META-ANALYSIS

# Thoracic spinal thrust manipulation for shoulder impingement syndrome: A meta-analysis of pain relief and functional outcomes

Bazal Bukhari, Sarwat Ali, Saba Afzal

## Abstract

**Objective:** To evaluate the effectiveness of thoracic spine thrust manipulation in managing shoulder impingement syndrome.

**Method:** The meta-analysis was conducted from April 25 to November 5, 2023, after approval from the ethics review board of the University of Lahore, Lahore, Pakistan, and comprised a comprehensive search on multiple databases, including Cochrane Central Register of Controlled Trials PubMed, PEDro and MEDLINE. Randomised controlled trials with patients of either gender aged 19-44 years who had been diagnosed with shoulder impingement syndrome were included. Data extraction was independently performed by two researchers, and meta-analysis was conducted using RevMan 5.2.

**Results:** Of the 14 studies comprising 749 participants, 8(57.14%) studies comprising 410(54.73%) participants involved quantitative analysis. The fixed-effect model revealed minimal heterogeneity (I2=0%) and a standardised mean difference of -0.03 (95% confidence interval: -0.22-0.16), indicating no significant improvement in clinical outcomes following thoracic spinal thrust manipulation.

**Conclusion:** The meta-analysis provided a more complex view of the efficacy of thoracic spinal thrust manipulation in treating shoulder impingement syndrome. Some researchers suggested that treatment by manipulation positively affected immediate changes in range of motion and pain, while others revealed no significant clinical changes. This indicates the need for the application of manipulation alongside other exercise therapies for functional changes to be observed clinically.

**Keywords:** Rotator cuff impingement, Rotator cuff impingement syndrome, Shoulder impingement, Shoulder impingement syndromes, Spinal manipulation. (JPMA 75: 456; 2025)

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## Introduction

Shoulder impingement syndrome (SIS) is one of the common musculoskeletal (MSK) disorders that involves the pinching of tendons and bursae within the shoulder joint, which triggers pain and functional restrictions.[1] Being one of the most prevalent diseases, SIS influences life processes in all age groups and impacts work productivity and quality of life (QOL). Socioeconomic implications remain high because chronic shoulder pain significantly raises healthcare costs and decreases productivity.[2] Conventional interventions for managing SIS include the use of physical therapy and analgesics, especially non-steroidal anti-inflammatory drugs (NSAIDs) and intra-articular corticosteroids, as well as surgical procedures for severe cases that do not respond to conservative measures.[3] While these approaches may offer relief, they are generally inefficient. For instance, physical therapy can provide short-term relief only, and NSAIDs can have adverse effects in the long run. While a local corticosteroid injection helps control acute inflammation, it is associated with tendon rupture when repeated, and surgery also has its own drawbacks, such as a longer duration of rehabilitation and postoperative complications.[4]

Due to these drawbacks, there has been a rising focus on other conservative approaches to treating the condition, including thoracic spinal thrust manipulation (TSTM), which is a manual therapy technique designed to apply high-velocity and low-amplitude thrusts to the thoracic spine to enhance joint mobility, reduce pain and enhance shoulder function.[5,6] The proposed underlying mechanisms for the effects of TSTM include the alteration of neural networks, the resetting of biomechanical abnormalities, and the enhancement of neuromuscular coordination. As a result of effectively treating spinal segmental dysfunctions that may cause shoulder impingement, TSTM may help release stress on the joint, and positively affect posture for better general joint biomechanics of the shoulder.[7] However, the evidence highlighting the effectiveness of TSTM in treating SIS is still insufficient. Yet, research has shown that TSTM relieves pain and temporarily increases the range of motion (ROM),[8] while some studies have reported no significant clinical improvement.[9] The inconsistency in the findings suggests the importance of conducting a systematic assessment of TSTM effectiveness in SIS management.[10] The current

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meta-analysis was planned to assess the efficacy of TSTM in treating SIS.

## Materials and Methods

The meta-analysis was conducted from April 25 to November 5, 2023, after approval from the ethics review board of the University of Lahore, Lahore, Pakistan, and comprised randomised controlled trials (RCTs) and controlled clinical trials (CCTs), adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[11] The study protocol was registered with the International Prospective Register of Systematic Reviews[12] (PROSPERO) (CRD 42021272608) or (272608).

Literature search was conducted using a search strategy developed for different databases, including Cochrane Central Register of Controlled Trials (CENTRAL), PubMed, Pedro and MEDLINE. The search terms and Boolean operators used were: "Shoulder impingement syndrome" OR "Rotator cuff impingement" OR "Shoulder impingement" OR "Rotator cuff impingement syndromes" AND "Thoracic" AND "Manipulation" AND "Spine" OR "Spinal" AND "Pain" OR "Range of motion "OR " Functional outcome". Study eligibility was based on Patient- Intervention-Comparison-Outcome (PICO)[13] format. The following inclusion criterion was used: inclusion of both male and female participants; a confirmed diagnosis of SIS; participants aged 19-44 years; the presence of shoulder pain related explicitly to SIS; ability of the participants to comprehend verbal and written information; peer-reviewed publications; inclusion of a group in RCTs that received thrust manipulation treatment targetted at the thoracic spine; RCTs or CCTs; and publication in the English language. The following exclusion criterion was used: involved treatments other than thrust manipulation; manipulations were performed under anaesthesia; lacked a detailed description of the methodology; investigated main diagnoses unrelated to the shoulder or resulting in referred shoulder pain; involved individuals who required evaluation for surgery or were in the post-surgical recovery phase; and editorials, commentaries or case series.

Two researchers conducted the search independently, employing a well-designed search strategy tailored to various databases. The search records were organised and managed using EndNote X8 software. Duplicate records were removed, and the remaining articles underwent a meticulous screening based on abstract and full-text evaluations. Ultimately, relevant articles were selected, and key variables, such as methodology, sample size and demographic data, were noted.

In RevMan 5.2, meta-analysis was performed using the generic inverse variance with a fixed- or random-effect model. The I2 test was used to assess the heterogeneity of individual research. I2 values 25%, 50% and 75% were used to simulate low, moderate and high degrees of heterogeneity, respectively. A random-effect model was applied if the I2 score exceeded 50%. Both high odds ratio (OR) and sensitivity analysis were applied to determine the reasons for the heterogeneity of the systematic review. As a further check on the sources of heterogeneity among the included studies, sensitivity analysis was conducted whereby the contributing studies with extreme OR were dropped to test their effects on the results. For effect size, Cohen's d[14] was calculated using the formula: (mean of the treatment group - mean of the control group) / pooled standard deviation.

The standardised mean difference (SMD) was calculated using individual study standard deviations (SDs) rather than pooled SDs, following standard methods for continuous outcome measures. In cases where pooled SD was used, the SMD was computed by dividing the difference in means by the pooled SD, which accounted for variance across both groups. This method ensured that the standardisation accounted for differences in sample size or variance between studies.

## Results

Of the 14 studies comprising 749 participants (Table 1), 6(42.85%) studies with 339(45.26%) participants were excluded for various reasons, including multi-group design or insufficient data to calculate effect size, while 8(57.14%) studies comprising 410(54.73%) participants involved quantitative analysis. The fixed-effect model revealed minimal heterogeneity (I2=0%) and SMD -0.03 (95% confidence interval [CI]: -0.22-0.16), indicating no significant improvement in clinical outcomes following TSTM ($p$=0.77) (Table 2).

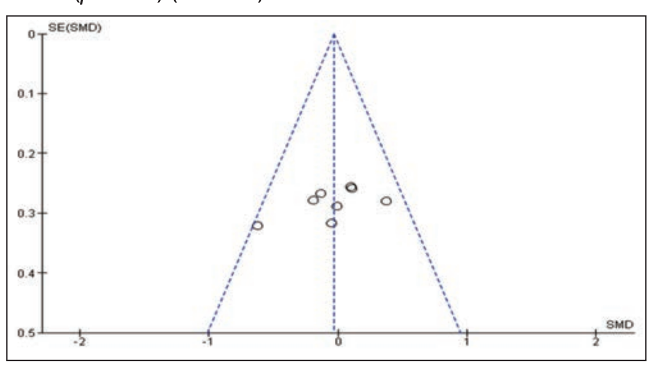



**Figure:** The funnel plot comparing thoracic spine thrust manipulation (TSTM) and sham TSTM. The X-axis represents the standardized mean difference (SMD), and the Y-axis shows the standard error (SE) of the SMD. The symmetrical appearance of the plot indicates there was no strong evidence of publication bias. Larger studies (with smaller SEs) are positioned towards the top, and smaller studies (with larger SEs) are towards the bottom.

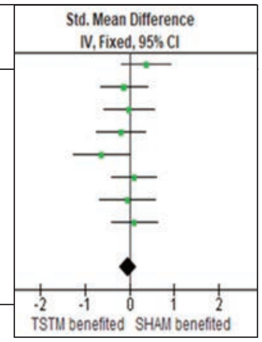
**Table-1:** Demographic data of the studies reviewed.

| No. | Study Author | | | Demographic data of Included Studies | | | | |
|---|---|---|---|---|---|---|---|---|
| | (Latest to old) | Country | Mean Age | Gender (M/F) | Dropout | Participants | Side(L/R) | Method |
| 1 | Park SJ et al., 2020[28] | Korea | G1: 49.20 (9.48)<br>G2: 50.90 (9.10)<br>G3: 50.20 (8.99) | M: 9<br>F: 21 | | 30<br>G1: 10<br>G2: 10<br>G3: 10 | L: 14<br>R: 16 | RCT<br>Computer based randomization |
| 2 | Land H et al.,2019[29] | Australia | G1: 51 ± 4.4<br>G2: 51 ± 5.4<br>G3: 51 ± 6.0 | M: 30<br>F: 30 | 9 | 69<br>G1: 23<br>G2: 22<br>G3: 24 | L: 7<br>R: 53 | RCT<br>Parallel group design<br>Randomization into three groups |
| 3 | Grimes JK et al.,2019[30] | Chicago | G1: 37.6 ± 15.3<br>G2: 35.6 ± 14.7<br>G3: 36.5 ± 15.5 | M: 37<br>F: 23 | 3 | 60<br>G1: 20<br>G2: 20<br>G3: 20 | L: 7<br>R: 53 | Randomized Clinical Trial |
| 4 | da Silva AC et al.,2019[9] | Brazil | MG: 46.06(16.11)<br>PG: 44.46(12.14) | M: 19<br>F: 41 | 0 | 60<br>MG: 30<br>PG: 30 | NM | RCT<br>Sealed envelope method |
| 5 | Haider R et al.,2018[8] | Pakistan | EG: 49.30(9.985)<br>CG: 49.80(9.671) | M: 18<br>F: 22 | 0 | 40<br>EG: 20<br>CG: 20 | L: 17<br>R: 19<br>BL: 4 | RCT<br>Computer based randomization |
| 6 | Wright AA et al.,2017[31] | UK | G1: 39.1 (15.8)<br>G2: 46.3 (15.9) | M: 9<br>F: 9 | 3 | 21<br>G1: 9<br>G2: 12 | NM | RCT concealed opaque envelops method of randomization |
| 7 | Vinuesa-Montoya S et al.,2017[32] | Spain | G1: 46.85 ± 8.02<br>G2: 51.21 ± 5.29 | M: 28<br>F: 13 | 1 | 41<br>G1: 21<br>G2: 20 | BL: 40 | RCT<br>Computer based randomization |
| 8 | Haik MN,et al.,2017[18] | Brazil | G1: 32.5(12.0)<br>G2: 31.3(11.0) | M: 38<br>F: 23 | 5 | 61<br>G1: 30<br>G2: 31 | L: 21<br>R: 40 | RCT<br>Computer based randomization |
| 9 | Michener LA et al.,2015[19] | USA | G1: 30.9 (11.9)<br>G2: 32.5 (12.4) | M: 30<br>F: 26 | 0 | 56<br>G1: 28<br>G2: 28 | L: 23<br>R: 33 | RCT<br>Computer based randomization |
| 10 | Kardouni JR et al.,2015[21] | USA | G1: 31.1 ±12.3<br>G2: 31.2 ±12.1 | M: 25<br>F: 23 | 3 | 48<br>G1: 24<br>G2: 24 | NM | Randomized Controlled Study |
| 11 | Kardouni JR et al.,2015[20] | USA | G1: 30.8 (11.9)<br>G2: 33.2 (12.6) | M: 28<br>F: 24 | 0 | 52<br>G1: 26<br>G2: 26 | L: 22<br>R: 30 | RCT<br>Computer based randomization |
| 12 | Coronado RA et al.,2015[33] | USA | G1: 36.7 (16.0)<br>G2: 39.4 (13.6)<br>G3: 41.0 (14.1) | M: 42<br>F: 36 | 15 | 78<br>G1: 26<br>G2: 27<br>G3: 25 | NM | Randomized Trial |
| 13 | Haik MN et al.,2014[34] | Brazil | G1: 25.5 (5.2)<br>G2: 26.1 (5.0)<br>G3: 33.8 (12.2)<br>G4: 29.7 (9.3) | M: 52<br>F: 45 | 3 | 97<br>Asymptomatic(48)<br>G1: 25<br>G2: 23<br>SIS (52)<br>G3: 26<br>G4: 26 | L: 40<br>R: 57 | RCT<br>Computer based randomization |
| 14 | Kachingwe AF et al.,2008[35] | USA | G1: 45.6 (13.0)<br>G2: 47.3 (20.1)<br>G3: 43.4 (14.7)<br>G4: 48.9 (13.7) | M: 17<br>F: 16 | 3 | 36<br>G1: 7<br>G2: 8<br>G3: 9<br>G4: 9 | L: 2<br>R: 31 | block randomization method |

G: Group, MG: Manipulation group, PG: Placebo group, EG: Experimental group, CG: Control group, SIS: Shoulder impingement syndrome, RCT: Randomised controlled trials, SD: Standard deviations.

**Table-2:** Comparison between TSTM and sham TSTM.

| Study or Subgroup | TSTM (Mean±SD) | TSTM (Total) | SHAM (Mean±SD) | SHAM (Total) | Weight (%) | Std. Mean Difference (IV, Fixed, 95% CI) | Year |
|---|---|---|---|---|---|---|---|
| study13 (Haik MN et al.,2014)[34] | 33.8±12.2 | 26 | 29.7±9.3 | 26 | 12.6% | 0.37 [-0.18, 0.92] | 2014 |
| Study 9 (Michener LA et al.,2015)[19] | 30.9±11.9 | 28 | 32.5±12.4 | 28 | 13.8% | -0.13 [-0.65, 0.39] | 2015 |
| study10 (Kardouni JR et al.,2015)[21] | 31.1±12.3 | 24 | 31.2±12.1 | 24 | 11.8% | -0.01 [-0.57, 0.56] | 2015 |
| study11 (Kardouni JR et al.,2015)[20] | 30.8±11.9 | 26 | 33.2±12.6 | 26 | 12.7% | -0.19 [-0.74, 0.35] | 2015 |
| study7 (Vinuesa-Montoya et al., 2017)[32] | 46.85±8.02 | 21 | 51.21±5.29 | 20 | 9.6% | -0.63 [-1.25, 0.00] | 2017 |
| study8 (Haik MN et al.,2017)[18] | 32.5±12 | 30 | 31.3±11 | 31 | 15.0% | 0.10 [-0.40, 0.61] | 2017 |
| Study 5 (Haider R et al.,2018)[8] | 49.3±9.985 | 20 | 48.9±9.671 | 20 | 9.8% | -0.05 [-0.67, 0.57] | 2018 |
| study4 (da Silva AC et al.,2019)[9] | 46.06±16.11 | 30 | 44.46±12.14 | 30 | 14.7% | 0.11 [-0.40, 0.62] | 2019 |
| **Total** (95% CI) | | 205 | | 205 | 100% | -0.03[ -0.22, 0.16] | |




Heterogeneity: $Chi^2$=6.58, df=7 (p=0.47); $I^2$= 0%; Test for overall effect: Z=0.30 (p=0.77); TSTM: Thoracic spine thrust manipulation.

## Discussion

The current meta-analysis was planned to evaluate the efficacy of TSTM for SIS patients. The findings from 8 RCTs present a rather diverse picture of the effectiveness of the TSTM in clinical practice. Some studies revealed positive findings in the reduction of pain and improvement of ROM, but more than half the studies did not demonstrate significant functional outcomes, pain levels and mobility (Table 2). The variation in outcomes may be explained by differences in patient characteristics, manipulation strategies, or different study designs (Table 1).

R. Haider et al. (2018)[8] observed that using TSTM with exercise therapy showed better outcomes in pain reduction and ROM, suggesting that a multimodal nonsurgical approach may be more beneficial than manipulation alone, which is in agreement with Kerry R et al. (2024)[15] and Michener et al. (2024).[16] Such a combination may be helpful since TSTM initially relieves MSK tension, exercise therapy stabilises muscles and enhances mobility,[17] eliminating biomechanical abnormalities of SIS. In contrast, some studies[9,18-21] found no significant benefit of TSTM as the sole intervention. This aligns with previous literature.[22-24] These outcomes indicate that TSTM alone might not significantly improve clinical efficiency in SIS patients who experience more chronic or severe symptoms. Given these findings, clinicians should be cautious about relying on TSTM as the primary treatment for SIS. Instead, it may be more beneficial as part of an integrative treatment plan that prioritises active rehabilitation strategies, such as strengthening and mobility exercises. By reserving TSTM for acute cases where pain or discomfort limits participation in exercise-based therapies, clinicians may enhance patient outcomes while minimising reliance on passive treatments.

The current meta-analysis has several important limitations. The included studies varied in terms of manipulation techniques, patient demographics, and study designs, which may have influenced the outcomes. Additionally, the small sample sizes in many of the included trials limit the generalisability of the findings. The lack of long-term follow-up in most studies also makes it difficult to understand the sustained effects of TSTM on SIS. Although the funnel plot does not indicate substantial publication bias (Figure), the exclusion of non-English studies may have still skewed the results. Including only English-language studies reduced the comprehensiveness of the meta-analysis and may have overlooked relevant findings from other linguistic or cultural contexts. Furthermore, no time filter was applied during the search process, which resulted in the inclusion of older references due to the limited number of recent studies on this topic. Amy L. Minkalis[25] systematic review in 2017 gave similar findings, where immediate pain relief was observed, but these benefits did not persist and overall improvements in functional activities were inconsistent.

To address these limitations, future research should focus on conducting larger, high-quality RCTs with more standardised manipulation techniques and longer follow-up periods.[26] Incorporating studies from non-English sources would also enhance the robustness of future meta-analyses. However, more studies regarding patient characteristics, including the severity and the duration of symptoms, are still required to provide more evidence for understanding which type of patients may primarily benefit from TSTM. The mixed findings in the current meta-analysis suggest that TSTM's effectiveness may depend on several factors, such as the chronicity of symptoms, patient characteristics, and the integration of complementary therapies, including tailored exercise programmes.[27] Future research should focus on conducting larger RCTs with standardised treatment protocols and extended follow-up periods, exploring the long-term effects of combining TSTM with exercise therapy, which appears to offer more comprehensive benefits for SIS patients. Including studies in languages other than English will reduce publication bias and ensure a more global perspective on the effectiveness of TSTM. Investigating patient-specific factors that may influence treatment efficacy, such as symptom duration, patient demographics, and the presence of other MSK conditions, will also add to the validity of the findings.

## Conclusion

TSTM alone may not result in long-term improvement with respect to ROM, pain relief, or functional activities in SIS patients. TSTM, when used in isolation, lacks substantial clinical effectiveness. However, combining TSTM with exercise therapies may offer more significant benefits, indicating the need for an integrated treatment approach.

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**Conflict of Interest:** None.

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## References

1. Garving C, Jakob S, Bauer I, Nadjar R, Brunner UH. Impingement Syndrome of the Shoulder. Dtsch Arztebl Int 2017;114:765-76. doi: 10.3238/arztebl.2017.0765
2. Marks D, Comans T, Bisset L, Thomas M, Scuffham PA. Shoulder pain cost-of-illness in patients referred for public orthopaedic care in Australia. Aust Health Rev 2019;43:540-8. doi: 10.1071/AH17242
3. Dong W, Goost H, Lin XB, Burger C, Paul C, Wang ZL, et al. Treatments for shoulder impingement syndrome: a PRISMA systematic review and network meta-analysis. Medicine (Baltimore) 2015;94:e510. doi: 10.1097/MD.0000000000000510
4. Creech JA, Silver S. Shoulder Impingement Syndrome. Treasure Island, FL: StatPearls Publishing; 2025.
5. LaPelusa A, Bordoni B. High-Velocity Low-Amplitude Manipulation Techniques. Treasure Island, FL: StatPearls Publishing; 2025.
6. Azin Z, Kamali F, Salehi Dehno N, Abolahrari-Shirazi S. Comparison of Manual Therapy Technique to Therapeutic Exercise in the Treatment of Patients With Subacromial Impingement Syndrome: A Randomized Clinical Trial. J Manipulative Physiol Ther 2023;46:98-10. doi: 10.1016/j.jmpt.2023.06.002
7. Hegarty AK, Hsu M, Roy JS, Kardouni JR, Kutch JJ, Michener LA. Evidence for increased neuromuscular drive following spinal manipulation in individuals with subacromial pain syndrome. Clin Biomech (Bristol) 2021;90:105485. doi: 10.1016/j.clinbiomech.2021.105485
8. Haider R, Bashir MS, Adeel M, Ijaz MJ, Ayub A. Comparison of conservative exercise therapy with and without Maitland Thoracic Manipulative therapy in patients with subacromial pain: Clinical trial. J Pak Med Assoc 2018;68:381-7.
9. Silva ACD, Santos GM, Marques CMG, Marques JLB. Immediate Effects of Spinal Manipulation on Shoulder Motion Range and Pain in Individuals With Shoulder Pain: A Randomized Trial. J Chiropr Med 2019;18:19-26.
10. Tedeschi R, Platano D, Melotto G, Danilo D. Effectiveness of manual thoracic therapy in treating impingement syndrome: a systematic review. Manuelle Medizin 2024;62:178-86. doi: 10.1007/s00337-024-01040-6
11. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71
12. Booth A, Clarke M, Dooley G, Ghersi D, Moher D, Petticrew M, et al. The nuts and bolts of PROSPERO: an international prospective register of systematic reviews. Syst Rev 2012;1:2. doi: 10.1186/2046-4053-1-2
13. Aslam S, Emmanuel P. Formulating a researchable question: A critical step for facilitating good clinical research. Indian J Sex Transm Dis AIDS 2010;31:47-50. doi: 10.4103/0253-7184.69003
14. Cohen J. Statistical Power Analysis for the Behavioral Sciences, 2nd ed. New York; USA: Routledge; 2013. doi: 10.4324/9780203771587
15. Kerry R, Young KJ, Evans DW, Lee E, Georgopoulos V, Meakins A, et al. A modern way to teach and practice manual therapy. Chiropr Man Therap 2024;32:17. doi: 10.1186/s12998-024-00537-0
16. Michener LA, McClure PW, Tate AR, Bailey LB, Seitz AL, Straub RK, et al. Adding Manual Therapy to an Exercise Program Improves Long-Term Patient Outcomes Over Exercise Alone in Patients With Subacromial Shoulder Pain: A Randomized Clinical Trial. JOSPT Open 2024;2:29-48. doi: 10.2519/josptopen.2023.1134
17. Tauqeer S, Arooj A, Shakeel H. Effects of manual therapy in addition to stretching and strengthening exercises to improve scapular range of motion, functional capacity and pain in patients with shoulder impingement syndrome: a randomized controlled trial. BMC Musculoskelet Disord 2024;25:192. doi: 10.1186/s12891-024-07294-4
18. Haik MN, Alburquerque-Sendín F, Camargo PR. Short-Term Effects of Thoracic Spine Manipulation on Shoulder Impingement Syndrome: A Randomized Controlled Trial. Arch Phys Med Rehabil 2017;98:1594-605. doi: 10.1016/j.apmr.2017.02.003
19. Michener LA, Kardouni JR, Sousa CO, Ely JM. Validation of a sham comparator for thoracic spinal manipulation in patients with shoulder pain. Man Ther 2015;20:171-5. doi: 10.1016/j.math.2014.08.008
20. Kardouni JR, Pidcoe PE, Shaffer SW, Finucane SD, Cheatham SA, Sousa CO, et al. Thoracic Spine Manipulation in Individuals With Subacromial Impingement Syndrome Does Not Immediately Alter Thoracic Spine Kinematics, Thoracic Excursion, or Scapular Kinematics: A Randomized Controlled Trial. J Orthop Sports Phys Ther 2015;45:527-38. doi: 10.2519/jospt.2015.5647
21. Kardouni JR, Shaffer SW, Pidcoe PE, Finucane SD, Cheatham SA, Michener LA. Immediate changes in pressure pain sensitivity after thoracic spinal manipulative therapy in patients with subacromial impingement syndrome: A randomized controlled study. Man Ther 2015;20:540-6. doi: 10.1016/j.math.2014.12.003
22. Paige NM, Miake-Lye IM, Booth MS, Beroes JM, Mardian AS, Dougherty P, et al. Association of Spinal Manipulative Therapy With Clinical Benefit and Harm for Acute Low Back Pain: Systematic Review and Meta-analysis. JAMA 2017;317:1451-60. doi: 10.1001/jama.2017.3086
23. Brindisino F, Garzonio F, Giovannico G, Isaia F, Fiorentino F, Cavaggion C, et al. Spinal manipulation does not improve short-term pain and function in persons with painful shoulder: a systematic review with meta-analysis. Disabil Rehabil 2024;46:6051-68. doi: 10.1080/09638288.2024.2322025
24. Thomas JS, Clark BC, Russ DW, France CR, Ploutz-Snyder R, Corcos DM. Effect of Spinal Manipulative and Mobilization Therapies in Young Adults With Mild to Moderate Chronic Low Back Pain: A Randomized Clinical Trial. JAMA Netw Open 2020;3:e2012589. doi: 10.1001/jamanetworkopen.2020.12589
25. Minkalis AL, Vining RD, Long CR, Hawk C, de Luca K. A systematic review of thrust manipulation for non-surgical shoulder conditions. Chiropr Man Therap 2017;25:1. doi: 10.1186/s12998-016-0133-8
26. Çelik EB, Tuncer A. Comparing the Efficacy of Manual Therapy and Exercise to Synchronized Telerehabilitation with Self-Manual Therapy and Exercise in Treating Subacromial Pain Syndrome: A Randomized Controlled Trial. Healthcare (Basel) 2024;12:1074. doi: 10.3390/healthcare12111074
27. Ribeiro DC, Jafarian Tangrood Z, Wilson R, Sole G, Abbott JH. Tailored exercise and manual therapy versus standardised exercise for patients with shoulder subacromial pain: a feasibility randomised

controlled trial (the Otago MASTER trial). BMJ Open 2022; 12:e053572. doi: 10.1136/bmjopen-2021-053572

28. Park SJ, Kim SH, Kim SH. Effects of Thoracic Mobilization and Extension Exercise on Thoracic Alignment and Shoulder Function in Patients with Subacromial Impingement Syndrome: A Randomized Controlled Pilot Study. Healthcare (Basel) 2020;8:316. doi: 10.3390/healthcare8030316
29. Land H, Gordon S, Watt K. Effect of manual physiotherapy in homogeneous individuals with subacromial shoulder impingement: A randomized controlled trial. Physiother Res Int 2019;24:e1768. doi: 10.1002/pri.1768
30. Grimes JK, Puentedura EJ, Cheng MS, Seitz AL. The Comparative Effects of Upper Thoracic Spine Thrust Manipulation Techniques in Individuals With Subacromial Pain Syndrome: A Randomized Clinical Trial. J Orthop Sports Phys Ther 2019;49:716-24. doi: 10.2519/jospt.2019.8484
31. Wright AA, Donaldson M, Wassinger CA, Emerson-Kavchak AJ. 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. J Man Manip Ther 2017;25:190-20. doi: 10.1080/10669817.2016.1251377
32. Vinuesa-Montoya S, Aguilar-Ferrándiz ME, Matarán-Peñarrocha GA, Fernández-Sánchez M, Fernández-Espinar EM, Castro-Sánchez AM. A Preliminary Randomized Clinical Trial on the Effect of Cervicothoracic Manipulation Plus Supervised Exercises vs a Home Exercise Program for the Treatment of Shoulder Impingement. J Chiropr Med 2017;16:85-93. doi: 10.1016/j.jcm.2016.10.002
33. Coronado RA, Bialosky JE, Bishop MD, Riley JL, Robinson ME, Michener LA, et al. The comparative effects of spinal and peripheral thrust manipulation and exercise on pain sensitivity and the relation to clinical outcome: a mechanistic trial using a shoulder pain model. J Orthop Sports Phys Ther 2015;45:252-64. doi: 10.2519/ jospt. 2015.5745
34. Haik MN, Alburquerque-Sendín F, Silva CZ, Siqueira-Junior AL, Ribeiro IL, Camargo PR. Scapular kinematics pre- and post-thoracic thrust manipulation in individuals with and without shoulder impingement symptoms: a randomized controlled study. J Orthop Sports Phys Ther 2014;44:475-87. doi: 10.2519/jospt.2014.4760
35. Kachingwe AF, Phillips B, Sletten E, Plunkett SW. Comparison of manual therapy techniques with therapeutic exercise in the treatment of shoulder impingement: a randomized controlled pilot clinical trial. J Man Manip Ther 2008;16:238-47. doi: 10.1179/106698108790818314

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**Author Contribution:**

**BB:** Literature search, design, concept, data collection, interpretation, revision, final approval and agreement to be accountable for all aspects of the work.

**SA:** Literature search, design, concept, data collection, interpretation, drafting and revision.

**SA:** Literature search, revision, final approval and agreement to be accountable for all aspects of the work.