrease in pain and improved function.

TSTM: Thoracic spine thrust manipulation, SMT: Spinal manipulative therapy, DASH: Disabilities of the arm, shoulder and hand, WORC:Western Ontario rotator cuff, SPADI: Shoulder pain and disability index, NPRS: Numeric pain rating scale, Penn: Pennsylvania shoulder score, SDQ: Shoulder disability questionnaire, IR: Internal roration.

Table-3: Methodological quality of articles assessed using Pedro Scale.

No	Study Author	Pedro scale items											
		Eligibility	Random allocation	Concealed allocation	Baseline comparability	Blind subjects	Blind therapists	Blind assessors	Adequate follow up	Intention to treat analysis	Between group comparisons	Point estimated variability	Total score
1	Park SJ et al., 2020[28]	1	1	1	1	0	0	1	0	0	1	1	6/10
2	Land H et al.,2019[29]	1	1	1	1	0	0	1	0	0	1	1	6/10
3	Grimes JK et al.,2019[30]	1	1	0	1	0	0	0	1	1	1	1	6/10
4	da Silva AC et al.,2019[31]	1	1	1	1	1	0	1	1	1	1	1	9/10
5	Haider R et al.,2018[32]	1	1	0	1	0	0	0	1	1	1	1	6/10
6	Wright AA et al.,2017[33]	1	1	1	1	1	0	0	1	1	1	1	8/10
7	Vinuesa-Montoya S et al.,2017[34]	1	1	1	1	1	1	1	1	1	1	1	10/10
8	Haik MN,et al.,2017[35]	1	1	0	1	1	0	1	1	1	1	1	8/10
9	Michener LA et al.,2015[36]	1	1	0	1	1	1	1	0	1	1	1	8/10
10	Kardouni JR et al.,2015[37]	1	1	1	1	1	0	1	1	0	1	1	8/10
11	Michener LA et al., 2015[36]	1	1	1	1	0	0	1	1	0	1	1	7/10
12	Coronado RA et al.,2015[39]	1	1	0	1	1	0	0	1	1	1	1	7/10
13	Haik MN et al.,2014[40]	1	1	0	1	0	0	1	1	0	1	1	6/10
14	Kachingwe AF et al.,2008[41]	1	1	0	0	1	0	1	1	1	1	1	7/10

Yes: 1, No: 0.

Table-4: Risk of bias for each included study.

Studies	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of outcome assessment (selection bias)
Park SJ et al., 2020[28]	+	+	+
Land H et al.,2019[29]	+	+	+
Grimes JK et al.,2019[30]	+	-	-
da Silva AC et al.,2019[31]	+	-	+
Haider R et al.,2018[32]	+	+	-
Wright AA et al.,2017[33]	+	+	-
Vinuesa-Montoya S et al.,2017[34]	+	+	+
Haik MN,et al.,2017[35]	+	-	+
Michener LA et al.,2015[36]	+	-	+
(ardouni JR et al.,2015[37]	+	+	+
Michener LA et al.,2015[36]	+	+	+
Coronado RA et al.,2015[39]	+	-	-
Haik MN et al.,2014[40]	+	-	+
Kachingwe AF et al.,2008[41]	+	-	+

Unclear:?, Low Risk: +, High Risk: -

pain after thoracic spinal manipulation,[34] and 1(7.1%) study manipulation with movement and exercise resulted in decreased pain and improved functions.[35]

Discussion

The review included 14 studies. In some studies there was immediate improvement in ROM and pain after thrust manipulation, but more than half the studies reported no such clinical difference. Treatment with manipulation alone is not much effective, and it should be combined with exercise therapy to attain clinical improvement.

A systematic review conducted in 2017 by Amy L. Minkalis[20] showed results that had strong resemblance with the current findings.

The limitation of this study is that no time-filter was applied which resulted in the usage of old references as in the past very few researches has been done on this topic.

Further extensive work should be done in terms of meta-analysis by including RCTs published in languages other than English alone.

Conclusion

There is no long-term improvement in ROM and in pain after thrust manipulation in shoulder impingement syndrome patients and there is no such clinical difference seen in the quality of functional activities in such patients. The sole treatment of manipulation is not much effective rather it should be combined with other exercise therapy to show some clinical improvement.

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