DOI: https://doi.org/10.54393/pbmj.v4i2.99

PAKISTAN BIOMEDICAL JOURNAL
https://www.pakistanbmj.com/journal/index.php/pbmj/index
Volume 4, Issue 2 (July-Dec 2021)

Original Article

Effects of Mulligan's Mobilization with Movement on First Rib to Reduce Pain and Improve Cervical Rotation in Mechanical Neck Dysfunction

Irfan Ahmad[1]*, Saima Riaz[2], Uzma Faiz[3], Muhammad Sulaman[4], Muhammad Zeeshan[5] and Tabassum Manzoor[6]

[1]Central Park Medical College, Lahore, Pakistan
[2]Riphah College of Rehabilitation Sciences Riphah International University, Lahore, Pakistan
[3] Ghazi University, Dera Ghazi Khan, Pakistan
[4]Government High School, Makoray Wala, Dera Ghazi Khan, Pakistan
[5]Tehsil Head Quater Hospital, Jampur, District Rajanpur, Pakistan
[6]Muzaffarabad General Hospital, Muzaffarabad, Azad Jammu & Kashmir, Pakistan

ARTICLE INFO

Keywords:
neck pain, range of motion, mechanical, cervical rotation

How to Cite:
Ahmad , I. ., Riaz , S. ., Faiz, U. ., Sulaman, M. ., Zeeshan , M., & Manzoor , T. . (2021). Effects OF Mulligan's Mobilization With Movement On First Rib To Reduce Pain And Improve Cervical Rotation In Mechanical Neck Dysfunction. *Pakistan BioMedical Journal*, *4*(2). https://doi.org/10.54393/pbmj.v4i2.99

***Corresponding Author:**
Irfan Ahmad
Central Park medical college Lahore, Lahore, Pakistan
faani.khan04@gmail.com

ABSTRACT

Mechanical Neck Pain (MNP) is a term used to describe pain that results from stress or strain on the structures of the vertebral column. Factors such as alteration in the anatomical structures, sprain or strain of the muscles or ligaments, and adaptation to a faulty posture can result in First rib dysfunction has been identified as a potential cause for faulty dynamic, static, traumatic or congenital factors, may contribute to the development of elevated first rib dysfunction. **Objective:** Was to determine the effects of Mulligan's mobilization with movement on first rib to reduce pain and improve cervical rotation in mechanical neck dysfunction. **Methods:** This study Quasi-experimental trial completed within the time duration of six months (July-Dec 2019. A total of 26 cases (13 in each group) were divided into 2 groups. Group A and Group B were treated with conventional exercise program and with Mulligan's mobilization with movement on first rib and conventional exercise program only respectively. Bubble inclinometer and NPRS tools were used to measure cervical rotation and Pain respectively. Data analysis was done by SPSS 21. **Results:** The mean change in NPRS was statistically higher in group-B (5.46 ± 0.78) as compared to group-A (2.62 ± 0.87), p-value < 0.001. The mean change in cervical rotation (ROM) was statistically higher in group-B (17.46 ± 5.19) as compared to group-A (31.23 ± 4), p-value < 0.001. **Conclusions:** Mulligan's mobilization with movement on first rib and conventional exercise program had statistically significant change in reduction of pain and had higher improvement in cervical rotation (ROM) right and left. Hence, by combining conventional treatment and Mulligan's mobilization, maximum clinical benefits to reduce pain and improve cervical rotation can be attained in mechanical neck dysfunction.

INTRODUCTION

Pain can be classified into various types and is defined in different literatures into various definitions. International association of pain has defined the cervical pain as the pain starting from nuchal region and extending towards the first vertebra of thoracic region [1, 2]. If the pain is occurring in the cervicothoracic region and no specific reason for pain is found than it may be defined as the Non-specific mechanical neck pain (MNP) [3, 4]. It aggravates by movement. The prevalence rate of this pain in players and sportsmen is 36% [5, 6]. Due to current life style, 22 to 70% of the population is expected to feel neck pain somewhere in their lives [7].

Many authors have claimed neck pain to be of non-organic origin that can be caused due to disturbed psychosocial factors. Others have described it as whiplash injury, occupation related sports-related and non-specific pain [8,9]. The severity of neck pain can be classified into 4 grades as recommend by the Neck Pain Task Force. Grade 1 having no signs or structural disease but mildly affecting of life activities. Grade 2 does interfere majorly in daily life activities. Grade 3 has nerve compression signs and grade IV has the signs of major pathology [10,11]. Physical examination can help in identifying signs and symptoms of compression. There may be present active myofascial trigger points. According to study 51.2% of the patients suffering from cervical radiculopathy suffer from these trigger points. But the hands and fingers numbness also indicate the presence of carpel tunnel syndrome or the cubital tunnel syndrome [12-14].

The examination techniques applied to diagnose nerve root compression are Spurling's test and upper limb tension test,

DOI: https://doi.org/10.54393/pbmj.v4i2.99

similarly, Spurling's test with shoulder abduction and distraction at neck [15, 16]. The non-radicular pain usually occurs own its own, however the distinguishing factor is the pattern of pain referral e.g. if the pain is presented at occiput, shoulder or midback, it indicates involvement of cervical facet joint [17].

Diagnostic imaging including MRI used in soft tissue injuries and nerve root compression and CT for differentiating osteophytes from soft tissue injuries is frequently used. EMG and further nerve conduction tests are used to diagnose injuries related to nerve root [18, 19]. The biopsychosocial model indicates that social, anatomical and occupational factors are involved in chronic pain [20]. As mentioned by a meta-analysis, education of patient and his awareness does not prevent back and neck pain [21, 22].

Previously different studies have been done to evaluate the effectiveness of mulligan mobilization in mechanical neck pain and to reduce limitations in neck movement [3, 23] but after advocating of mulligan about the effectiveness of rib mobilization along with other techniques to make the treatment protocol more effectiveness of rib mobilization in mechanical neck pain to make treatment protocol more specific and efficient. To determine the Mulligan's mobilization with movement's effects on first rib to reduce pain and improve cervical rotation in mechanical neck dysfunction.

METHODS:

This study was Quasi-experimental trial conducted at PT CARE, MM Alam road Lahore within the time duration of six months (July-Dec 2019). Consecutive sampling technique was used. Sample size was 26, calculated by online sample size calculator the EPITOOL by putting values of cervical rotation from previous study [24]. Inclusion criteria was age range of 25 to 60 years, both genders, pain over neck and trapezius area, restricted cervical rotation ROM, positive manual rib spring test and unilateral elevated first rib dysfunction either left or right. Exclusion criteria was cervical radiculopathy, first Rib fracture or dislocation, vertebro-basilar Insufficiency (VBI), previous surgery in cervical or thoracic region.

Data Collection Procedure and tool

Bubble inclinometer is gravity dependent, having a partially-filled circular tube with a colored fluid which moves with motion. It has a degree marking with moveable circular dial. Each measuring device requires the knowledge of expected measurement and its placement. In the measurement one should include the type of device needed to be used. Ideally, for there-measuring of patients reading the same type of device would be used. Both the left and the right sided movements should be measured and compared. Inclinometers are the devices which used to measure the joints range-of-motion. Neutral position as a reference used in measuring range-of-motion such as flexion, extension, rotation and side bending. It can also measure the whole range to vintage a total range-of-motion of the joint. The inclinometer is simple in usage as by placing it near the joint and turn the dial to zero degree than take the joint over the range and read the range directly from the dial. Measuring neck rotation with a bubble inclinometer. Active cervical rotation range was measured by placing the subject in supine position with the cervical spine in neutral. The bubble inclinometer was placed in the middle of the forehead and adjusted to zero. The subject was instructed to rotate the head one side and the difference of reading at the completion of range of motion was noted to record the degrees of rotation to that side. The head was repositioned to neutral and measurement for other side rotation was record.

Numeric pain rating scale (NPRS)

NPRS describe pain in terms of numbers, according to it severity extremes. The 11 -point of numeric scale are there which ranges from '0' to '10' representing two extremes of pain; 0 for "no pain" and '10' for pain as bad as one can imagine" or "worst pain.

Treatment Approach

The protocol of exercises after confirmed by a specialized rehabilitation consultant was as follows:

During 1st visit these steps were taken: A complete physical examination, history and thoroughly assessment done by researcher. The patient completed NPRS as subjective measurement. The researcher checked neck rotation ROM with bubble inclinometer. Treatment was then continued to the selected subject according to their allocation.

In next visits: Patient was reassessed by researcher. 6 treatment sessions of were given to the patient. Pretreatment and post treatment evaluation through bubble inclinometer and NPRS was done after 6th session.

Treatment Procedures

Group A: Conventional exercise program was given

Group B: Mulligan's mobilization with movement on first rib and conventional exercise program was given.

Group A

Isometric Neck Exercises

Patients were instructed to do self -assisted neck isometric exercises. If the exercises added pain or discomfort, then patient was instructed to stop doing it immediately. Patient was asked to remember to continuously breathe throughout the routine. Neck was kept aligned. Isometric Neck Flexion – Patient was asked to put both hands on your forehead and gently push against their resistance. Patient tightened the neck muscles and tries his/her best not to let his/her head move forward. Patient was asked to hold the contraction for 10 seconds and perform two sets with 10 repetitions in a day.

DOI: https://doi.org/10.54393/pbmj.v4i2.99

One set with 10 repetitions was performed by researcher.

Isometric Neck Extension -- Patient was asked to place both hands against the lower back of your head. Patient was given slight forward pressure, but he/she made sure to resist the movement as he/she pushed his/her head back into his/her hands. Patient was asked that his/her head was not fallen backward. Patient was asked to hold the contraction for 10 seconds and perform two sets with 10 repetitions in a day. One set with 10 repetitions was performed by researcher. It was helpful to have a mirror beside patient so that he/she can check his/her position and posture while doing the exercises.

Isometric Lateral Flexion -- Patient was asked to place the right hand on the right side of head, just above the right ear. Patient was tightening his/her neck muscles and resists the pressure to move his/her head sideways. Patient was asked to hold the contraction for 10 seconds and perform two sets with 10 repetitions in a day Do the same procedure to your left side. One set with 10 repetitions was performed by researcher.

Ultrasound Therapy

All the patients in both groups received ultrasound therapy with continuous mode for 10 mints per session with intensity of 1.2W/cm2 and frequency of 1MHz. Patients were assumed a lean forward sitting. Posterior aspect of neck was cleaned and exposed. Ultrasound probe was applied directly on the upper trapezius muscle. It was given 6 sessions per week for six days.

Group B

In group B conventional exercise program as mentioned above was as well as Mulligan's mobilization with movement technique over the first rib was performed with the patient seated comfortably in a low back supported chair, and the cervical spine in neutral. Standing behind the patient, the first rib was palpated and using the radial border of the second metacarpal of the hand over the first rib, an inferior and medial pain-free Mulligan's mobilization with movement was applied while the therapist used their other hand to laterally flex the cervical spine on the contra lateral side of dysfunction with overpressure. The procedure was repeated six times, in a single session. Total six sessions were given to each patient in six days.

Data Analysis Procedure

SPSS 21 was used to analyze the data using statistical significance p=0.05. Shapiro-Wilk Test was used to check the normality of data. Value of the Shapiro-Wilk Test was greater than 0.05, the data was normal and parametric tests of analysis were used. Frequency tables were used to show summary of group measurements measured over time. Paired sample t test was used to show change of subjective as well as objective measurements over time. Difference between groups: Independent sample t test was used to show the difference between the groups.

RESULTS:

Table 1 data is showing the Age, Height, Weight and BMI of patients in the study. In Group A Mean age of the patients was 39.50 +9.17 and Mean of height of patient was 1.67 +0.09. Mean BMI of patient was 22.62+4.54, mean weight of patient was 63.03+12.01. In Group B Mean age of the patients was 39.12+10.57 and mean of height of patient was 1.70 +0.08. Mean BMI of patient was 27.81+3.71. Mean Weight of patient was 63.03+9.73. In group-A there were 10 (76.92%) male and 3 (23.08%) female cases while in group-B there were 9 (69.23%) male and 4 (30.77%) female cases. Table 2 is showing a description about within group. Pair wise comparison of NPRS. The pre-treatment NPRS in group A 7.61 & Post-treatment NPRS was5.00, mean difference 2.61 with p value <0. 001. In group B the pre-treatment NPRS was 9.30& Post-treatment NPRS was3.84, mean difference 5.46 with p value <0.001.

Table 2 is showing a description about within group. Pair wise comparison of Cervical Rotation ROM. The pre-treatment Cervical Rotation ROM in group A 56.84 & Post-treatment Cervical Rotation ROM was 74.14, mean difference 17.46 with p value <0. 001. In group B The pre-treatment Cervical Rotation ROM was 50.92& Post-treatment Cervical Rotation ROM was 82.15, mean difference 31.23 with p value <0.001.

Variables	Group	Minimum	Maximum	Mean + SD
Age	GroupI	35.00	57.00	39.50 +9.17
	GroupII	26.00	59.00	39.12+10.57
Height	GroupI	1.49	1.89	1.67 + 0.09
	GroupII	1.58	1.85	1.70+0.08
Weight	GroupI	49.00	91.00	63.03+12.01
	Group II	48.00	87.00	63.09+9.73
BMI	GroupI	16.09	35.10	22.62+4.54
	GroupII	14.61	30.09	21.81+3.71

Table 1: Age, Height, Weight and BMI of the patients

	Group A mean NRPS		Group B mean NRPS		Group A mean cervical ROM		Group B mean cervical ROM	
Pre Treatment	7.61		9.30		56.84		50.92	
Post Treatment	5.00		3.84		74.14		82.15	
	Mean difference	P value	Mean difference	P value	Mean difference	P value	Mean difference	P value
Pre Treatment-Post Treatment	2.61	<0.001	5.46	<0.001	17.46	<0.001	31.23	<0.001

Table 2: Within group pair wise comparison of NPRS score and cervical ROM score (paired Sample T Test)

DOI: https://doi.org/10.54393/pbmj.v4i2.99

DISCUSSION:

A study was done on patients with non-specific neck pain in 2016, they presented their conclusion with the suggestions of that mulligan's mobilizations techniques for example NAGs were more efficient in comparison to the techniques of Maitland according to study indicators such as NDI and NPRS scorer [25]. In our study also, therapeutic role of Mulligan's technique when combined with conventional treatment is supported i.e. In current study the mean change was statistically higher in group-B (5.46 ± 0.78) as compared to group-A (2.62 ± 0.87), p-value < 0.001. The mean change in cervical rotation (ROM) was statistically higher in group-B (17.46 ± 5.19) as compared to group-A (31.23 ± 4), p-value < 0.001. The mean change in cervical rotation (ROM) was statistically higher in group-B (17.46 ± 5.19) as compared to group-A (31.23 ± 4), p-value < 0.001.

In one study researchers reported the mean age in traditional physiotherapy group was 67 years and BMI were 27.78 kg/m2 and in mulligan mobilization group it was 69 years and BMI was 28.34kg/m2 [23]. In our study the mean age in traditional physiotherapy group was 39 years and BMI were 22.62 kg/m2 and in mulligan mobilization group it was 39 years and BMI was 21.81kg/m^2. Recently one study with mulligan concept of positional SNAGs was done to mechanical neck pain patients to evaluate the outcome of trials. The main findings of the study exposed that patients, reductions of pain counted over the NPRS scale [5.4 to .16, p = .001] with improving functional activity over the PSFS scale [5.2 to 10, p = 0.001], and there also increases in cervical range of motion [ext p = .003, flex p = .009, left rot p = .001, right rot p = .002] instantly between the treatments and the treatment session. Positional SNAGs indication for the cervicothoracic region is there is variety of patient who reported the symptoms of MNP so the treatment protocol to be in single sitting rather than a several treatments [22]. Our study shows in pre-treatment NPRS in group A were noted as 7.61 & Post-treatment NPRS was noted as 5.00. In group B the pre-treatment NPRS was 9.30 & Post-treatment NPRS was noted as 3.84. According to the key description provided for the mobilization pain-reducing effect is that they correct the positional or mechanical faults in joints hence decreases the pain of bony structure. Studies have testified that spinal manipulative therapy generate the hypo-analgesic effect which is nonopioid in nature so it is not overturned by the naloxone and could not improve tolerance to recurrent stimulation [3].

Similarly, another study was done for the management of neck pain of mechanical origin with thoracic manipulation to reduce pain and disability. The main results demonstrated that due to absence of blinding of participate with insufficient provider there is risk of increased biasness. The Grade method proved an inclusive level of suggestion ranging from very low to moderate. Meta-analysis that equated TSM to thoracic and cervical mobilization bare a substantial effect supporting the TSM group for pain and disability. Meta-analysis comparing TSM to a standard care bare a substantial effect supporting the TSM group for pain and disability for a short-term follow-up with a sufficient outcome for disability for long-term follow-up. Meta-analysis study comparing thoracic spine mobilization with the cervical spine manipulation showed a non-significant effect for pain deprived of a discrepancy between instantaneous and short-term follow-up. The main restriction in this research was the array between the studies making it difficult to assess the true clinical benefit, as well as the overall level of quality of evidence [26]. This and several other studies [11] comply with our study showing that TSM is revealed to be more advantageous than thoracic mobilization, cervical mobilization, and standard care in the short-term, but no better than cervical manipulation or placebo thoracic spine manipulation to improve pain and disability.

CONCLUSIONS:

Patients treated with Mulligan's mobilization with movement on first rib and conventional exercise program had statistically higher change in reduction of pain and improvement in cervical rotation (ROM) right and left. Hence, by combining conventional treatment and Mulligan's mobilization we can attain maximum clinical benefits to reduce pain and improve cervical rotation in mechanical neck dysfunction.

REFERENCES:

[1] Merskey HE. Classification of chronic pain: Descriptions of chronic pain syndromes and definitions of pain terms. Pain. 1986. https://pubmed.ncbi.nlm.nih.gov/3461421/

[2] Vicenzino B, Paungmali A, Teys P. Mulligan's mobilization-with-movement, positional faults and pain relief: current concepts from a critical review of literature. Manual therapy. 2007; 12(2):98-108. doi.org/10.1016/j.math.2006.07.012

[3] Stathopoulos N, Dimitriadis Z, Koumantakis GA. Effectiveness of Mulligan's mobilization with movement techniques on pain and disability of

DOI: https://doi.org/10.54393/pbmj.v4i2.99

peripheral joints: a systematic review with meta-analysis between 2008-2017. Physiotherapy. 2019;105(1):1-9.doi.org/10.1016/j.physio.2018.10.001

[4] Aker PD, Gross AR, Goldsmith CH, Peloso P. Conservative management of mechanical neck pain: systematic overview and meta-analysis. Bmj. 1996; 313(7068):1291-6.doi.org/10.1136/bmj.313.7068.1291

[5] Bogduk N, McGuirk B. Management of acute and chronic neck pain: an evidence-based approach: Elsevier Health Sciences; 2006. https://www.elsevier.com/books/management-of-acute-and-chronic-neck-pain/bogduk/978-0-444-50846-1

[6] Heintz MM, Hegedus EJ. Multimodal management of mechanical neck pain using a treatment based classification system. J. Manu. Manipu. Ther. 2008;16(4):217-24. doi.org/10.1179/106698108790818260

[7] Stump JL, Redwood D. The use and role of sport chiropractors in the national football league: a short report. J. manipulative and physiological therapeutics. 2002;25(3):A2-A5.doi.org/10.1067/mmt.2002.122326

[8] Brønfort G, Nilsson N, Haas M, Evans RL, Goldsmith CH, Assendelft WJ, et al. Non-invasive physical treatments for chronic/recurrent headache. Cochrane Database of Systematic Reviews. 2004(3). doi.org/10.1002/14651858.CD001878.pub2

[9] Delgado-Gil JA, Prado-Robles E, Rodrigues-de-Souza DP, Cleland JA, Fernández-de-las-Peñas C, Alburquerque-Sendín F. Effects of mobilization with movement on pain and range of motion in patients with unilateral shoulder impingement syndrome: a randomized controlled trial. J. Manipu. Physio. Therap. 2015; 38(4):245-52. doi.org/10.1016/j.jmpt.2014.12.008

[10] Di Fabio RP, Boissonnault W. Physical therapy and health-related outcomes for patients with common orthopaedic diagnoses. J. Ortho. Spo. Phy. Ther. 1998;27(3):21930.doi.org/10.2519/jospt.1998.27.3.219

[11] González-Iglesias J, Fernandez-De-Las-Penas C, Cleland JA, del Rosario Gutiérrez-Vega M. Thoracic spine manipulation for the management of patients with neck pain: a randomized clinical trial. J. Ortho. Spo. Phy. Ther. 2009;39(1):20-7. doi.org/10.2519/jospt.2009.2914

[12] Elliott J, Jull G, Noteboom JT, Darnell R, Galloway G, Gibbon WW. Fatty infiltration in the cervical extensor muscles in persistent whiplash-associated disorders: a magnetic resonance imaging analysis. Spine. 2006;31(22):E847-E55. doi.org/10.1097/01.brs.0000240841.07050.34

[13] Reid SA, Rivett DA, Katekar MG, Callister R. Sustained natural apophyseal glides (SNAGs) are an effective treatment for cervicogenic dizziness. Manual therapy. 2008;13(4):357-66.doi.org/10.1016/j.math.2007.03.006

[14] Yao M, Sun Y-l, Dun R-l, Lan T-y, Li J-l, Lee HJ, et al. Is manipulative therapy clinically necessary for relief of neck pain? A systematic review and meta-analysis. Chinese J. Integrative Med. 2017;23(7):543-54. doi.org/10.1007/s11655-016-2506-1

[15] McLean SM, May S, Klaber-Moffett J, Sharp DM, Gardiner E. Risk factors for the onset of non-specific neck pain: a systematic review. J. Epidem. Comm. Hlth. 2010;64(7):565-72.doi.org/10.1136/jech.2009.090720

[16] Young JL, Walker D, Snyder S, Daly K. Thoracic manipulation versus mobilization in patients with mechanical neck pain: a systematic review. J. Man. Manipu. Thera. 2014;22(3):141-53. doi.org/10.1179/2042618613Y.0000000043

[13] Guzman J, Hurwitz EL, Carroll LJ, Haldeman S, Côté P, Carragee EJ, et al. A new conceptual model of neck pain: linking onset, course, and care: the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. J. Man. Manipu. Thera. 2009;32(2):S17-S28. doi: 10.1097/BRS.0b013e3181643efb

[18] Spitzer WO. Scientific monograph of the Quebec Task Force on Whiplash-Associated Disorders: redefining" whiplash" and its management. Spine. 1995;20:1S-73S. doi.org/10.1097/00007632-199504151-00004

[19] Ali A, Shakil-ur-Rehman S, Sibtain F. The efficacy of sustained natural apophyseal glides with and without isometric exercise training in non-specific neck pain. Pak. J. Med. Sci. 2014;30(4):872. doi.org/10.12669/pjms.304.5148

[20] Treede R-D. The International Association for the Study of Pain definition of pain: as valid in 2018 as in 1979, but in need of regularly updated footnotes. Pain reports.2018;3(2).doi.org/10.1097/PR9.0000000000000643

DOI: https://doi.org/10.54393/pbmj.v4i2.99

[21] Fishbain DA, Cole B, Lewis JE, Gao J. What is the evidence that neuropathic pain is present in chronic low back pain and soft tissue syndromes? An evidence-based structured review. Pain Medicine. 2014;15(1):4-15. doi.org/10.1111/pme.12229

[22] Andrews DP, Odland-Wolf KB, May J, Baker R, Nasypany A, Dinkins EM. Immediate and short-term effects of mulligan concept positional sustained natural apophyseal glides on an athletic young-adult population classified with mechanical neck pain: an exploratory investigation. J. Man. Manipu. Thera. 2018;26(4):203-11. doi.org/10.1080/10669817.2018.1460965

[23] Buyukturan O, Buyukturan B, Sas S, Karartı C, Ceylan I. The effect of mulligan mobilization technique in older adults with neck pain: A randomized controlled, double-blind study. Pain Research and Management. 2018; doi.org/10.1155/2018/2856375

[24] Prayerna B, SuBBiah K, antony Leo aSSer P, MiLaneSe S. Effectiveness of Mulligan's Sustained Natural Apophyseal Glide (SNAG) over First Rib in Reducing Pain and Improving Cervical Rotation in Individuals with Mechanical Neck Dysfunction. Journal of Clinical & Diagnostic Research. 2019;13(3). doi.org/10.7860/JCDR/2019/39626.12733

[25] Hussain SI, Ahmad A, Amjad F, Shafi T, Shahid HA. Effectiveness of natural apophyseal glides versus grade I and II Maitland mobilization in non specific neck pain. Annals of King Edward Med. Uni. 2016;22(1):23-. doi.org/10.21649/akemu.v22i1.792

[26] Masaracchio M, Kirker K, States R, Hanney WJ, Liu X, Kolber M. Thoracic spine manipulation for the management of mechanical neck pain: A systematic review and meta-analysis. PloS one. 2019;14(2):e0211877. https://doi.org/10.1371/journal.pone.0211877