

A Cochrane Review of Manipulation and Mobilization for Mechanical Neck Disorders

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Study Design and Objectives. Our systematic review of randomized trials assessed whether manipulation and mobilization relieve pain or improve function/disability, patient satisfaction, and global perceived effect in adults with mechanical neck disorders.

Summary of Background Data. Neck disorders are common, disabling, and costly.

Methods. Computerized bibliographic databases were searched up to March 2002. Two independent reviewers conducted study selection, data abstraction, and methodologic quality assessment. Relative risk and standardized mean differences were calculated. In the absence of heterogeneity, pooled effect measures were calculated using a random effects model.

Results. Of the 33 selected trials, 42% were high quality trials. Single or multiple (3–11) sessions of manipulation or mobilization showed no benefit in pain relief when assessed against placebo, control groups, or other treatments for acute/subacute/chronic mechanical neck disorders with or without headache. There was strong evidence of benefit favoring multimodal care (mobilization and/or manipulation plus exercise) over a waiting list control for pain reduction [pooled standardized mean differences -0.85 (95% CI: -1.20 to -0.50)], improvement in function [pooled SMD -0.57 (95% CI: -0.94 to -0.21)] and global perceived effect [standardized mean differences -2.73 (95% CI: -3.30 to -2.16)] for subacute/chronic mechanical neck disorders with or without headache.

Conclusions. Mobilization and/or manipulation when used with exercise are beneficial for persistent mechanical neck disorders with or without headache. Done alone, manipulation and/or mobilization were not beneficial; when compared to one another, neither was superior. There was insufficient evidence available to draw conclusions for neck disorder with radicular findings. Factorial design would help determine the active agent(s) within a treatment mix.

Key words: systematic review, mobilization, manipulation, pain, function, mechanical neck disorders, whiplash-associated disorders, arthritis. **Spine 2004;29:1541–1548**

Neck disorders are common, disabling to various degrees, and costly.^{1–3} A significant proportion of direct health care costs associated with neck disorders are attributable to visits to health care providers, to sick leave, and to the related loss of productive capacity.^{2–4} Manipulation and mobilization are commonly used approaches to treatment in this situation. However, studies of their effectiveness have generally been short-term and inconclusive.^{5–10}

Our systematic review assessed the effect of manipulation and mobilization either alone or in combination with other treatments on pain, function/disability, patient satisfaction, and global perceived effect in adults with mechanical neck disorders (MND). Where appropriate, the influence of treatment, methodologic quality, symptom duration, and subtypes of neck disorder on the effect is also assessed.

■ Methods

Criteria for Considering Studies to Review.

Type of Study. Published or unpublished randomized controlled trials (RCT) or quasi-RCTs.

Type of Participant. Adults (18 years or older) with the following acute (less than 30 days), subacute (30 days to 90 days), or chronic (greater than 90 days) neck disorders:

- MND including whiplash-associated disorders (WAD) category I and II,^{11,12} myofascial neck pain, and degenerative changes¹³
- Neck disorder with headache^{14–16}
- Neck disorders with radicular findings, including WAD category III^{11,12}

Type of Intervention. Studies using manipulation or mobilization techniques were included. Manipulation is a localized force of high velocity and low amplitude directed at cervical joint segments. Mobilizations use low-grade/velocity, small or large amplitude, passive movement techniques or neuromuscular techniques within the patient's range of cervical motion and control.

Type of Outcome. The outcomes of interest were pain relief, disability/function, patient satisfaction, and global perceived effect.

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The manuscript submitted does not contain information about medical device(s)/drug(s).

Federal and Foundation funds were received to support this work. No benefits in any form have been or will be received from any commercial party related directly or indirectly to the subject of this manuscript.

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Table 2. Number Needed to Treat and Treatment Advantage for Pain Relief Following Multimodal Care: Mobilization/Manipulation and Exercise

Author, Year: Comparison	Disorder	NNT	Treatment Advantage
Brodin 1985 ⁷⁰ : Group 3 v Group 1	Chronic MND +/- radicular findings or degenerative changes	4 for complete neck pain reduction	NA
Bronfort <i>et al</i> , 2001 ³³ : SMT/Ex v SMT	Chronic MND	10 for a clinically important pain reduction	12.5%
Geibel <i>et al</i> , 1997 ⁵⁴ : Group 1 v Group 2	Acute MND with headache, WAD	8 for complete neck pain reduction 9 for complete headache reduction	5.5%
Hoving <i>et al</i> , 2002 ⁶⁵ : MT v GP	Acute, subacute, chronic MND +/- radicular findings, neck disorder with headache	20 for a clinically important pain reduction	5.0%
Jull <i>et al</i> , 2002 ⁶¹ : MT/ExT v Control	Chronic neck disorder with headache	5 for a clinically important pain reduction	27.1%
Karlberg <i>et al</i> , 1996 ⁵⁵ : treatment v delayed treatment	Subacute MND with headache	2 for a clinically important pain reduction	40.8%
McKinney <i>et al</i> , 1989 ^{25,26} : Group 2 v Group 1	Acute MND, WAD	11 for clinically important pain reduction	17.1%
Mealy <i>et al</i> , 1986 ²⁴	Acute MND, WAD	6 for a clinically important pain reduction	40.8%
Provinciali <i>et al</i> , 1996 ⁵³ : Group A v Group B	Acute, subacute, MND with headache, WAD	6 for a clinically important pain reduction 31 for complete pain reduction	36.9%
Skargren <i>et al</i> , 1998 ⁴ : PT v Chiro	Chronic MND	4 for a clinically important pain reduction	26.1%
Vasseljen <i>et al</i> , 1995 ²⁸	Chronic MND	11 for a clinically important pain reduction 4 for a substantive pain reduction	11.9%

For comparison group definition, see Table 1.

NNT = the number of clients treated to prevent one occurrence of worsening, no change or mild neck pain; treatment advantage = the difference between the change in the treatment group divided by the baseline as a percent and a similar comparison in the control group; MND = mechanical neck disorder; WAD = whiplash-associated disorder.

Search Strategy for Identifying Studies. A research librarian searched computerized bibliographic databases, without language restrictions, for medical, chiropractic, and allied health literature. The following databases were searched from their respective beginning to March 2002: CENTRAL (The Cochrane Library Issue 4, 2002), MEDLINE, EMBASE, Manual Alternative and Natural Therapy (MANTIS), Cumulative Index to Nursing and Allied Health Literature (CINAHL), and the Index to Chiropractic Literature (ICL). Screening of references, communication with the coordinator of the Cochrane Back Group, personal communication with identified content experts, and our own personal files were also used to identify potential references. Subject headings (MeSH) and key words included anatomic terms, disorder or syndrome terms, treatment terms, and methodologic terms consistent with those advised by the Cochrane Back Group.

Methods of the Review. Four pairs of 2 independent reviewers each with expertise in medicine, physiotherapy, chiropractic, massage therapy, statistics, and clinical epidemiology conducted citation identification, study selection, data abstraction, and assessment of methodologic quality. Agreement was assessed for study selection using the quadratic weighted Kappa statistic (Kw); Cicchetti weights.¹⁷ A third reviewer was consulted in case of persisting disagreement.

Assessment of Methodologic Quality. Three reviewers independently assessed each selected study for quality of methodology, based on the validated 5-point Jadad *et al* (1996)¹⁸ criteria list (See Table 1, available for viewing on Article Plus, for the criteria and scoring.)

Quantitative Analysis of Trial Results. For continuous data, standardized mean differences (SMD) [95% confidence inter-

vals (CI)] were calculated using a random effects model. In the absence of clear guidelines on the size of sizes, we used a commonly applied system by Cohen (1988)¹⁹: small (0.20), medium (0.50), or large (0.80). We assumed the minimum clinically important difference to be 10 on a 100-point pain intensity scale. Similarly, a minimum clinically important difference of 5 neck disability index units was considered relevant for the neck disability index.²⁰ For continuous outcomes reported as medians, effect sizes were calculated.²¹ Relative risks (RR) were calculated for dichotomous outcomes. To facilitate analysis, data imputation rules were used when necessary.¹⁰ The number needed to treat (NNT) and treatment advantages were calculated for primary findings¹⁰ (Table 2). Power analyses were conducted for each article reporting nonsignificant findings (Table 1).²²

Before calculation of a pooled effect measure, the reasonableness of pooling was assessed based on clinical judgment. Statistical heterogeneity using the χ^2 method between the studies was tested using a random effects model. In the absence of heterogeneity (P greater than 0.05), a pooled SMD or RR was calculated. Sensitivity analysis or meta-regression for the factors—symptom duration, methodologic quality, and subtype of neck disorder—were planned but were not carried out because we did not have enough data in any one category.

Qualitative Analysis of Trial Results. To reach final conclusions, qualitative analysis was carried out, using the levels of evidence listed below.

- “Strong evidence” denoted consistent findings in multiple high quality RCTs.
- “Moderate evidence” denoted findings in a single, high-quality RCT or consistent findings in multiple low-quality trials.

- “Limited evidence” indicated a single low-quality RCT.
- “Conflicting evidence” denoted inconsistent results in multiple RCTs.
- “No evidence” meant no studies were identified.
- “Evidence of adverse effect” was used for trials that showed lasting negative changes.

■ Results

Description of Studies

Thirty-three trials in 52 publications were selected from 528 initially identified articles:

- 19 studied MNDs: acute,^{23–26} subacute,²⁷ chronic,^{4,28–34} mixed,^{35–50} and symptom duration not reported^{51,52};
- 12 studied headache of cervical origin: acute,^{53,54} subacute,⁵⁵ chronic,^{56–61} mixed,^{50,62–67} and symptom duration not reported⁶⁸;
- 6 studied neck disorder with some radicular findings: chronic,^{69–74} mixed,^{50,62,64–67} and symptom duration not reported⁷⁵;
- 6 studied WADs: acute,^{24–26,53,54} chronic,⁵⁷ and mixed⁴⁶; and
- 6 studied degenerative changes: chronic.^{32,35,37,38,46,56,69,70}

Table 1 provides details on treatment characteristics, cointerventions, baseline values, absolute benefits, reported results, SMD, RR, side effects, and costs of care. Agreement between pairs of independent reviewers was Kw 0.83, standard deviation (SD) 0.15. We excluded 13 RCTs based on the type of participant (*i.e.*, spasmodic torticollis), intervention (*i.e.*, manual therapy was in both the treatment and control group), or design reasons (*i.e.*, mechanistic trial design).

Methodologic Quality of Included Studies

See Table 1 for methodologic quality scores of each trial. We noted that 42% of the included studies were rated as high quality. We found common methodologic weaknesses of included studies to be failure to describe or use appropriate concealment of allocation (58%) and lack of effective blinding procedures, including blinding of the outcome assessor (66%). Cointerventions were avoided in only a small number of studies (24%). We do not believe that methodologic quality influenced the end result of our review, as both high- and low-quality studies had similar outcome directions. However, we were unable to formally test this notion using sensitivity analysis/metaregression because we did not have enough data in any one disorder and treatment category.

We were unable to carry out sensitivity analyses for symptom duration and subtype of neck disorder because we did not have enough data in any one category. Primary studies within a given treatment category frequently examined various disorder types of mixed symptom duration.

Manipulation Alone. Four RCTs from 5 publications assessed the effect of a single session of manipulation.^{35–38,62}

Review: Manipulation and Mobilisation for Mechanical Neck Disorders
Comparison: 01 MANIPULATION AND MOBILIZATION: Meta-analyses
Outcome: 01 Pain Intensity

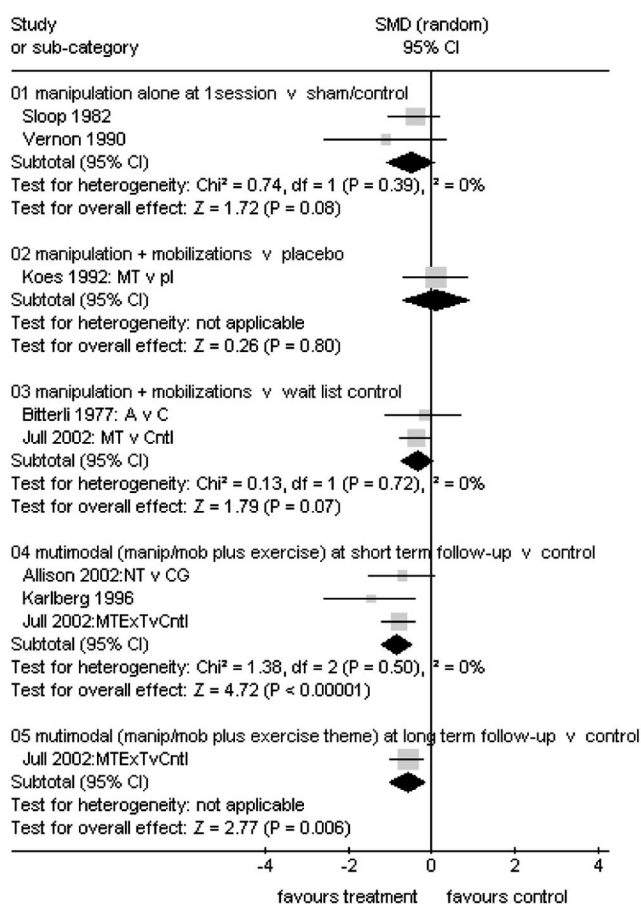


Figure 1. Meta-analysis: mobilization, manipulation, and multimodal care compared to a placebo or control for mechanical neck disorder pain relief.

When compared to a control (other treatments deemed to be ineffective), there was moderate evidence that single sessions did not result in short-term pain relief [pooled SMD -0.51 (95% CI: -1.10 – 0.07)]^{35,36} for acute, subacute, or chronic MND (Figure 1). We judged these 2 trials to be clinically comparable, and they were not statistically heterogeneous. Recent research suggests that muscle relaxants show no evidence of benefit and so would not have an interactive effect.^{76,77} It is our clinical belief, substantiated by evidence from the section below on mobilization, that a sham mobilization would have minimal to no clinical effect. Two further trials showed a similar negative effect but were not included in the meta-analysis due to the type of outcomes and disorder subtype: Howe *et al* (1983)⁶² compared manipulation plus azapropazone with azapropazone in patients with chronic radicular findings or headache, whereas Cassidy (1993)³⁷ compared manipulation to a muscle energy technique for acute, subacute, and chronic MND.

Five trials assessed the effect of 6 to 20 sessions of manipulation, conducted over 3 to 11 weeks, against various comparisons. The comparisons were wait list

control⁵⁶; soft tissue treatments^{58–60}; high-technology exercise³³; manipulation with low-technology exercise³³; tenoxicam with ranitidine³²; low voltage electrical acupuncture³²; and physiotherapy.^{4,30,31} In every case, the results were negative. No group showed more benefit than another for the outcomes pain, function, patient satisfaction, or global perceived effect in short-term follow-up assessments for chronic MNDs.

Three trials found no difference in short and intermediate-term pain relief when manipulation was compared to mobilizations for acute, subacute, and chronic MNDs^{36–38,50} or subacute/chronic neck disorder with headache or radicular findings.⁵⁰

Three further trials compared one manipulation technique to another. There was limited evidence of no difference in pain relief and functional improvement at short-term follow-up when:

- Thoracic manipulation was added to cervical manipulation⁵¹ for MND with symptom duration not defined;
- A rotatory manipulation was compared to a lateral break manipulation⁵² for MND with symptom duration not defined; and
- Instrumental manipulation was compared against manual manipulation²⁷ for subacute MND.

Mobilization Alone. Four trials from 6 publications compared mobilization against cold pack,⁵⁷ collar,²³ transcutaneous electrical nerve stimulation,²³ acupuncture,⁴⁶ and ultrasound.^{47–49} There was moderate evidence of no difference in pain and function outcomes from one high-quality trial with long-term follow-up for subacute/chronic MND including WAD⁴⁶ and 3 smaller trials with short-term follow-up for acute^{23,57} or subacute/chronic MND including WAD.^{47–49}

Multimodal Care: Manipulation and Mobilization. Six trials represented by 14 publications assessed manipulation and mobilization. When mobilization and manipulation were compared to a placebo, there was no evidence of difference in pain and function noted in one very small but high-quality RCT for subacute and chronic MND.^{39–45} When compared to no treatment, results showed a tendency toward short-term and long-term benefit for chronic neck disorder with headache across 3 outcomes:

- Pain relief [pooled SMD -0.34 (95% CI: -0.71 – 0.03)]^{56,61} (Figure 1);
- Function improvement [SMD -0.39 (95% CI: -0.79 – 0.02)]⁶¹; and
- Global perceived effect [SMD -2.36 (95% CI: -2.89 to -1.83)].⁶¹

When trials studied the effects of mobilization against physiotherapy care,^{4,30,31,39–45,68} general practitioner care,^{39–45} and exercise,⁶¹ conflicting results were shown for the outcomes of pain and function. This may have occurred in part from the use of different exercise regimes

and, of course, from the use of differing comparison groups. There was limited evidence that mobilization and manipulation gave results similar to manipulation alone for chronic MND.⁵⁶ In addition, there was moderate evidence from 1 high-quality trial with long-term follow-up of no difference in pain, function, or satisfaction for chronic MND, when one combination of mobilization, manipulation, and other soft-tissue techniques was compared to another.²⁹

Multimodal Care. Manipulation or Mobilization Plus Other Physical Medicine Agents. Six trials compared manipulation and/or mobilization in combination with various physical medicine agents against:

- No treatment controls^{69,70} for chronic neck disorder with radicular findings and degenerative changes;
- Placebo tablets for neck disorder with radicular findings of unclear symptom duration⁷⁵;
- Exercise for chronic MND²⁹;
- Combined exercise/traction/massage for neck disorder with radicular findings of unclear symptom duration⁷⁵;
- Various combinations of manipulation for chronic MND²⁹;
- Intermittent collar use for acute WAD^{25,26};
- Direct galvanic current, ultrasound, and ultraviolet light for acute, subacute, and chronic neck disorder with headache⁶³;
- Massage/munaripack for acute, subacute, and chronic neck disorder with headache⁶³;
- Mobilization or manipulation plus heat or electric muscle stimulation for subacute and chronic MND with or without radicular findings or headache⁵³; and
- A combination of massage, manual traction, electrical stimulation, analgesics, and education for chronic neck disorder with radicular findings.^{69,70}

In summary, there is moderate evidence showing no difference in benefit for pain relief, improvement in function, and global perceived effect for various disorder subtypes and for various symptom durations. This finding was from both low and higher quality trials with both short-term and long-term follow-up periods.

Multimodal Care. Mobilization and Manipulation Plus Exercise Focus. Fifteen trials with both short-term and long-term follow-up met the inclusion criteria for chronic MND,^{33,34} subacute or chronic neck disorder with headache,^{55,61} as well as acute, subacute, and chronic neck disorder with or without radicular findings or headache.^{64–67,69–70} When compared to a wait list control, there was strong evidence of maintained long-term benefit favoring multimodal care for:

- Pain relief [pooled SMD -0.85 (95% CI: -1.20 to -0.50)] for chronic MND,³⁴ for chronic neck disorder with or without radicular findings,^{69,70} and for subacute and chronic neck disorder with headache^{55,61} (Figure 1). This translates into an absolute

Review: Manipulation and Mobilisation for Mechanical Neck Disorders
 Comparison: 02 MULTIMODAL CARE - Manipulation or Mobilization plus Exercise: Qualitative Assessment
 Outcome: 03 Pain Intensity: multimodal [theme: mobilization and/or manipulation + exercise v control/comparison]

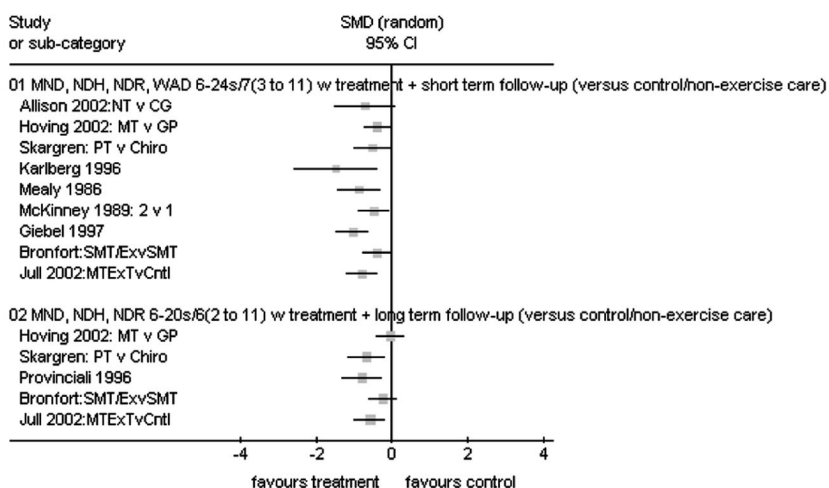


Figure 2. Qualitative analysis: multimodal care (manipulation and mobilization plus exercise) for mechanical neck disorder pain relief. s = sessions, w = weeks, MND = mechanical neck disorder; NDH = neck disorder with headache; NDR = neck disorder with radicular findings; WAD = whiplash-associated disorder. For comparisons, see Table 1.

benefit of 23 to 27 mm visual analogue scale (VAS) units and treatment advantage as high as 41%. The NNT to achieve this advantage was from 2 to 5 (Table 2).

- Improved function [pooled SMD -0.57 (95% CI: -0.94 to -0.21)] for chronic MND³⁴ and for subacute/chronic neck disorder with headache.⁶¹
- Global perceived effect [SMD -2.73 (95% CI: -3.30 to -2.16)] for subacute and chronic neck disorder with headache.⁶¹

The common elements in this care strategy in all the studies were mobilization or manipulation plus exercise. Other elements that may have been included were medication, thermal agents (heat or cold), and education. These results were also noted when compared against nonexercise-based treatments (Figure 2).

Is exercise the “active ingredient”? We do not know. On the one hand, patients were more satisfied with manipulation plus exercise over manipulation or exercise alone. On the other hand, when mobilization and manipulation plus exercise was compared against exercise, there was moderate evidence of no difference for pain relief or improvement in function.^{33,61,64–67}

Persson *et al* evaluated chronic neck disorders with radicular findings.^{71–74} At short-term follow-up, there was evidence of benefit favoring surgery over physiotherapy care and collar use. At long-term follow-up, no difference was found between physiotherapy care, collar use, and surgery.

Other Considerations

Adverse Events. Side effects were reported in 31% of the trials. They were benign, transient, and included headache, radicular pain, thoracic pain, increased neck pain, distal paraesthesia, dizziness, and ear symptoms. The rate of serious adverse events could not be determined in this review.

Cost of Care. There was moderate evidence favoring reduced costs for manual therapy care for acute, subacute, and chronic MND with or without headache or radicular findings.^{4,30,31,53,54,64–67}

■ Discussion

Methodologic Quality

We have observed 4 positive advances in more recently published reports of trials. Trials were larger, were of higher methodologic quality, had longer-term follow-up, and used self-reported ratings (*e.g.*, pain, disability self-report questionnaires, global perceived effect) as primary outcomes on a more consistent basis. We attach great value to the patient’s opinion, as do recent guidelines in the low back literature,^{78,79} and believe its subjectivity is insufficient argument against its use. Balancing self-report outcomes with “observer-based performance measures” would be ideal; unfortunately, the latter measures do not yet exist in the neck care literature.

Certain methodologic issues are inherent to the design of trials on manual therapy for neck pain. Manual therapy cannot easily be studied in a double-blinded manner (blinding therapists and patients) in clinical practice. Therefore, it is essential to blind the outcome assessor and the investigator doing the analyses. Expectation bias could be minimized by selecting patients without prior knowledge/experience or without strong expectations for either treatment. This could be achieved through administration of a brief questionnaire before inclusion into the trial (*e.g.*, How do you expect your neck pain to change as a result of the following treatments you may receive in the study?). Even though some would suggest modifying the quality assessment instrument for studies in which the nature of intervention precludes blinding of participants and therapist, using a common validated tool to assess RCTs keeps the methodologic quality and resulting strength of the evidence in perspective.

In our previous Cochrane systematic review, which included studies to 1997, results remained inconclusive and were available only for the short-term. Since then, 13 RCTs have been published and included in our current review. Recent trials have added further support to the role of multimodal care (mobilization/manipulation and exercise) in achieving clinically important pain reduction, global perceived effect, and patient satisfaction in acute and chronic neck disorder with or without headache. We continue to not find evidence in support of manipulation or mobilization as solo treatments, and some reviews^{7,12,80,81} agreed with these findings. Our findings are in disagreement with other reviews.^{6,80,82–84} We agree with Peeters *et al* (2001)⁹ that it is difficult to identify the effective components of a multimodal active treatment approach without using factorial design. In addition, there are differences between reviews in the definition or clustering of different treatments, disorder subgroups reviewed, the technique definition, and outcome measures reported.⁸

Adverse Events and Cost of Care

Adverse events reported from RCTs in this review were benign, transient side effects. Clearly, smaller randomized trials are unlikely to detect rare adverse events. From surveys and review articles, the risk of a serious irreversible complication for cervical manipulations has been reported to vary from 1 adverse event in 3020 to 1 in 1,000,000 manipulations.^{85,86} Better reporting of adverse events is required. In addition, there was moderate evidence of an economic advantage in using multimodal care, defined as mobilization or manipulation plus exercise, for mechanical neck disorders. As more trials become available, details of direct and indirect costs can be better summarized.

Reviewer Conclusions

Implications for Practice. Multimodal care, including mobilization and/or manipulation plus exercise, is beneficial for pain relief, functional improvement, and global perceived effect for subacute/chronic MND with or without headache. The evidence did not favor manipulation and/or mobilization done alone or in combination with various other types of treatments for pain, function, and global perceived effect. It was not possible to determine which technique or dosage was more beneficial or if certain subgroups benefited more from one form of care than another. There was insufficient evidence available to draw conclusions for neck disorder with radicular findings.

Implications for Research. Meta-analysis of data across trials and sensitivity analysis was hampered by the wide spectrum of comparisons, treatment characteristics, and dosages. Factorial design would help determine the active treatment agent(s) within a treatment mix. Phase II trials would help identify the most effective treatment

characteristics and dosages. Greater attention to methodologic quality is needed.

Key Points

- Mechanical neck disorders are common, costly, and can be disabling.
- This systematic review of 33 trials did not favor mobilizations and/or manipulations done alone or combined with other treatments like heat for relieving acute or persistent pain and improving function when compared to no treatment.
- Mobilization and/or manipulation when used with exercise are effective for alleviating persistent neck pain and improving function when compared to those who received no treatment. When compared to one another, neither mobilization nor manipulation was superior.
- There was insufficient evidence available to draw conclusions for mechanical neck disorder with radicular findings.

Acknowledgments

We are indebted to the many authors of primary studies for their support in retrieving original research. We thank our volunteers, translators, and the editors of the Cochrane Collaboration Back Review Group. The Cervical Overview Group is an interdisciplinary and internationally based working group interested in conducting and maintaining system reviews on conservative management for mechanical neck disorders. Cervical Overview Group members: P. Peloso, MSc; N. Graham, BScPT; P. Santaguida, PhD; K. Trinh, MSc; B. Haraldsson RMT; and A.M. Eady, MLS.

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