A Systematic Review: Manipulation vs. Mobilization for Mechanical Neck Pain

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Abstract

Objectives: To identify the efficacy of manipulation and mobilization in managing mechanical neck pain (MNP), based on their effects on pain reduction, range of motion (ROM), and functional improvement, and to assess their relative benefits in guiding clinical practice.

Methods: A systematic review was conducted using five databases (PubMed, Google Scholar, PEDro, Cochrane Library, and CINAHL) to identify randomized controlled trials (RCTs) and pilot RCTs published between 2009 and 2024. Studies involving adult participants with MNP were included, emphasizing interventions like manipulation, mobilization, and SNAGs. The quality of studies was evaluated using the Physiotherapy Evidence Database (PEDro) scale and Cochrane RoB 2.0 framework, with data extracted on outcomes including pain intensity, ROM, and functional improvements. A narrative synthesis was performed due to heterogeneity among the studies.

Results: Twelve studies met the inclusion criteria, with PEDro scores ranging from 6 to 9, indicating fair to high quality. Both manipulation and mobilization significantly improved pain and ROM in the short term, with no clear superiority of one intervention over the other. Thoracic manipulation often yielded better immediate and short-term outcomes than cervical mobilization. SNAGs and manipulation demonstrated comparable efficacy in improving cervical ROM and reducing pain. However, limitations such as small sample sizes, variable methodologies, and short follow-up periods restricted the strength of conclusions.

Conclusion: While both manipulation and mobilization are effective for managing MNP, variability in techniques and study designs precludes definitive recommendations. Thoracic manipulation may offer additional benefits for immediate pain relief, but further research is needed to establish long-term efficacy, standardized protocols, and integration with other therapeutic modalities. The findings underscore the need for multicentre trials with robust methodologies to refine clinical guidelines for MNP management.

Keywords: Thrust manipulation, non-thrust, manipulation, Mobilization, SNAGs, Mechanical neck pain, Systematic review, Pain reduction, Range of motion (ROM)

Introduction

Neck discomfort is a prevalent and often debilitating condition that significantly contributes to self-reported pain, disability, and the global burden on individuals and healthcare systems.[1] It is the fourth most common cause of disability among the general population.[2,3,4,5] Estimates suggest that 20–70% of people will experience neck pain at some point in their lives,[2,3,4,6,7,8,9,10,11] and up to 60% of patients report chronic pain persisting five years after the onset of symptoms.[6] Neck pain is most commonly observed during the fourth to fifth decades of life and its incidence increases with age.[7] The root cause of neck pain rarely originates from a single anatomical structure. Instead, they often involve multiple contributing factors.[3] Non-specific neck pain is defined as neck discomfort that worsens with cervical motion. As most neck pain is mechanical in nature, it is typically impossible to pinpoint a single cause.[5]

Mechanical neck pain (MNP) is one of the most prevalent musculoskeletal conditions, affecting 30%–50% of the general population and workers. Repeated neck movements and prolonged neck postures can cause neck pain, which is a hallmark of MNP.[8] Several pain-sensitive structures, such as the zygapophyseal joints, ligaments, muscles, uncovertebral joints, intervertebral discs, and neural tissues surrounding the cervical spine, can cause mechanical neck pain. Mechanical dysfunction of the cervical spine can lead to decreased neck mobility.[9] One of the main characteristics of patients with MNP is the impairment of cervical proprioception, which results in abnormalities in cervical sensorimotor control, which in turn affects balance and postural control. Patients with MNP have also been found to exhibit changes in dynamic scapular stabilization, including protracted acromions and scapulae.[8]

Neurological impairments referred or radiating pain into the upper extremities, or headaches of cervical origin known as cervicogenic headaches can all accompany neck pain; however, these symptoms are frequently neglected when discussing mechanical neck pain. With headaches and referred or radiating pain into the upper extremities falling into different categories, the current physical therapy clinical practice guidelines for neck pain have divided the clinical findings of patients presenting with neck pain into distinct groups. Patients with mechanical neck pain may react differently to physical therapy procedures, particularly manipulation and mobilizations, and those who experience headaches and/or radiating pain.[6] This systematic review focused on mechanical neck discomfort to exclude radiculopathy and cervicogenic headache.

Mechanical neck pain is a prevalent symptom that is frequently treated conservatively during outpatient physical therapy.[6] Physical therapists use a range of techniques to treat neck discomfort, including mobilization, therapeutic exercises, thrust manipulation, and modalities.[9] Manual therapy is a popular intervention for increasing range of motion, enhancing tissue extensibility, and reducing pain.[6]

Manipulation and mobilization are techniques that use skilful passive movements applied to the soft tissues and joints at different amplitudes and speeds.[6] Studies showing the cost-effectiveness of manual therapy for neck discomfort emphasize the necessity for efficient therapies to avoid chronic pain and impairment.[2] Neck and musculoskeletal pain can be relieved by manual cervical spinal mobilization (CSMobs) and manipulation (CSMs). Through neurophysiological, mechanical, and biochemical effects, CSMs employ high-velocity, low-amplitude thrusts to enhance joint, muscle, and nerve function, whereas CSMobs apply non-thrust oscillatory movements to the spine. The expectations of the patient and psychological variables may also affect the treatment results.[2]

Although there is insufficient information to support clinical decision-making, evidence-based practice recommendations suggest that for mechanical neck discomfort, manual treatment and therapeutic exercises should be combined.[7] Studies have demonstrated that both thrust and non-thrust cervical spine manipulations can improve function, increase range of motion, and reduce pain. The results of these procedures are similar. Reducing discomfort and increasing cervical spine range of motion are the main objectives of treatment.[7,10]

Recently, there has been an increasing interest in thoracic spine manual therapy as an adjunct to traditional cervical spine treatments. This approach is based on the conceptual model of regional interdependence, which suggests that thoracic spine dysfunction can influence cervical spine mechanics and contribute to neck pain. Furthermore, neurophysiological effects such as pain modulation and improved mobility provide additional theoretical support for this intervention.[6]

Several studies have explored the efficacy of manual thoracic and cervicothoracic therapies. Masaracchio et al.[7] demonstrated that combining thoracic thrust manipulation with cervical non-thrust manipulation and exercise leads to better short-term outcomes in terms of pain intensity, disability indices, and perceived recovery.[7] Similarly; Dunning JR. et al.[11] found that a combination of upper cervical and thoracic thrust manipulations was more effective than non-thrust mobilization for the short-term relief of mechanical neck pain.[11] However, Griswold D[12] found in his study equivalent outcomes for both the groups (thrust manipulation vs non thrust manipulation) leading to question which technique is better than other.[12] Loreto et al.[2] also highlighted the potential of a single session of skilled manual therapy to reduce acute neck pain and disability, showing promise for non-specific mechanical neck pain.[2]

The cervicothoracic (CT) junction, a critical link between the cervical and thoracic spine, has also been the focus of research.[3,4] Stiffness in this region contributes to neck pain and its associated symptoms.[4] While Joshi et al.[4]'s study comparing CT junction-specific mobilization and mid-thoracic manipulation found no significant superiority of the former,[4] similar results were observed in a randomized clinical trial conducted by Saddique et al.[3] in Pakistan. Both studies concluded that mid-thoracic manipulation and CT junction mobilization had comparable effects on the cervical range of motion and pain relief.[3,4]

Additionally, mobilization with movement such as Mulligan SNAGs (Sustained Natural Apophyseal Glides) have shown promise.[8,10] Sodany et al.[10] reported that SNAGs combined with exercise were more effective than exercises alone in managing cervical spine disorders.[10] Saleh et al.[8]'s findings further supported that adding Mulligan SNAGs to conventional physiotherapy improved pain intensity, proprioception, and scapular function more significantly than conventional therapy alone.[8] Although Mulligan mobilization use different biomechanics from classical Maitland mobilizations, both involve non-thrust oscillatory movements of the spine. While Mulligan SNAGs involve sustained accessory glides during active movement versus passive oscillatory techniques in Maitland—they both fall under non-thrust manual therapy techniques.[8,13] A study by Izquierdo Pérez, H. directly compared the efficacy of these three techniques of manual therapy including HVLA thrust, Maitland mobilization and Mulligan's SNAG.[13]

Despite these advances, the relative efficacy of mobilization versus manipulation for mechanical neck pain remains controversial. Although these techniques have demonstrated benefits, there is a need for a comprehensive comparison between all three manual therapy techniques applied at both the cervical and thoracic spine to guide sound clinical decision-making. Therefore, for the purpose of this review, studies comparing SNAGs are grouped within the mobilization/ non-thrust category, with subgroup analysis and interpretation under 'mobilization with movement' category accounting for their mechanical differences. This systematic review sought to evaluate and synthesize the available evidence, provide clarity on the effectiveness of these interventions, and inform best practices in mechanical neck pain management.

Methodology

Data Sources and Searches

This systematic review followed PRISMA guidelines ensuring transparency in methods and reporting. A comprehensive literature search was conducted to evaluate the comparative efficacy of mobilizations (without and with movement including SNAGs) and manipulation in the treatment of mechanical neck pain. The search was carried out by three independent reviewers from November 2024 to January 2025. Five electronic databases were systematically searched: NCBI-PubMed, Google Scholar, PEDro, Cochrane Library and CINAHL (Cumulative Index to Nursing and Allied Health Literature). There were limitations on study design as we select RCTs and the search was restricted to studies published in English from 2009 to 2024. Boolean operators were used to structure the search strategy, with search strings tailored to each database. A typical search included combinations such as: ("mobilization" OR "non-thrust" OR "SNAGs") AND ("manipulation" OR "thrust") AND ("mechanical neck pain" OR "cervical spine" OR "thoracic spine").

Study Selection

As part of the study selection process, Interventions were grouped into three categories for comparison: (1) traditional mobilization techniques, (2) mobilization with movement (SNAGs), and (3) high-velocity low-amplitude thrust/ manipulation. This allowed for analysis of treatment effect heterogeneity and helped prevent conflation of fundamentally different manual therapy approaches. Studies were included in this systematic review based on the following inclusion criteria:

Inclusion Criteria

- Only randomized controlled trials (RCTs), including pilot RCTs with a clearly defined control group, were included. Studies needed to directly compare manual mobilization techniques (with or without movement, including SNAGs) with spinal manipulation interventions in adult patients with a confirmed diagnosis of mechanical neck pain.
- Studies involving adult participants diagnosed with mechanical neck pain.
- Studies reporting primary outcomes such as pain reduction, range of motion (ROM), and functional improvement.
- Studies published in English and available as full-text PDFs.

Exclusion Criteria

Studies were excluded based on the following exclusion criteria:

- Non-randomized trials, observational studies, and case reports.
- Studies focused on conditions other than mechanical neck pain, such as radiculopathy, cervicogenic headache or whiplash.
- Studies that did not compare mobilizations (without or with movement including SNAGs) with manipulation interventions.
- Non-peer-reviewed articles or studies with insufficient data for outcome analysis.

Discrepancies in study selection were resolved through discussion and consensus.

Data Extraction

Data were extracted independently by three reviewers using a pre-designed standardized extraction form, which included study identifiers, participant demographics, intervention protocols (frequency, duration, techniques), outcome measures (pain, ROM, function), follow-up intervals, and statistical findings. Discrepancies were resolved by consensus or consultation with a fourth reviewer.

Quality Assessment

To ensure a comprehensive and robust evaluation of the methodological quality of studies included in this systematic review, a dual framework combining the Physiotherapy Evidence Database (PEDro) Scale was employed, and the Cochrane Risk of Bias 2.0 (RoB 2.0) tool was used to assess bias across five domains for each included RCT. This integrative method allowed for a nuanced assessment of both the internal validity of individual studies and the overall strength of evidence.

The PEDro Scale

The PEDro Scale was selected as a primary tool for evaluating the methodological rigor of randomized controlled trials (RCTs). Developed as a standardized checklist, the PEDro Scale has been widely adopted in clinical research for its reliability and validity in assessing both internal and external validity.[14,15] Comprising 11 criteria, the first item addresses external validity, while the remaining 10 focus on internal validity aspects such as randomization, allocation concealment, and blinding.

For this review, the external validity item was excluded from scoring, as the focus was primarily on internal validity, in line with established practices in systematic reviews[16]. Studies scoring between 7 and 10 were classified as high quality, scores between 5 and 6 indicated fair quality, and scores ≤4 were categorized as poor quality[17].

Of the twelve studies included in this review, eight had pre-existing, peer-reviewed PEDro scores. These were independently verified for accuracy and consistency by two reviewers. One study was found to have conflicting pre-existing score due to mentioning no blindness of assessors whereas; it was found that outcome assessor was blinded in the study. Hence, the score was upgraded from 7 to 8/10.[12] For the four studies without prior PEDro scores, three independent reviewers conducted assessments, resolving any discrepancies through discussion and consensus (Table 1). The reliability of PEDro scores has been consistently reported as "fair to excellent" across diverse contexts, further justifying its use in this review[18.]

Table 1. PEDro Scoring of Included Studies

Reference	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Total Score**	**Study Quality**
Salom et al.[19]	Y	Y	Y	N	N	Y	Y	N	Y	Y	7	High
Cleland JA et al.[20]	Y	Y	Y	N	N	N	Y	Y	Y	Y	7	High
Dunning JR et al.[11]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8	High

Griswold D et al.[12]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8	High
Saddique et al.[3]	Y	Y	Y	N	N	N	Y	N	Y	Y	6	Fair
Joshi et al.[4]	Y	Y	Y	N	N	Y	Y	N	Y	Y	7	High
Mastracchio et al.[7]	Y	Y	Y	N	N	N	Y	Y	Y	Y	7	High
Suvarnnato et al.[9]	Y	Y	Y	N	N	Y	Y	N	Y	Y	7	High
Loreto et al.[2]	Y	N	Y	Y	N	N	Y	N	Y	Y	6	Fair
Saleh et al.[8]	Y	Y	Y	N	N	Y	Y	N	Y	Y	7	High
Sodany et al.[10]	Y	N	Y	Y	N	Y	N	N	Y	Y	6	Fair
Izquierdo Pérez H et al.[13]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	9	High
Total of 'yes' scores	12	10	12	3	0	8	11	5	12	12		
% of 'yes' per criterion	100%	83%	100%	25%	0%	67%	92%	42%	100%	100%		

Score Average 7.08 High
Standard Deviation 0.90

Y5 Criterion satisfied; N5 Criterion not satisfied.
2. Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received).
3. Allocation was concealed.
4. The groups were similar at baseline regarding the most important prognostic indicators.
5. There was blinding of all subjects.
6. There was blinding of all therapists who administered the therapy.
7. There was blinding of all assessors who measured at least one key outcome.
8. Measurements of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.
9. All subjects for whom outcome measurements were available received the treatment or control condition as allocated, or where this was not the case, data for at least one key outcome were analysed by 'intention to treat'.
10. The results of between-group statistical comparisons are reported for at least one key outcome.
11. The study provides both point measurements and measurements of variability for at least one key outcome.

The Risk of Bias Assessment

In addition to the PEDro scale, the Cochrane Risk of Bias 2.0 (RoB 2.0) tool was also applied to assess the quality of the included randomized controlled trials across five domains: randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result (Table 2). Each domain is assessed based on series of question leading to hierarchical judgment i.e., Low risk of bias, some concerns and High risk of bias, which in turn leads to an overall risk-of-bias judgment of the study.[21]

Table 2. Risk of Bias (RoB 2.0) Assessment of Included Studies

Study	PEDro Score	Randomization Process	Deviations from Intended Interventions	Missing Outcome Data	Measurement of the Outcome	Selection of the Reported Result	Overall RoB
Salom-Moreno et al.[19]	7/10	Low Risk	High Risk	Low Risk	Low Risk	Low Risk	High Risk
Cleland JA et al.[20]	7/10	Low Risk	High Risk	Low Risk	High Risk	Low Risk	High Risk
Dunning JR et al.[11]	8/10	Low Risk	High Risk	Low Risk	Low Risk	Low Risk	High Risk
Griswold D et al.[12]	8/10	Low Risk	High Risk	Low Risk	Low Risk	Low Risk	High Risk
Saddique et al.[3]	6/10	Low Risk	High Risk	Low Risk	High Risk	Some Concerns	High Risk
Joshi et al.[4]	7/10	Low Risk	High Risk	Low Risk	Low Risk	Some Concerns	High Risk
Masaracchio et al.[7]	7/10	Low Risk	High Risk	Low Risk	High Risk	Low Risk	High Risk
Suvarnnato et al.[9]	7/10	Low Risk	High Risk	Low Risk	Low Risk	Some Concerns	High Risk
Loreto et al.[2]	6/10	Some Concerns	High Risk	Low Risk	High Risk	Low Risk	High Risk
Saleh et al.[8]	7/10	Low Risk	High Risk	Low Risk	Low Risk	Some Concerns	High Risk
El-Sodany et al.[10]	6/10	Some Concerns	High Risk	Some Concerns	Low Risk	Some Concerns	High Risk
Izquierdo Pérez H et al.[13]	9/10	Low Risk	Some Concerns	Low Risk	Low Risk	Low Risk	Some Concerns

Data Synthesis

Given the variability in study designs, outcome measures, and intervention protocols, a narrative synthesis approach was used to compare the results of the included studies. This synthesis focused on the comparative efficacy of mobilization (including SNAGs) versus manipulation for key outcomes such as pain reduction, ROM, and functional improvement. Due to high heterogeneity in study design, outcome measures, and follow-up durations, meta-analysis was not conducted. However, effect sizes (Cohen's d) were calculated for key outcomes such as pain, disability, and ROM where data permitted. Table X summarizes these between-group differences with 95% confidence intervals.

The PRISMA flow diagram (Fig. 1), which describes the study's identification procedure, abstract screening results, and full-text eligibility assessments, including the rationale for exclusions, was followed in the data synthesis. In the end, twelve articles fulfilled the eligibility criteria for full-text evaluation.

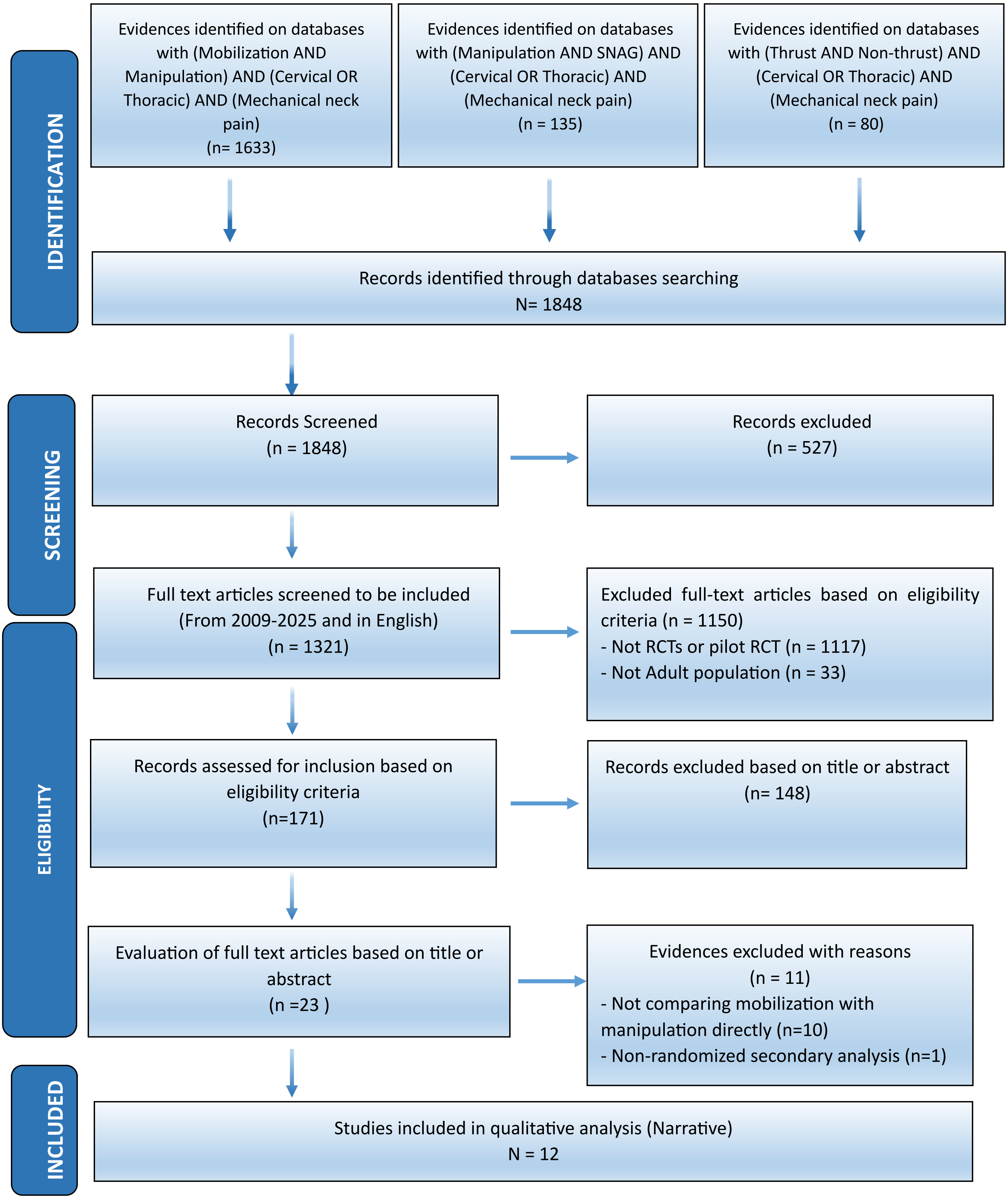

Fig. (1): PRISMA Diagram.

Result

A total of 23 studies were identified for potential inclusion. After reviewing the abstracts, only 12 met the inclusion criteria (Fig. 1). Ten of the included studies were randomized controlled trials.[2,3,7,8,10,11,12,13,19,20] The remaining two studies were randomized controlled trial (RCT) pilot studies.[4,9] The twelve studies included a mixed population of men and women. All patients were diagnosed with mechanical neck pain. Each patient had varying symptom durations and ages, ranging from 18 to 70 years. Twelve different outcome measures were used in the 12 studies reviewed. The two most commonly used outcome measures in the included studies were the NPRS[2,3,4,7,11,12,20,19] and NDI.[2,7,10,11,12,13,20] Physical impairment of cervical ROM was measured post-intervention in five studies.[3,4,9,10,13] All these have been shown to be reliable measures of clinical improvement. Follow-up times ranged from immediately post-intervention to 3 months after treatment. (Table 3)

Methodological quality assessment

The PEDro scores of each study are listed in Table 1. The scores of the included studies ranged from 6 to 9 with a mean score of 7.08 (SD 0.90), indicating that the average quality of the included studies was high. Based on PEDro scoring (Table 1), nine studies were classified as high quality (scores ≥7), while three studies scored between 5 and 6 and were classified as fair quality. The cutoff thresholds followed the convention used in recent reviews to ensure comparability. Four PEDro criteria were observed in all of the included studies: random allocation, baseline comparability, between-group statistical comparisons, and reporting of point measures and variability.[2,3,4,7,9,11,12,13,20] Only three met criterion five regarding the blinding of subjects.[2,10,13] while, eight studies reported blinding of the assessor who measured outcomes pre and post intervention.[4,8,9,10,11,12,13,19] Due to the nature of manual therapy interventions, blinding of treating clinicians was not feasible in any study. This inherent limitation should be considered when interpreting outcomes involving subjective measures like pain or disability.

The Risk of Bias assessment (RoB 2.0) for each study is mentioned in Table 2. Only one study (Izquierdo Pérez H et al.[13]) was judged to have overall some concerns of RoB and rest of eleven studies have overall High RoB. As all the studies involved different interventions of manual therapy delivered by the therapist and being distinguishable from each other, there was lack of therapist blindness in all studies leading to therapist bias. Another factor of domain 2 being high risk of bias in all studies except one (with some concerns) was that primary outcome measures were subjective- self-reported pain and disability in almost all studies making it highly susceptible to bias specially when either the participants or the assessors are not blinded. These findings highlight the methodological variability across studies and emphasize the need for cautious interpretation of their results.

Mobilization vs Manipulation

Six studies[3,4,11,12,19,20] were found to directly compare manipulation with mobilization. The sample sizes ranged from 36[2] to 107[10] patients. Salom-Moreno, J. et al.[19] (PEDro score=7), Cleland, J. A. et al.[20] (PEDro score=7) and Dunning J.R. et al.[11] (PEDro score=8) demonstrated that manipulation group showed statistically significant greater reduction in neck pain and disability, follow-ups ranging from immediately post-intervention (for neck pain $p<0.001$, between-group mean difference: 1.4; 95% confidence interval, 0.8-2.1)),[19] 2-4 days on initial intervention and examination (reductions in disability $p<0.001$, between-group difference of 10% (95% confidence interval [CI]=5.3-14.7) and in pain $p<.001$, between-group difference of 2.0 (95% CI=1.4-2.7))[20], and up to 48-hours after the initial examination (for disability $p<0.001$, between-group mean change (8.0 points [95% CI: 5.9, 10.2]) and for pain $p<.001$, between-group mean reduction (2.0 [95% CI: 1.5, 2.5]))[11]. Whereas Joshi et al.[4]

(PEDro score=7) and Saddique et al.[3] (PEDro score=6) demonstrated no statistically significant differences between the groups in post-treatment ROM or pain at immediate follow-ups (for pain p>0.05, mean difference − 0.12 (− 0.9–0.6), 95% CI,[4] p>0.05 between group difference 2.1 (1.7, 2.8), 95% CI)[3] However, within-group, pre, and post comparison showed significant improvements in cervical ROM and pain in both groups (p<0.01, mean difference = 1.19 for mobilization group, p<0.01, mean difference = 1.28 for manipulation group)[4] and (p<0.01, 3.0 (2.5, 3.5) manipulation group, p<0.01, 1.2 (0.7, 1.2) mobilization group)[3]. Another study by Griswold, D. et al.[12] (PEDro score=8) also stated similar results where between-group analyses of NTM or TM revealed no significant differences in outcomes on the NDI (p = .67, between group difference 0.47 (–2.7, 1.7)), PSFS (p= .26), NPRS (p = .25, between group difference 0.20 (–0.15, 0.55)), DCF (p = .98), GROC (p = .77), number of visits (p = .21), and duration of care (p = .61). Within group analysis showed significant difference for disability NDI, (difference estimate, 17.39; 95% confidence interval [CI]: 4.5, 20.1; P<.001) and pain NPRS (difference estimate, 3.00; 95% CI: 0.769, 3.45; P<.001).[12]

One study also compared mobilization with added manipulation along with active CROM. Mastracchio et al.[7] (PEDro score=7) compared manipulation along with mobilization and cervical AROM exercises with mobilization and cervical AROM exercises in 66 patients. The study demonstrated significantly greater improvements in both the NPRS and NDI at the 1-week follow-up for the 33 patients in the manipulation group (p<0.001) between-group difference of 1.3 points (95% confidence interval [CI]: 0.7, 2.0) on the NPRS and 8.8% (95% CI: 5.4%, 12.2%) on the NDI.[7]

Two studies compared mobilization with manipulation alongside a control group.[2,9] Suvarnnato et al.[9] (PEDro score=7) compared manipulation with mobilization and a control group not receiving any compressive pressure on joints in 39 patients with 13 subjects in each group. Both manipulation and mobilization showed significant reductions in VAS pain ratings and increases in CROM at the immediate and 24-hour follow-ups (p<0.05) compared to the control group. But no significant improvement in CROM and pain between mobilization and manipulation group was found (For VAS p>0.05, mean difference (95% CI) –1.94 (–11.72–7.84)).[9] Loreto et al.[2] (PEDro score=6) compared manipulation with mobilization and a control group of 36 patients. The manipulation group showed a significant increase in GROC (p=0.025) over time compared to the mobilization and control groups (p = 0.472 and p = 0.176, respectively). There was a significant decrease in NPRS in the manipulation and mobilization groups (p<0.002 and p<0.001, respectively) and a non-significant decrease in NPRS (p=0.642) in the control group. Similarly, there was a significant decrease in NDI for the manipulation and mobilization groups (p<0.001 and p<0.001) and a non-significant decrease in NDI (p=0.084) in the control group at immediate to 4 days post corresponding intervention.[2]

Mobilization with movement/ SNAGs vs Manipulation

Saleh et al.[8] (PEDro score=7) and Sodany et al.[10] (PEDro score=6) utilized manipulation compared to mobilization (SNAGs) and conventional physical therapy (CPT) which includes isometric, stretching and stabilization exercises of neck. The sample sizes were 60[8] and 42[10]. Both the manipulation and SNAGs groups showed significantly better outcomes than the CPT group (p<0.05, p<0.05)[8,10]; however, there were no significant differences between the manipulation and SNAGs groups (p>0.05, p>0.05) at follow-ups ranging from immediately post-intervention to one month duration. However, in Saleh's study significant reduction in pain was found in SNAG group compared to thoracic manipulation and CPT group and in Thoracic manipulation group compared to CPT group using VAS (p value<0.05, between

SNAG vs TM: MD (95% CI) -5 (-9.77, -0.22), SNAG vs CPT: MD (95% CI) -10.75 (-15.52, -5.97), and TM vs CPT: MD (95% CI) -5.75 (-10.52, -0.97))

Mobilization vs SNAGs vs Manipulation

The only study that compared all three manual therapy interventions was conducted by Izquierdo Pérez H et al.[13] with highest PEDro score of all (PEDro score=9). Total of 61 patients were randomized into three groups with 19 in HVLA thrust group and 21 each in SNAG and Mobilization group. The study concluded no long-term significant differences between groups in outcome with assessment performed 5 times including before intervention, immediate after intervention and follow up until 3 months post intervention. There was significant reduction in pain across all groups but no significant difference between groups was found using VAS (Follow up after 3 months, $p > 0.05$, Mean ± SD (95%IC) HVLA group: 1.0 ± 1.7 (0.3-1.8), Mob group: 0.6 ± 1.1(-0.1-1.3), SNAG group: 1.2 ± 1.9 (0.5-1.9).

Table 3. Study characteristics

Article	Control group	Experimental group	Intervention	Frequency	Assessment post-intervention	Follow-Up	Results

Mobilization vs Manipulation							
Salom-Moreno et al.[19]	None	*Group:1* Thoracic manipulation *n=27*; *Group:2* Thoracic mobilization *n=25*	*Group:1* High-velocity, end-range, anterior-posterior thrust (T3-T6, max 2 attempts); *Group:2* 20-second bouts of grades III-IV central posterior-anterior non-thrust mobilization (T3-T6)	One time treatment after initial evaluation	Pressure pain thresholds (PPTs); 11-point Numerical Pain Rate Scale (NPRS)	Immediate	No significant difference in PPT between groups. Thoracic manipulation group showed significantly greater reduction in neck pain.

Cleland JA et al.[20]	None	*Group 1: Non thrust mobilization n=30* *Group 2: Thrust mobilization/ manipulation n=30*	*Group 1:* 30-second bouts of grades III-IV central posterior-anterior non-thrust mobilization (T1-T6) + General cervical mobility exercises. Group 2: High-velocity, low-amplitude anterior-posterior thrust Upper thoracic (T1-T4),	One time treatment after initial evaluation	NDI (Neck Disability Index), NPRS, GROC Scale (global rating of change).	Within 2-4 days of initial examination and intervention session.	Thrust mobilization showed significantly greater short term reduction in pain and disability then non-thrust mobilizations.

			and middle thoracic (T5-T8) (max 2 attempts) + General cervical mobility exercises.				

Dunning JR et al.[11]	None	*Group:1* HVLA thrust manipulation *n=56*; *Group:2* Non thrust mobilization *n=51*	*Group:1* HVLA thrust manipulation (C1-2 & T1-2); *Group:2* Grade IV PA mobilizations (C1-2 & T1-2)	One time treatment after initial evaluation	NDI, NPRS, FRT (flexion-rotation test), CCFT (craniocervical flexion test), GROC.	48-hours after the initial examination	HVLA thrust manipulation group showed significantly greater reductions in disability and pain than the non-thrust mobilization group at 48 hours. Significantly greater improvement in C1-2

							rotation and deep cervical flexor motor performance.

Griswold D et al.[12]	None	*Group:1* HVLA thrust manipulation *n=48*; *Group:2* Non thrust manipulation *n=55*	*Group: 1* High-velocity, low-amplitude thrust to the most symptomatic segment of both the cervical and thoracic spines + HEP (AROM exercises for cervical and Thoracic, DCF) *Group: 2* Graded oscillatory	Determined pragmatically based on individual patient needs. NTM (5.7 ± 2.4) TM (6.4 ± 3.1)	NDI, PSFS (Patient-Specific Functional Scale), NPRS, DCF (deep cervical flexion endurance), GROC.	At baseline, visit 2, and discharge.	NTM and TM produce equivalent outcomes for patients with mechanical neck pain.

			technique to both the cervical and thoracic spines + HEP (AROM exercises for cervical and Thoracic, DCF)				

Saddique et al.[3]	None	*Group:1* Thoracic manipulation *n=23*; *Group:2* Maitland mobilisation *n=23*	*Group:1* Mid-thoracic manipulation (T3-T6) *Group:2* Cervicothoracic mobilization (C7-T1 Maitland technique)	One time treatment	CROM, NPRS.	Immediate	No significant differences between the groups in post-treatment ROM or pain. Significant improvements within-group in both groups.

Joshi et al.[4]	None	*Group:1* Thoracic manipulation *n=21*; *Group:2* Maitland mobilization *n=21*	*Group:1* HVLA thrust manipulation (T3-T6, max 2 attempts); *Group:2* Maitland mobilization(C7-T1) (30-second bouts, 3 sets)	One time treatment after initial evaluation	CROM (Cervical ROM flexion, extension, lateral flexion, rotation using CROM device), NPRS.	Immediate	No significant differences between the groups in post-intervention, Significant improvements within-group in both groups.

Masaracchio et al.[7]	None	*Comparison group: n=32* *Experimental group: n=34*	*Comparison group:* Grade 3 posterior-to-anterior oscillatory manipulation (C2-C7) + active cervical ROM exercises; *Experimental group:* Same as comparison+ thoracic spine thrust manipulation (T1-T3 & T4-T7)	Two treatment sessions	NPRS, NDI, GROC.	1 week	Experimental group showed significantly greater improvements on both NPRS and NDI at 1-week follow-up.

Suvarnnato et al.[9]	*Control group* Rest in a prone position *n=13*	*Group:1* Single level Thoracic manipulation *n=13*; *Group:2* Single level Thoracic mobilization *n=13*	*Group:1* HVLA thrust manipulation (T6-T7) *Group:2* Grade III unilateral postero-anterior mobilization (T6-T7) *Group 3:* Rest in a prone position	One time treatment	CROM, VAS (Visual Analogue Scale for Neck pain intensity)	Before, immediate and after 24-hours	Both thoracic manipulation and thoracic mobilization show significant reductions in VAS pain ratings and increases in CROM at immediate and 24-hour follow-ups than control group.

Loreto et al.[2]	*Control group:* Educational video *n=12*	*Experimental Group 1:* Cervical spinal manipulation *n=12*; *Experimental Group 2:* Cervical spinal mobilization *n=12*	*Group 1:* Standardized educational video (6 minutes) on postural correction; *Group 2:* High-velocity, mid-range, low-amplitude thrust manipulation; *Group 3:* 60 seconds low force (Grade II), 60 seconds high force (Grade III), 60	One time treatment	NDI, NPRS, GROC	5-minutes post, and 4 days post corresponding intervention	CSM group showed a significant increase in GROC compared to CSMob and PE groups. Significant decreases in NPRS and NDI for CSM and CSMob groups, non-significant decrease in PE group.

			seconds low force (Grade II) mobilizati ons.				
Mobilization with movement/ SNAGs vs Manipulation							

Saleh et al.[8]	*Control Group:* CPT only *n=20*	*Experimental Group:1* Mulligan SNAGs + CPT *n=20*; *Experimental Group:2* Thoracic Manipulation + CPT *n=20*	*Group:1* Mulligan SNAGs to the middle thoracic spine + CPT *Group:2* Thoracic HVLA thrust manipulation (T3-T7) + CPT *Group:3* Conventional physical therapy (CPT) - isometric neck exercises, chin tucks, neck	Three sessions a week for 4 weeks	VAS, Neck Proprioception (using CROM Device), Scapular Retraction (tape measurement)	4 weeks	Both SNAGs and TM groups showed significantly better outcomes than CPT group in all measured variables (pain, proprioception, scapular retraction). No significant difference between SNAGs

			muscle stretching, neck stabilization exercises (5 sets of 10 repetitions, 2 minutes rest between sets).				and TM groups in neck proprioception.

Sodany et al.[10]	*Control Group:* Exercise only *n=16*	*Experimental Group:1* SNAGs mobilization + exercise *n=18*; *Experimental Group:2* Manipulation + exercise *n=15*	*Group:1* SNAGs mobilization + exercise; *Group:2* HVLA cervical manipulation + exercise; *Group:3* Isometric, stretching, postural exercises.	Two sessions per week for 6 weeks	CROM, VAS, NDI	Before treatment, immediately after treatment, and at one month follow up	Significant improvements in ROM, pain reduction, and functional recovery in all. No significant difference between SNAGs and manipulation groups. Both groups 1 & 2

							showed significantly better outcomes than the exercise only group.
Mobilization vs SNAGs vs Manipulation							

Izquierdo Pérez H et al.[13]	None	*Group 1:* HVLA n= 19 *Group 2:* Mobilization n= 21 *Group 3:* SNAG n= 21	*Group 1:* High velocity Low amplitude thrust applied at most hypomobile vertebra for most limited cervical movement: lateral flexion or rotation (maximum of 2 thrusts) *Group 2:* Unilateral posteroanterior (PA) oscillatory	Four treatment sessions over 2 weeks	VAS, NDI, ACROM, GROC	Five evaluations: Before treatment, immediately after treatment, and one, two and three months after treatment	No significant differences were found between HVLA, Mob and SNAG at the end of treatment and during the follow-up in any of the analysed outcomes. There were no differences in satisfacti

			pressure was applied at hypomobile cervical vertebra (frequency of 2Hz for 2 mins, repeated 3 times with 1 min rest in between) *Group 3:* SNAG applied at most hypomobile and painful vertebra (3 sets of 10 reps)				on for all techniques.

Table 4: Effect Size Analysis for Neck Pain Treatment Interventions

Study	Comparison	Outcome Measure	Effect Size (d)	95% CI	Interpretation
Salom-Moreno et al.[19]	Manipulation vs Mobilization	NPRS (pain)	0.82	[0.32, 1.32]	Large effect favoring manipulation
Cleland et al.[20]	Manipulation vs Mobilization	NDI (disability)	0.75	[0.26, 1.24]	Medium-large effect favoring manipulation
Dunning et al.[11]	Manipulation vs Mobilization	NDI (disability)	0.68	[0.30, 1.06]	Medium effect favoring manipulation
Griswold et al.[12]	Manipulation vs Mobilization	NPRS (pain)	0.12	[-0.18, 0.42]	Negligible difference
Joshi et al.[4]	Manipulation vs Mobilization	CROM (ROM)	0.15	[-0.44, 0.74]	Negligible difference
Saleh et al.[8]	SNAGs vs Manipulation	VAS (pain)	0.18	[-0.32, 0.68]	Negligible difference
Sodany et al.[10]	SNAGs vs Manipulation	NDI (disability)	0.22	[-0.34, 0.78]	Negligible difference
Izquierdo Pérez et al.[13]	SNAGs vs Mobilization vs Manipulation	NDI (disability)	0.10 (between groups)	[-0.30, 0.50]	Negligible differences

Note: Effect sizes (Cohen's d) were computed using reported between-group means and pooled standard deviations, using the formula:
$d = (M_1 - M_2) / SD_{pooled}$,
where $SD_{pooled} = \sqrt{[(SD_1^2 + SD_2^2)/2]}$. Effect sizes were interpreted using standard thresholds: 0.2 = small, 0.5 = medium, and 0.8 = large. These calculations provide a standardized measure of treatment efficacy across studies.

The analysis of effect sizes revealed important patterns in the comparative efficacy of different manual therapy interventions for mechanical neck pain. Three high-quality studies (Salom-Moreno, Cleland, and Dunning) demonstrated medium-to-large short-term benefits of manipulation over conventional mobilization for both pain and disability outcomes, with effect sizes ranging from 0.68 to 0.82. However, four other studies (Griswold, Joshi, Saleh, and Sodany) found no significant differences between manipulation and mobilization techniques (including SNAGs), showing only negligible to small effect sizes between 0.12 and 0.22. When comparing all three approaches simultaneously, three-way comparisons indicated minimal differences between mobilization, SNAGs, and manipulation, with an overall effect size of just 0.10. This synthesis revealed considerable heterogeneity in treatment effects across studies in terms of intervention techniques, outcome measures, and follow-up durations. While, some demonstrating substantial advantages for manipulation, others showed equivalent outcomes across interventions. This variation limits the generalizability of pooled findings and emphasizes the need for individualized clinical decision-making based on patient-specific factors.

Discussion

The methodological quality of the included studies varied, with an average PEDro score of 7.08 (SD 0.90), indicating high quality evidence. While most studies adhered to proper randomization and statistical methodologies, blinding of participants and therapists remained a significant concern. Although the evidence in this review is categorized from 'fair to high' based on the PEDro scale but is graded as overall High risk of Bias on RoB 2.0 assessment for all studies except one with overall some concerns. The lack of long-term follow-up in several studies further limits the strength of recommendations derived from the evidence. Additionally, studies varied in their intervention protocols, sample sizes, and follow-up durations. Due to these limitations, the comparative efficacy of mobilization and manipulation in treating mechanical neck pain (MNP) became more challenging.

A thorough analysis of twelve randomized controlled trials (RCTs) was conducted to compare the efficacy of manipulation and mobilization in mechanical neck pain (MNP) patients. The results varied across studies, but several common themes emerged regarding pain reduction, range of motion (ROM), and functional improvement.

The studies included in this review reported follow-up durations ranging from immediate post-intervention[2,3,4,9,10,13,19] to four weeks[8,10,13], with only one study extending beyond one month (upto 3 months)[13]. Concerns regarding limited sampling were observed, as some studies were conducted at single clinical locations[3,8]. Additionally, variations in the application of mobilization and manipulation techniques were evident. Manipulation techniques included high-velocity, low-amplitude (HVLA) thrusts applied to the Cervical[2,10,11,12,13] or/and upper and middle Thoracic spine[3,4,7,8,9,11,12,19,20], while mobilization techniques encompassed central posterior-to-anterior (PA) mobilizations[2,3,4,7,9,11,12,13,19,20] and Mulligan SNAGs[8,10,13]. There were differences seen in the variety of application of manual therapy techniques, but for a thorough review all these studies were included in order to find out which one has greater benefits.

Studies involving a direct comparison of manipulation to mobilization had varying results. These studies utilized different techniques including single HVLA thrust manipulation directed to the upper cervical spine (C1-2)[11] in supine and anterior-posterior HVLA thrust manipulation applied to the upper and mid-thoracic spine in prone[3,4] and in supine[11,19,20.] These were in comparison to central grade IV PA mobilizations to the (C1-2) in supine[11] and central grades III to IV PA mobilization from T3 to T6 spinous process[19] , from T1-T6[20] and central PA glide to the C7-T1[3,4] in prone. Only one study had a pragmatic approach where technique and parameters were determined by the treating therapist based on patients' evaluation. Either a high-velocity, low-amplitude thrust, or a graded oscillatory technique was targeted to the symptomatic level to both cervical and thoracic spine.[12] In this study by Griswold D et al.[12] no significant differences were found between the groups controlling for clinical equipoise, but better outcomes were achieved for patients treated by clinicians with a preference toward TM. However, significant differences were found within both groups for pain and disability including other outcomes as well indicating effectiveness of both techniques.[12]

Study by Dunning Jr et al.[11], revealed that thoracic spine manipulation provided superior reductions in pain and disability at 48-hour follow-ups compared to cervical mobilization. The study was methodologically robust but lacked long-term follow-up, highlighting the need for further research into the sustained effects of manipulation[11]. A high-quality study by Salom-Moreno et al.[19] that found thoracic thrust manipulation to be significantly more effective than non-thrust mobilization in reducing neck pain intensity. However, both groups demonstrated similar improvements in pressure pain thresholds, indicating comparable effects on pain sensitivity. The study supports the hypothesis that manipulation may provide additional benefits beyond mobilization in terms of immediate pain relief.[19] Similarly, Cleland JA et al.[20] also found significant reduction in pain, disability and higher scores on GROC for patients who received thrust mobilization/manipulation. He also mentioned number of side effects experienced by subjects in each group, which were reported as non-significant between the groups. Side effects in the NTM group included an aggravation of symptoms (n2), muscle spasm (n1), neck stiffness (n2), headache (n2), and radiating symptoms (n2) and in the TM group, aggravation of symptoms (n8), muscle spasm (n1), and headache (n1). Although the time of initiation to lasting of symptoms was reported within 24 hours by all subjects.[20]

The study by Saddique et al.[3] compared mid-thoracic (T3-T6) manipulation to cervicothoracic junction (CT) mobilization. Both interventions resulted in significant within-group improvements in pain and ROM post-treatment, but no significant between-group differences were observed, suggesting both techniques are equally effective.[3] This aligns with findings from Joshi et al.[4], which also demonstrated no significant differences between the two interventions. These results are consistent with other studies that suggest both mobilization and manipulation can be effective interventions for MNP.[6]

A study by Mastracchio et al.[7], compared a group receiving PA NTM (grade 3) at spinous processes of cervical spine (C2-C7) with similar treatment plus 2 thoracic spine TM at upper thoracic spine (T1-T3) and 2 at the middle thoracic spine (T4-T7). It was found that combining thoracic and cervical manipulations to a classical mobilizations, led to greater improvements in NPRS and NDI scores at one-week follow-up compared to cervical mobilization alone.[7] These findings support the role of multimodal manual therapy in managing MNP, suggesting that addressing both thoracic and cervical dysfunction may provide superior clinical outcomes.

Loreto et al.[2]**,** assessed the effects of cervical spine mobilization versus manipulation on pain and disability alongside a control group. One group received a single session of CSM “Minimal Leverage Thrust” (HVLA force with either left side bending and right rotation or right side bending with left rotation targeted at the painful and/or restricted segment) in supine position, while the CSMob group received Grade II and III mobilization in prone. The control group was shown a postural education video. The manipulation group exhibited a significant increase in Global Rating of Change (GROC) scores compared to the mobilization and placebo groups. A significant reduction in NPRS and Neck Disability Index (NDI) scores were observed for both groups compared to the non-intervention group. However, no significant differences were found between the groups for each of the outcomes. These results suggest patient’s satisfaction influenced by increasing rends for high-thrust manipulation. Another study by Suvarnnato et al.[9], compared single level thoracic manipulation (T6-7) with PA grade III mobilization (at the zygapophyseal joint of T6-T7 on both sides) in prone with control group only lying in prone position. It demonstrated significant improvements in Visual Analog Scale (VAS) pain scores and ROM in both thoracic manipulation and mobilization groups compared to a control group where no compressive forces were applied. However, no significant differences were found between the two manual therapy techniques, indicating that both approaches may be equally beneficial which is consistent with above findings.[9]

Two studies compared mobilization with movement (SNAGs) and thoracic manipulation on neck pain. The study of Saleh et al.[8] used technique of Mulligan's SNAG at middle thoracic spine with the patient sitting astride a chair, the other group received thoracic manipulation (T3 and T7) in prone, and the control group was given conventional physical therapy. His study showed significant improvements in cervical ROM and pain reduction by both interventions, no significant differences were observed between groups. The study lacked sufficient blinding but featured strong randomization methods and concealed allocation. Sodany et al.[10] compared cervical SNAG (applied to the affected side in sitting position) along with cervical manipulation (cervical rotatory and lateral tilting techniques in supine position). He also found that SNAGs and manipulation were equally effective in improving cervical ROM and reducing pain compared to exercise-only groups. However, there was no significant difference between the SNAGs and manipulation groups.[10] These findings align with previous studies suggesting that SNAGs and manipulation may produce similar therapeutic effects.

The only study found that compared all three techniques altogether was rated as high quality evidence. Izquierdo Pérez, H. et al.[13] in his study randomized participants in three experimental groups to find the best technique. All techniques were applied at hypomobile vertebra One group was allocated for HVLA thrust (applied for the most limited movement: lateral flexion or rotation in supine), other received (PA) oscillatory pressure (mobilization at a frequency of 2Hz for 2 mins in prone) and the last group was given SNAG (on transverse process in sitting). This was the only study that had a long-term follow up for upto 3 months. The results of this study were no different from the above findings. All three techniques demonstrated significant reduction in pain and disability and increase in ACROM and GROC score. However, no significant differences in any of the outcomes were found between the groups. There was one interesting finding for ACROM, improved extension was noted only immediately in mob group, at only one month follow up in SNAG group and in HVLA thrust group at all follow up months than other groups.[13] These results cannot be generalized due to lack of sufficient data and small sample size.

Limitations

This systematic review has several limitations that impact the strength and generalizability of its findings. The lack of high-quality randomized controlled trials (RCTs) focused on mobilization for mechanical neck pain necessitated the inclusion of studies with lower methodological rigor. Variability in methodologies, techniques, outcome measures, and follow-up durations made it challenging to synthesize findings into precise clinical recommendations. The exclusion of non-English studies may have further restricted the scope of the review. Concerns highlighted by the PEDro scale included issues with blinding and treatment consistency, as most studies did not blind subjects and therapists, increasing the risk of expectation bias. Short follow-up durations, with most studies reporting outcomes up to only four weeks, limited the understanding of long-term intervention efficacy. Additionally, small sample sizes in several studies reduced the generalizability of results, while variability in manipulation and mobilization techniques hindered direct comparisons across studies.

Recommendations for Future Research

Future studies should directly compare manipulation and mobilization for MNP, using well-defined treatment protocols, long follow-up periods to assess the longer-term effects beyond four weeks, and multicentre trials across diverse clinical settings. Future studies should ensure adequate blinding of assessors. Thus, different methods of thoracic manipulations for instance, manipulation supine versus manipulation seated need to be investigated comparatively in order to see which one yields better results. Moreover, the examination of potential synergy between manual therapy and therapeutic exercise would have useful clinical implications.

Conclusions

As a result of the methodological concerns associated with the current research comparing mobilization and manipulation for mechanical neck pain (MNP), there is no clear evidence that supports one technique over the other. Both treatments significantly improved pain, range of motion, and functional outcomes in the short term; however, the evidence on their relative efficacy was limited by a wide variability in study designs, small sample sizes, and short follow-up. On the other hand, manipulation, especially thoracic manipulation, has a fair to good evidence base of variable quality to improve immediate and short-term neck pain and disability. Further studies are needed to establish the effectiveness of manipulation and mobilization in the long term, study standardized treatment protocols, and assess the effectiveness of manipulation and mobilization as an adjunct to other treatments.

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