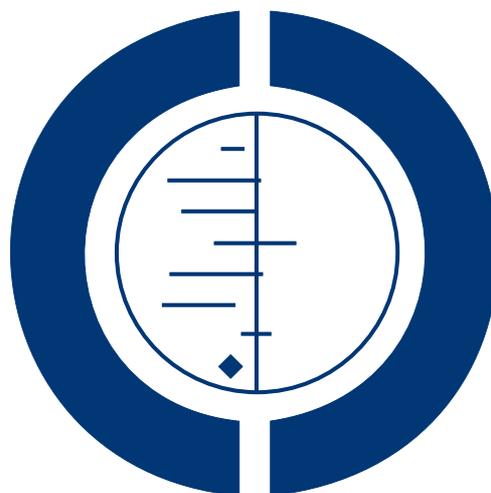


Manipulation or Mobilisation for Neck Pain (Review)

Gross A, Miller J, D'Sylva J, Burnie SJ, Goldsmith CH, Graham N, Haines T, Brønfort G, Hoving JL



**THE COCHRANE
COLLABORATION®**

This is a reprint of a Cochrane review, prepared and maintained by The Cochrane Collaboration and published in *The Cochrane Library* 2010, Issue 5

<http://www.thecochranelibrary.com>



TABLE OF CONTENTS

HEADER	1
ABSTRACT	1
PLAIN LANGUAGE SUMMARY	2
BACKGROUND	3
OBJECTIVES	3
METHODS	3
Figure 1.	6
RESULTS	6
Figure 2.	7
Figure 3.	9
Figure 4.	10
Figure 5.	11
Figure 6.	12
Figure 7.	13
Figure 8.	14
Figure 9.	15
Figure 10.	16
Figure 11.	17
Figure 12.	19
Figure 13.	19
DISCUSSION	20
AUTHORS' CONCLUSIONS	22
ACKNOWLEDGEMENTS	23
REFERENCES	23
CHARACTERISTICS OF STUDIES	33
DATA AND ANALYSES	85
Analysis 1.1. Comparison 1 SINGLE CARE, Outcome 1 Cervical Manipulation vs Cntl or varied comparisons: PAIN - Single Session.	87
Analysis 1.2. Comparison 1 SINGLE CARE, Outcome 2 Cervical Manipulation vs Cntl or varied comparisons: PAIN - Low dose trials.	88
Analysis 1.3. Comparison 1 SINGLE CARE, Outcome 3 Cervical Manipulation vs Cntl or varied comparisons: PAIN - Multiple Session.	89
Analysis 1.4. Comparison 1 SINGLE CARE, Outcome 4 Cervical Manipulation vs Mobilisation: PAIN.	90
Analysis 1.5. Comparison 1 SINGLE CARE, Outcome 5 Cervical Manipulation vs same treatment in both arms: PAIN Intensity.	91
Analysis 1.6. Comparison 1 SINGLE CARE, Outcome 6 Cervical Manipulation vs Placebo: PAIN PRESSURE.	91
Analysis 1.7. Comparison 1 SINGLE CARE, Outcome 7 Cervical Manipulation vs Cntl or varied comparisons: FUNCTION.	92
Analysis 1.8. Comparison 1 SINGLE CARE, Outcome 8 Cervical Manipulation vs Mobilisation/comparison: FUNCTION - Manipulation vs Mobilisation - short term follow-up.	93
Analysis 1.9. Comparison 1 SINGLE CARE, Outcome 9 Cervical Manipulation vs Mobilisation/comparison: PATIENT SATISFACTION.	94
Analysis 1.10. Comparison 1 SINGLE CARE, Outcome 10 Thoracic Manipulation vs Cntl: PAIN.	95
Analysis 1.11. Comparison 1 SINGLE CARE, Outcome 11 Cervical Mobilisation vs Comparison: PAIN.	96
Analysis 1.12. Comparison 1 SINGLE CARE, Outcome 12 Cervical Mobilisation one technique vs another technique: PAIN.	97
Analysis 1.13. Comparison 1 SINGLE CARE, Outcome 13 Cervical Mobilisation one technique vs another technique: PAIN.	98
Analysis 1.14. Comparison 1 SINGLE CARE, Outcome 14 Cervical Mobilisation vs Comparison: FUNCTION.	99
Analysis 1.15. Comparison 1 SINGLE CARE, Outcome 15 Cervical Mobilisation one technique vs another technique: GLOBAL PERCIEVED EFFECT.	99

Analysis 1.16. Comparison 1 SINGLE CARE, Outcome 16 Cervical Mobilisation vs Comparison: PATIENT SATISFACTION.	100
ADDITIONAL TABLES	100
APPENDICES	102
WHAT'S NEW	105
HISTORY	105
CONTRIBUTIONS OF AUTHORS	106
DECLARATIONS OF INTEREST	106
SOURCES OF SUPPORT	106
INDEX TERMS	107

[Intervention Review]

Manipulation or Mobilisation for Neck Pain

Anita Gross¹, Jordan Miller², Jonathan D'Sylva³, Stephen J Burnie⁴, Charles H Goldsmith⁵, Nadine Graham⁶, Ted Haines⁷, Gert Brønfort⁸, Jan L Hoving⁹

¹School of Rehabilitation Science & Dept Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, Canada. ²Georgetown, Canada. ³Markham, Canada. ⁴Department of Clinical Education, Canadian Memorial Chiropractic College, Toronto, Canada. ⁵Department of Clinical Epidemiology & Biostatistics, McMaster University, Hamilton, Canada. ⁶School of Rehabilitation Science, McMaster University, Ancaster, Canada. ⁷Clinical Epidemiology & Biostatistics, McMaster University, Hamilton, Canada. ⁸Wolfe-Harris Center for Clinical Studies, Northwestern Health Sciences University, Bloomington, MN, USA. ⁹Coronel Institute of Occupational Health, Academic Medical Center, Universiteit van Amsterdam, Amsterdam, Netherlands

Contact address: Anita Gross, School of Rehabilitation Science & Dept Clinical Epidemiology and Biostatistics, McMaster University, 1400 Main Street West, Hamilton, Ontario, L8S 1C7, Canada. grossa@mcmaster.ca. grossa@sympatico.ca.

Editorial group: Cochrane Back Group.

Publication status and date: Edited (no change to conclusions), published in Issue 5, 2010.

Review content assessed as up-to-date: 7 July 2009.

Citation: Gross A, Miller J, D'Sylva J, Burnie SJ, Goldsmith CH, Graham N, Haines T, Brønfort G, Hoving JL. Manipulation or Mobilisation for Neck Pain. *Cochrane Database of Systematic Reviews* 2010, Issue 1. Art. No.: CD004249. DOI: 10.1002/14651858.CD004249.pub3.

Copyright © 2010 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

ABSTRACT

Background

Manipulation and mobilisation are often used, either alone or combined with other treatment approaches, to treat neck pain.

Objectives

To assess if manipulation or mobilisation improves pain, function/disability, patient satisfaction, quality of life, and global perceived effect in adults with acute/subacute/chronic neck pain with or without cervicogenic headache or radicular findings.

Search strategy

CENTRAL (*The Cochrane Library* 2009, issue 3) and MEDLINE, EMBASE, Manual Alternative and Natural Therapy, CINAHL, and Index to Chiropractic Literature were updated to July 2009.

Selection criteria

Randomised controlled trials on manipulation or mobilisation.

Data collection and analysis

Two review authors independently selected studies, abstracted data, and assessed risk of bias. Pooled relative risk and standardised mean differences (SMD) were calculated.

Main results

We included 27 trials (1522 participants).

Cervical Manipulation for subacute/chronic neck pain: Moderate quality evidence suggested manipulation and mobilisation produced similar effects on pain, function and patient satisfaction at intermediate-term follow-up. Low quality evidence showed manipulation alone compared to a control may provide short-term relief following one to four sessions (SMD pooled -0.90 (95%CI: -1.78

to -0.02)) and that nine or 12 sessions were superior to three for pain and disability in cervicogenic headache. Optimal technique and dose need to be determined.

Thoracic Manipulation for acute/chronic neck pain : Low quality evidence supported thoracic manipulation as an additional therapy for pain reduction (NNT 7; 46.6% treatment advantage) and increased function (NNT 5; 40.6% treatment advantage) in acute pain and favoured a single session of thoracic manipulation for immediate pain reduction compared to placebo for chronic neck pain (NNT 5, 29% treatment advantage).

Mobilisation for subacute/chronic neck pain: In addition to the evidence noted above, low quality evidence for subacute and chronic neck pain indicated that 1) a combination of Maitland mobilisation techniques was similar to acupuncture for immediate pain relief and increased function; 2) there was no difference between mobilisation and acupuncture as additional treatments for immediate pain relief and improved function; and 3) neural dynamic mobilisations may produce clinically important reduction of pain immediately post-treatment. Certain mobilisation techniques were superior.

Authors' conclusions

Cervical manipulation and mobilisation produced similar changes. Either may provide immediate- or short-term change; no long-term data are available. Thoracic manipulation may improve pain and function. Optimal techniques and dose are unresolved. Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

PLAIN LANGUAGE SUMMARY

Manipulation and Mobilisation for Mechanical Neck Disorders

Neck pain is a common musculoskeletal complaint. It can cause varying levels of disability for the affected individual and is costly to society. Neck pain can be accompanied by pain radiating down the arms (radiculopathy) or headaches (cervicogenic headaches). Manipulation (adjustments to the spine) and mobilisation (movement imposed on joints and muscles) can be used alone or in combination with other physical therapies to treat neck pain.

This updated review included 27 trials (1522 participants) that compared manipulation or mobilization against no treatment, sham (pretend) treatments, other treatments (such as medication, acupuncture, heat, electrotherapy, soft tissue massage), or each other.

There is low quality evidence from three trials (130 participants) that neck manipulation can provide more pain relief for those with acute or chronic neck pain when compared to a control in the short-term following one to four treatment sessions. Low quality evidence from one small (25 participants) dosage trial suggests that nine or 12 sessions of manipulation are superior to three for pain relief at immediate post treatment follow-up and neck-related disability for chronic cervicogenic headache. There is moderate quality evidence from 2 trials (369 participants) that there is little to no difference between manipulation and mobilisation for pain relief, function and patient satisfaction for those with subacute or chronic neck pain at short and intermediate-term follow-up. Very low quality evidence suggests that there is little or no difference between manipulation and other manual therapy techniques, certain medication, and acupuncture for mostly short-term and on one occasion intermediate term follow-up for those with subacute and chronic neck pain (6 trials, 494 participants) and superior to TENS for chronic cervicogenic headache (1 trial, 65 participants).

There is very low to low quality evidence from two trial (133 participants) that thoracic (mid-back) manipulation may provide some immediate reduction in neck pain when provided alone or as an adjunct to electrothermal therapy or individualized physiotherapy for people with acute neck pain or whiplash. When thoracic manipulation was added to cervical manipulation alone, there was very low quality evidence suggesting no added benefit for participants with neck pain of undefined duration.

There is low quality evidence from two trials (71 participants) that a mobilisation is as effective as acupuncture for pain relief and improved function for subacute and chronic neck pain and neural dynamic techniques produce clinically important pain reduction for acute to chronic neck pain. Very low to low quality evidence from three trials (215 participants) suggests certain mobilisation techniques may be superior to others.

Adverse (side) effects were reported in 8 of the 27 studies. Three out of those eight studies reported no side effects. Five studies reported minor and temporary side effects including headache, pain, stiffness, minor discomfort, and dizziness. Rare but serious adverse events, such as stroke or serious neurological deficits, were not reported in any of the trials.

Limitations of this review include the high number of potential biases found in the studies, thus lowering our confidence in the results. The differences in participant and treatment characteristics across the studies infrequently allowed statistical combination of the results.

Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change

BACKGROUND

Neck disorders are common, disabling to various degrees, and costly (Borghouts 1999; Côté 1998; Hogg-Johnson 2008; Linton 1998). Neck pain with or without symptoms that radiate to the arms or head may involve one or several neurovascular and musculoskeletal structures such as nerves, ganglion, nerve roots, uncovertebral joints, intervertebral joints, discs, bones, periosteum, muscle and ligaments. We included neck pain with cervicogenic headache, which is pain that emanates from the neck and suboccipital region and radiates to the forehead, orbital region, temples, vertex or ears and is aggravated by specific neck movements or sustained neck postures.

A significant proportion of direct healthcare costs associated with neck disorders are attributable to visits to healthcare providers, sick leave, and the related loss of productive capacity (Borghouts 1998; Côté 2008, Linton 1998; Skargren 1998). Manipulation and mobilisation are commonly used treatments for neck pain and may be performed by physical therapists, chiropractors, traditional bone setters, osteopaths, medical doctors, and massage therapists. Spinal mobilisation or manipulation has demonstrated mechanical effects including permanent or short-term change in length of connective tissue and neurophysiological effects including analgesic effects, motor effects, and sympathetic nervous system effect dysfunction (Souvlis 2004). Based on our earlier Cochrane Review, published in 2004 (Gross 1996; Gross 2004a; Gross 2004b), and other reviews (Bogduk 2000; Gross 2002a; Gross 2007; Hoving 2001; Peeters 2001; Vernon 2006; Vernon 2007), studies of their effectiveness have generally been noted when combined with other treatment like exercise and had short-term with inconclusive long-term results. Our former Cochrane review has been split; this review explores manipulation or mobilisation as a single-modal treatment and has excluded combined therapies.

OBJECTIVES

This update of our systematic review assessed the effect of manipulation or mobilisation alone on pain, function, disability, patient satisfaction, quality of life, and global perceived effect in adults experiencing neck pain with or without radicular symptoms and cervicogenic headache. Where appropriate, it also assessed the influence of treatment characteristics (i.e. technique, dosage), methodological quality, symptom duration, and subtypes of neck disorder on the effect of treatment.

METHODS

Criteria for considering studies for this review

Types of studies

Any published or unpublished randomised controlled trial (RCT) or quasi-RCT (QRCT), either in full text or abstract form, was included. A QRCT uses methods of allocation that are subject to bias in assignment, such as odd-even numbers, day of week, patient record, or social security number. As the total number of studies in this field is not large, we included quasi-RCTs. We had no restrictions on methodological quality of RCTs.

Types of participants

The participants were adults (18 years or older) with the following:

- Neck pain without radicular findings, including neck pain without specific cause, whiplash associated disorder (WAD) category I and II (Guzman 2008; Spitzer 1987; Spitzer 1995), myofascial pain syndrome, and neck pain associated with degenerative changes (Schumacher 1993);
- Cervicogenic headache (Olesen 1988; Olesen 1997; Sjaastad 1990); and
- Neck disorders with radicular findings (Rubinstein 2007), including degenerative joint or disc disease with spinal stenosis, spondylolisthesis, or discogenic radiculopathy; WAD category III (Spitzer 1995; Spitzer 1987).

We defined symptom duration as acute (less than 30 days), subacute (30 days to 90 days) or chronic (greater than 90 days).

Studies were excluded if they investigated neck disorders with the following specific causes:

- definite or possible long tract signs (e.g. myelopathies);
- neck pain caused by other pathological entities (Schumacher 1993);
- headache not of cervical origin but associated with the neck;
- co-existing headache when either neck pain was not dominant or the headache was not provoked by neck movements or sustained neck postures; or
- 'mixed' headache, which includes more than one headache classification

Types of interventions

We included studies using either manipulation or mobilisation techniques. Although typically applied to the cervical region, they could also be applied to other body regions; the guiding principle was a mobilisation or manipulation intervention with the intention to treat neck pain. Manipulation is a localised force of high velocity and low amplitude directed at specific spinal segments. Mobilisations use low-grade/velocity, small or large amplitude passive movement techniques or neuromuscular techniques within the patient's range of motion and within the patient's control. In the studies, these techniques might be used alone or in conjunction with other treatment agents, for example: mobilisation plus ultrasound versus ultrasound. All studies were compared to either a control or another treatment as follows:

Controls

- a) placebo, for example: sham/mock mobilisation or other sham treatment (e.g. sham TENS);
- b) adjunct treatment, for example: mobilisation plus a treatment (e.g. ultrasound) versus that same treatment (e.g. ultrasound); and
- c) wait list or no treatment;

Another Treatment

- a) manipulation or mobilisation versus another intervention (e.g. manipulation versus exercise);
- b) one technique of manipulation or mobilisation versus another (e.g. rotatory break versus lateral break manipulation);
- c) one dose of manipulation or mobilisation versus another dose (e.g. three weeks at nine sessions manipulation versus four weeks at 12 sessions).

Types of outcome measures

The outcomes of interest were pain relief, disability, function, patient satisfaction, global perceived effect and quality of life. We did not set any restriction on the type of tool used in the studies to measure these outcomes as there are no universally accepted tools available; albeit, we found a number of studies did use validated tools. Function and disability could be measured using either self-report measures or observer-based physical performance tests (Beattie 2001, Finch 2002). Measures of physical performance require testing the subject's ability to execute a simple activity in a standardised environment using a standardised test and scoring procedure; they are concerned with the testing of a co-ordinated set of functions, which forms a component of functional purposeful activity (i.e. reaching, walking, driving). Although moderate correlation between self-report scales and physical performance tests exists in the low back literature, it remains unclear if one is superior (Lee 2001) and this relationship in the neck literature remains unclear. We excluded tests used during a standard physical examination such as inspection, range of motion, strength, palpation, provocation, muscular stability, neurological tests, and cervical proprioception. We also extracted data on adverse effects and cost of treatments. The duration of follow-up is defined as:

- immediately post treatment (within one day);
- short-term follow-up (closest to four weeks);
- intermediate-term follow-up (closest to six months); and
- long-term follow-up (closest to 12 months).

Search methods for identification of studies

A research librarian searched bibliographic databases, without language restrictions, for medical, chiropractic, and allied health literature. We searched CENTRAL (The Cochrane Library 2009, issue 3) and MEDLINE, EMBASE, Manual Alternative and Natural Therapy, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Index to Chiropractic Literature (ICL) were updated to July 2009. All databases were originally searched from their beginning. We also screened references, personally communicated with identified content experts, and checked our own personal files to identify potential references. Subject headings (MeSH) and key words included anatomical terms, disorder or syndrome terms, treatment terms, and methodological terms consistent with those advised by the Cochrane Back Review Group. See [Appendix 1](#) for the search strategy for MEDLINE.

Data collection and analysis

Study Selection, Data Extraction

At least two reviewer authors with expertise in medicine, physiotherapy, chiropractic, massage therapy, statistics, or clinical epidemiology independently conducted citation identification, study selection, and data extraction. Agreement for study selection was assessed using the quadratic weighted Kappa statistic (Kw); Cicchetti weights (Cicchetti 1976). A third review author was consulted in case of persisting disagreement. Pre-piloted forms were used for all phases.

Risk of Bias Assessment

The Cervical Overview Group uses a calibrated team of interdisciplinary assessors. At least two review authors independently assessed the risk of bias ([Appendix 2](#)). The consensus team met to reach a final decision. The following characteristics for risk of bias (maximum criteria = 12, low risk of bias = more than six criteria met) were assessed: randomisation; concealment of treatment allocation; blinding of patient, provider, and outcome assessor; incomplete data: withdrawal/drop-out rate and intention-to-treat analysis; selective outcome reporting; other: similar at baseline, similar co-interventions, acceptable compliance, similar timing of assessment. Studies were not excluded from further analyses based on results of risk of bias assessments. We noted explicit details on study design, number analysed and randomised, intention-to-

treat analysis, and power analysis in the methods column of the Characteristics of included studies table.

Data Analysis

We used descriptive statistics to provide a summarized description of the groups, interventions, outcomes, adverse effect of treatments, and cost of care. All results reported were based on the sample size analysed using 'intention-to-treat' principle, in other words, the sample entering the study.

For continuous data, we calculated standardized mean differences with 95% confidence intervals (SMD; 95% CI). Standardized mean difference was used because different measures are frequently used to address the same clinical outcome. The Cochrane Back Review Group guidelines (Furlan 2009) were foundational to key estimations of minimum clinically important differences for pain and function/disability. We assumed the minimum clinically important difference to be 10 on a 100-point pain intensity scale (Farrar 2001; Felson 1995; Goldsmith 1993). Similarly, we judged a minimum clinically important difference of 5/50 neck disability index units or 10% to be relevant for the neck disability index (Stratford 1999); a recent systematic review (MacDermid 2009) reports the minimal detectable change to vary from 5/50 for non-complicated neck pain up to 10/50 for cervical radiculopathy. The

Assessment of heterogeneity

Prior to calculation of a pooled effect measure, we assessed the reasonableness of pooling on clinical grounds. The possible sources of heterogeneity considered were: symptom duration (acute versus chronic); subtype of neck pain (e.g. WAD); intervention type (e.g. mobilisation versus manipulation); characteristics of treatment (e.g. dosage, technique); and outcomes (pain relief, measures of function and disability, patient satisfaction, quality of life). We had planned to test the statistical heterogeneity between the studies using a random-effects model. In the absence of heterogeneity ($P > 0.1$ and $I^2 > 40$), the studies were calculated as pooled SMD or RR.

Subgroup analysis

Although planned, subgroup analyses to assess the influence of three factors: risk of bias (concealment of allocation, blinding of outcome assessor), duration (acute, subacute, chronic), and subtypes of the disorder (non-specific, WAD, work-related, degenerative change-related, radicular findings, cervicogenic headache) were not possible. We denoted subgroups to explore the effects of treatment dosage for manipulation alone or mobilisation alone descriptively as meta-regression was not possible.

clinically important difference ranges from 5/50 to 19/50 and was noted to be inconsistent across different studies. For other outcomes (i.e. global perceived effect and quality of life scales) where there is an absence of clear guidelines on the size of a clinically important effect sizes, we used a commonly applied system by Cohen 1988: small (0.20), medium (0.50) or large (0.80).

For continuous outcomes reported as medians, we calculated effect sizes [Kendal 1963 (p 237)]. We calculated relative risks (RR) for dichotomous outcomes. A relative risk less than one represented a beneficial treatment. To facilitate analysis, we only used data imputation rules when necessary (Appendix 3). When neither continuous nor dichotomous data were available, we extracted the findings and the statistical significance as reported by the author(s) in the original study and noted them in the Characteristics of included studies table. We calculated the number-needed-to-treat (NNT: the number of patients a clinician needs to treat in order to achieve a clinically important improvement in one) and treatment advantages (%: the clinically important difference or change in percent) for primary findings, to give the reader a sense of the magnitude of the treatment effect (Gross 2002a; See Table 1 and Table 2 for operational definition, calculations, results). Power analyses were conducted for each article reporting non-significant findings (Dupont 1990).

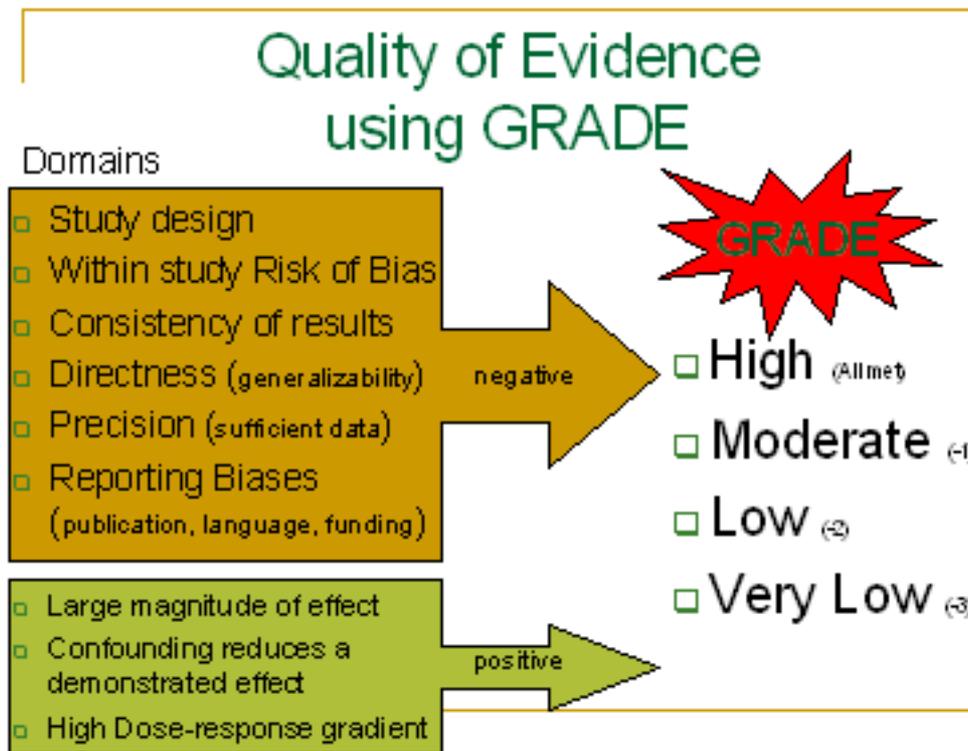
Sensitivity analysis

Sensitivity analyses on other factors (i.e. characteristics of the intervention, the comparator and outcome (time point), arising analysis factors) or meta-regression were not calculated due to a lack of data in any one category of mobilisation or manipulation.

Qualitative Analysis of Trial Results

We assessed the quality of the body of the evidence using the GRADE approach (Furlan 2009; Higgins 2008; See Figure 1; Appendix 4). Domains that may decrease the quality of the evidence are: 1) the study design, 2) risk of bias, 3) consistency of results, 4) directness (generalizability), 5) precision (sufficient data), and 6) reporting of the results for studies that measure one particular outcome. Domains that may increase the quality of the evidence are 1) large magnitude of effect; 2) all residual confounding would have reduced the observed effect, and 3) a dose-response gradient is evident. High quality evidence was defined as RCTs with low risk of bias that provided consistent, direct and precise results for the outcome. The quality of the evidence was reduced by a level for each of the domains not met or increased by factors such as large magnitude of effect; all plausible confounding would reduce a demonstrated effect and dose-response gradient.

Figure 1. Depiction of GRADE domains and scoring. Six domains may result in (-1) subtraction while three domains may result in (+1) addition.



- **High quality evidence:** Further research is very unlikely to change our confidence in the estimate of effect. There are consistent findings among 75% of RCTs with low risk of bias that are generalizable to the population in question. There are sufficient data, with narrow confidence intervals. There are no known or suspected reporting biases. (All of the domains are met.)

- **Moderate quality evidence:** Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate. (One of the domains is not met.)

- **Low quality evidence:** Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate. (Two of the domains are not met.)

- **Very low quality evidence:** We are very uncertain about the estimate. (Three of the domains are not met.)

- **No evidence:** no RCTs were identified that measured the outcome

We also considered a number of factors to place the results into a

larger clinical context: temporality, plausibility, strength of association, dose response, adverse events, and costs.

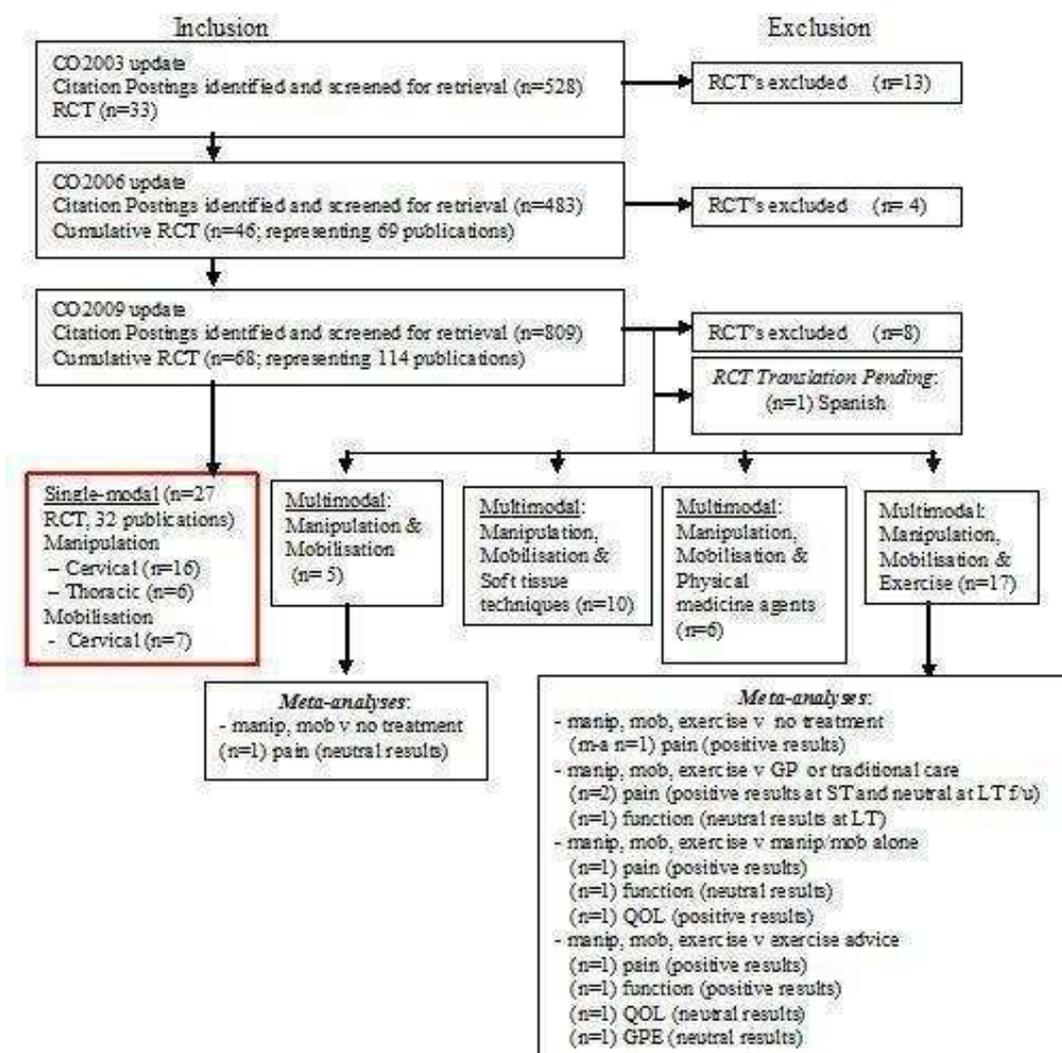
RESULTS

Description of studies

See: [Characteristics of included studies](#); [Characteristics of excluded studies](#); [Characteristics of studies awaiting classification](#); [Characteristics of ongoing studies](#).

Figure 2 describes the flow of the studies from our previous updates (1011 citation postings) and this update (809 citation postings). Of 68 identified RCTs representing 114 publications, we selected 27 RCTs (1522/1805 participants analysed/randomised) representing 32 publications for manipulation or mobilisation performed as a single-modal application; multimodal approaches that included manual therapy were split from this report and are reported separately (Miller 2009, D'Sylva 2009):

Figure 2. Flowchart for inclusion/exclusion of trials



- 26 studied subjects with neck pain: acute (Gonzalez-Iglesias 2009); subacute (Yurkiw 1996; Wood 2001); chronic (Bitterli 1977; Cleland 2005; Giles 1999; Haas 2004; Kanlayanaphotporn 2009; Kanlayanaphotporn 2009a; Muller 2005; Nilsson 1997); mixed (Cassidy 1992; Coppieiers 2003; David 1998; Egwu 2008; Fernandez 2004a; Howe 1983; Hurwitz 2002; Martinez-Segura 2006; Sloop 1982; Strunk 2008; Vernon 1990) and symptom duration not reported (Krauss 2008; Parkin-Smith 1998; Savolainen 2004; van Schalkwyk 2000)
 - two of these studies investigated whiplash-associated disorders: mixed (David 1998; Fernandez 2004a)
 - six of these studies investigated degenerative changes: chronic (Bitterli 1977; Giles 1999); and mixed (Cassidy 1992;

David 1998; Egwu 2008; Sloop 1982;)

- six of these studies investigated cervicogenic headache: chronic (Bitterli 1977; Chen 2007; Haas 2004; Nilsson 1997); mixed (Howe 1983; Hurwitz 2002).
 - two of these studies investigated neck disorders with radicular signs and symptoms: mixed (Howe 1983; Hurwitz 2002)

See the reference list for multiple publications per study; the primary trials are depicted here. All included trials were small, with fewer than 70 subjects per intervention arm. See Characteristics of included studies table for further details on treatment characteristics, co-interventions, baseline values, absolute benefits, reported

results, SMD, RR, side effects, and costs of care. Agreement between pairs of independent review authors from diverse professional backgrounds for manual therapy was Kw 0.83, SD 0.15. One Spanish trial is awaiting translation (Escortell 2008). We excluded 63 RCTs based on the type of participant (i.e. spasmodic torticollis, unable to split data from combined neck and low back trials, normal cervical spine), intervention (i.e. manual therapy was both in the treatment and control group), outcome (i.e. range of motion data only), or design (i.e. mechanistic or multimodal trial design) (See Characteristics of excluded studies table). The remaining excluded studies were not RCTs

Risk of bias in included studies

See Figure 3 for summary table of risk of bias findings. Nine of 27 studies had a low risk of bias. We found common risks of bias in the included studies to be: failure to describe or use appropriate concealment of allocation (59%, 16/27) and lack of effective blinding procedures (observer 55% (15/27); patient 81% (22/27); care provider 100% (27/27)). We acknowledge that it is difficult to blind the patient and impossible to blind the care provider in manual treatments. Co-intervention was avoided in only a small number of studies (37%; 10/27) and compliance monitored in 51% (14/27). We do not believe that risk of bias influenced the conclusions, however, we were unable to formally test this notion using meta-regression because we did not have enough data in any one disorder and treatment category.

Figure 3. Methodological quality summary: review authors' judgements about each methodological quality item for each included study.

	Allocation concealment?	Randomization?	Patient blinding?	Care provider blinding?	Outcome assessor blinding?	Dropout acceptable?	Intention to treat?	Free of selective outcome reporting?	Similar groups at baseline?	co-interventions avoided or similar?	Compliance acceptable?	Similar timing of outcome assessment?
Bitterli 1977	-	-	-	-	-	+	-	?	+	-	-	+
Cassidy 1992	-	-	-	-	-	+	+	?	+	+	+	+
Chen 2007	-	-	-	-	-	+	-	?	+	+	+	+
Cleland 2005	+	+	+	-	-	+	-	+	+	+	+	+
Coppieters 2003	+	+	-	-	+	+	-	?	+	+	+	+
David 1998	-	+	-	-	+	+	-	?	+	+	-	+
Egwu 2008	-	-	-	-	-	-	?	?	?	?	?	?
Fernandez 2004a	-	+	-	-	-	+	+	?	-	-	+	+
Giles 1999	+	-	-	-	-	-	-	?	+	-	+	+
Gonzalez-Iglesias 2009	+	+	-	-	-	+	+	?	+	-	-	+
Haas 2004	+	+	-	-	-	+	+	?	+	-	+	+
Howe 1983	+	+	-	-	+	-	-	?	-	-	+	-
Hurwitz 2002	+	+	-	-	-	+	+	+	+	+	-	+
Kanlayanaphotporn 2009	+	+	+	-	+	+	+	?	+	+	+	+
Kanlayanaphotporn 2009a	+	+	+	-	+	+	+	?	+	+	+	+
Krauss 2008	-	-	-	-	-	+	+	?	-	+	+	+
Martinez-Segura 2006	-	+	-	-	-	+	+	?	+	-	+	+
Muller 2005	-	-	-	-	-	-	-	?	-	+	-	+
Nilsson 1997	-	-	-	-	-	+	+	?	+	-	-	+
Parkin-Smith 1998	-	-	-	-	-	-	-	?	+	-	-	+
Savolainen 2004	-	-	-	-	-	-	-	?	+	-	-	+
Sloop 1982	+	+	+	-	+	+	+	?	+	-	+	+
Strunk 2008	+	+	-	-	-	+	+	?	-	-	+	+
van Schalkwyk 2000	-	-	-	-	-	+	+	?	+	-	-	+
Vernon 1990	-	+	-	-	+	+	+	?	-	+	+	+
Wood 2001	-	-	-	-	-	+	+	?	+	+	-	+
Yurkiw 1996	-	+	-	-	+	+	+	?	-	-	+	+

Effects of interventions

We were unable to carry out subgroup analyses or meta-regression for symptom duration, subtype of neck disorder or methodological quality because we did not have enough data in any one treatment approach. These factors are consistently noted within the text.

I. Manipulation alone of Cervical Region

Sixteen trials met the inclusion criteria for this section. Four of these studies had a low risk of bias (Haas 2004; Hurwitz 2002; Sloop 1982; Strunk 2008) and 12 had a high risk of bias (Bitterli 1977; Cassidy 1992; Chen 2007; Giles 1999; Howe 1983; Martinez-Segura 2006; Muller 2005; Nilsson 1997; van

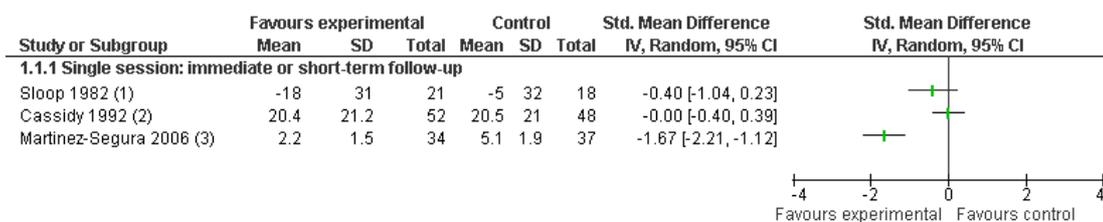
Schalkwyk 2000; Vernon 1990; Wood 2001; Yurkiw 1996). We describe the following three observations: a) the results from a single session, which may not depict clinical practice but nevertheless was assessed in clinical trials; b) the results of lower dose trials (one to four sessions); and c) trials using multiple treatment sessions, dose response and comparison trials.

Pain

a) Single Session

Five RCTs assessed the effect of a single session of manipulation (See Figure 4):

Figure 4. Forest plot of comparison: cervical manipulation - single session - pain



(1) Sloop 1982: manipulation (manip) v medication in both arms (cntl); duration: 1 session; follow up: 3 weeks; instrument: VAS (0 to 100)

(2) Cassidy 1992: manipulation (manip) v mobilisation (mob); duration: 1 session; follow up: none; instrument: NRS 101

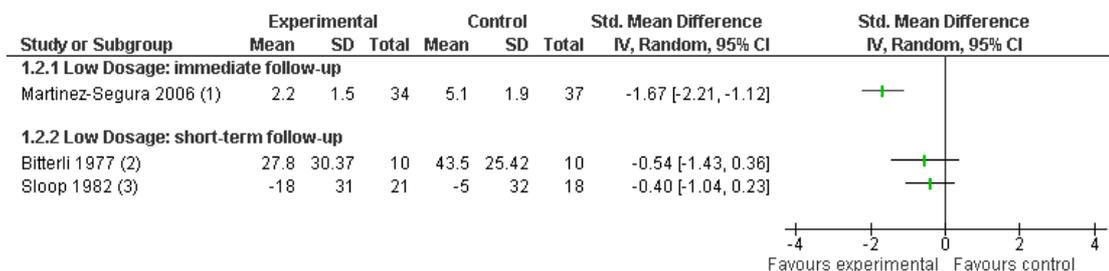
(3) Martinez-Segura 2006: manipulation (manip) v placebo (cntl); duration: 1 session; follow up: none; instrument: VAS (0 to 10)

- two mock treatment or sham trials independently concluded that a single session of manipulation resulted in immediate pain relief (Martinez-Segura 2006: NNT 2; treatment advantage 54%) and reduced tenderness (Vernon 1990) for neck disorders of mixed duration;
- two trials showed a single session of manipulation as an adjunct treatment to certain medication had no short-term benefit for pain relief in chronic neck disorders with radicular findings or headache (Howe 1983) or in subacute and chronic neck disorder with associated cervical spondylosis (Sloop 1982); and
- one trial concluded that a single session of manipulation was comparable to a muscle energy technique for immediate pain relief in neck disorders of mixed duration (Cassidy 1992).

b) Low Dose Trials

Five RCTs (Bitterli 1977; Howe 1983; Martinez-Segura 2006; Sloop 1982; Vernon 1990) investigated low dose manipulation versus a control in people with subacute and chronic neck pain. Results from three trials that were clinically comparable suggest equal or greater pain relief with manipulation (SMD pooled -0.90 (95% CI: -1.78 to -0.02); heterogeneity: $P = 0.006$, $I^2 = 80\%$; See Figure 5). Statistically, the results of the studies differ; however, the difference may be explained by difference in follow-up periods. Two studies compared low dose cervical manipulation to cervical mobilisation (Cassidy 1992) and to manual therapy in other spinal regions (Strunk 2008). Both studies reported no difference in pain measures immediately following the treatment period.

Figure 5. Forest plot of comparison: cervical manipulation - low dose trials - pain

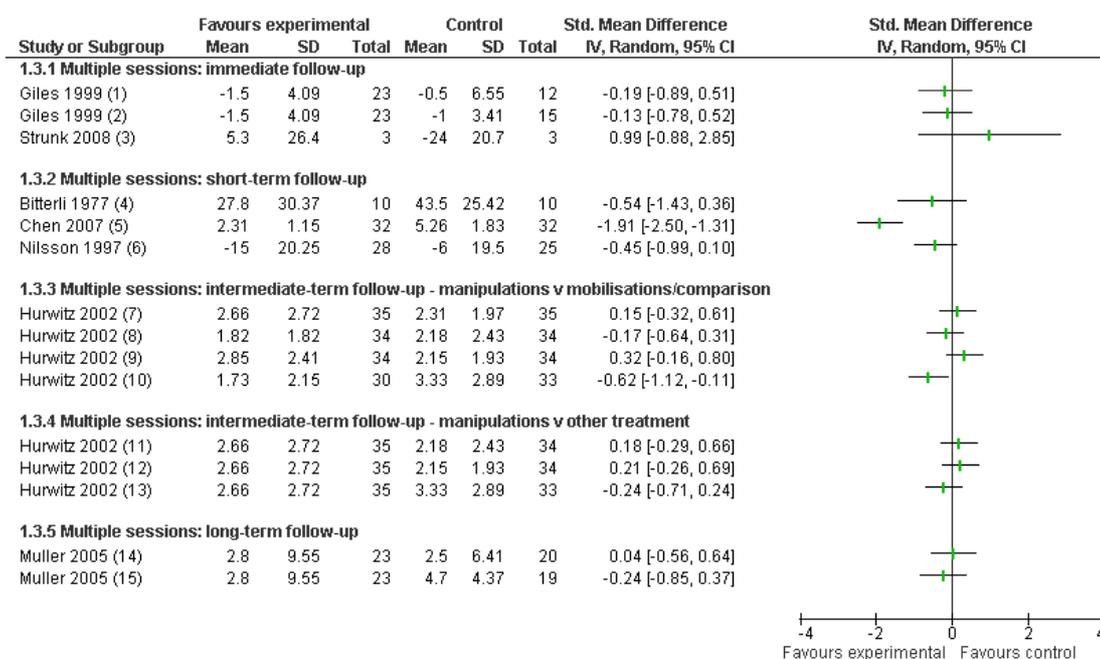


(1) Martinez-Segura 2006: manipulation (manip) v placebo (cntl); duration: 1 session; follow up: none; instrument: VAS (0 to10)
 (2) Bitterli 1977: manipulation (B) v w-cntl (C); duration: 3 weeks, 3 to 4 sessions; follow up: 12 weeks; instrument: VAS (0 to100)
 (3) Sloop 1982: manipulation (manip) v medication in both arms (cntl); duration: 1 session; follow up: 3 weeks; instrument: VAS (0 to100)

c) Multiple Sessions

Six trials assessed the effect of four to 20 sessions of manipulation conducted over two to 11 weeks against (see [Figure 6](#)):

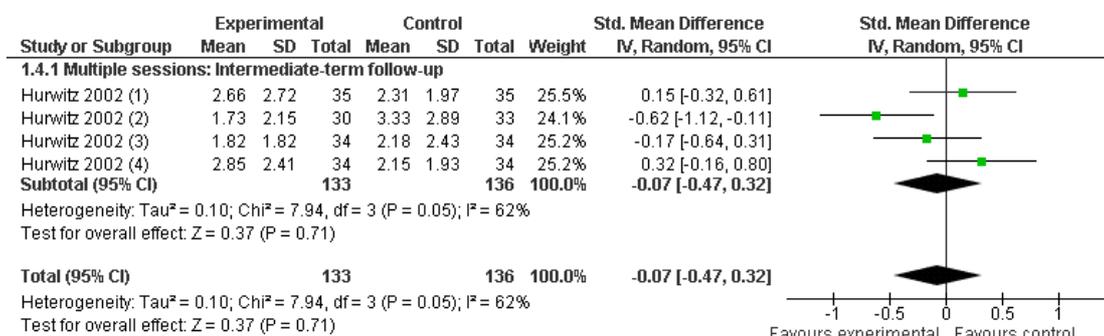
Figure 6. Forest plot of comparison: cervical manipulation - multiple sessions - pain
 * reported as median +/-SD where SD= SQRT (pi/3)* (4/3IQR)
 ** VAS reported as headache intensity per episode



- (1) Giles 1999: manipulation vs medication; duration: 3-4 weeks, 6 session; follow up: none; instrument: VAS (0 to 10)*
 (2) Giles 1999: manipulation vs acupuncture; duration: 3-4 weeks, 6 session; follow up: none; instrument: VAS (0 to 10)*
 (3) Strunk 2008: manipulation v combined approach (CTA); duration: 2 weeks, 4 sessions; follow up: none; instrument: VAS (0 to 100)
 (4) Bitterli 1977: manipulation (B) v w-ctrl (C); duration: 3 weeks, 3 to 4 sessions; follow up: 12 weeks; instrument: VAS (0 to 100)
 (5) Chen 2007: manipulation v TENS; duration: 3 weeks, 10 sessions; follow up: 1 weeks; instrument: NRS (0 to 10)
 (6) Nilsson 1997: manipulation v soft tissue techniques; duration: 3 weeks, 6 sessions; follow up: 1 week; instrument: VAS (0 to 100)**
 (7) Hurwitz 2002: manipulation v mobilisation; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)
 (8) Hurwitz 2002: manipulation and heat (h) v mobilisation and h; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)
 (9) Hurwitz 2002: manipulation and EMS (E) v mobilisation and E; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)
 (10) Hurwitz 2002: manipulation and h and E v mobilisation and h and E; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)
 (11) Hurwitz 2002: manipulation v mobilisation and h; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)
 (12) Hurwitz 2002: manipulation v mobilisation and E; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)
 (13) Hurwitz 2002: manipulation v mobilisation and h and E; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)
 (14) Muller 2005: manipulation v acupuncture; duration: max 9 weeks and 18 sessions; follow up: 12 months; instrument: VAS(0 to 10)*
 (15) Muller 2005: manipulation v medication; duration: max 9 weeks, max 18 sessions; follow up: 12 months; instrument: VAS(0 to 10)*

- wait list control (Bitterli 1977);
- mobilisations [Hurwitz 2002: SMD pooled -0.07 (95% CI: -0.47 to 0.32); heterogeneity: P = 0.05, I²= 62%) (see Figure 7);

Figure 7. Forest plot of comparison: Cervical manipulation: manipulation versus mobilisation (pooled) - pain



(1) Hurwitz 2002: manipulation v mobilisation; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)
 (2) Hurwitz 2002: manipulation and heat and EMS v mobilisation and heat and EMS; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)
 (3) Hurwitz 2002: manipulation and heat v mobilisation and heat; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)
 (4) Hurwitz 2002: manipulation and EMS v mobilisation and EMS; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

- soft tissue treatments (Nilsson 1997);
- combined therapeutic approach including manipulation and muscle energy performed to the thoracic spine and sacroiliac joint (Strunk 2008);
- medication: tenoxicam with ranitidine (Giles 1999); celecoxib, rofecoxib or paracetamol (Muller 2005);
- TENS (Chen 2007);
- acupuncture (Muller 2005), low voltage electrical acupuncture (Giles 1999); and
- mobilisation plus heat, mobilisation plus EMS, and mobilisation plus heat and EMS (Hurwitz 2002).

None of the above trials except for Chen 2007, showed a difference between groups for pain relief at either immediate-, short- or intermediate-term follow-up for individuals with subacute or chronic neck disorders. Chen 2007 demonstrated that manipulation was more effective than TENS for individuals with chronic cervicogenic headache at short term follow-up. One pilot study evaluated dose response for chronic cervicogenic

headache: three sessions over three weeks, nine sessions over three weeks, and 12 sessions over three weeks (Haas 2004). An immediate benefit for both neck pain and headache intensity was reported by the author with 12 sessions when compared to three sessions (SMD -0.48 (95%CI:-1.51 to 0.56)), but the benefit was not maintained in the short-term.

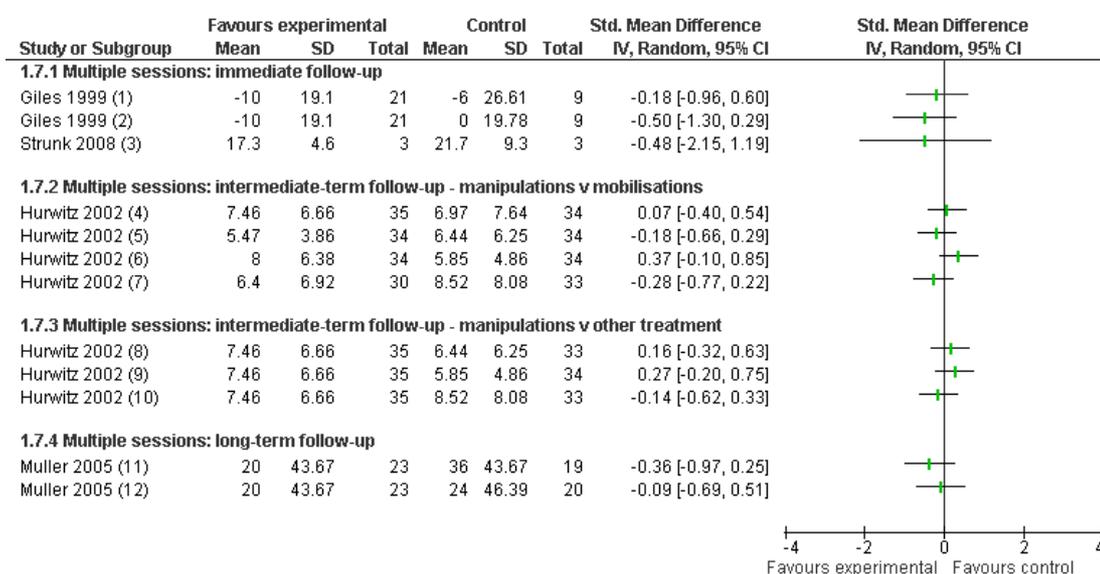
Three trials compared one manipulation technique to another and found no difference in immediate and short-term pain relief when:

- a rotary break manipulation was compared to a lateral break manipulation for 10 sessions over four weeks in subjects with neck disorder of undefined duration (van Schalkwyk 2000); and
- instrumental manipulation (Activator) was compared to manual manipulation for subacute neck disorder after one session (Yurkiw 1996) or eight sessions over four weeks (Wood 2001).

Function and Disability

Four trials assessed the effect of four to 18 sessions of manipulations conducted over two to nine weeks against (See Figure 8):

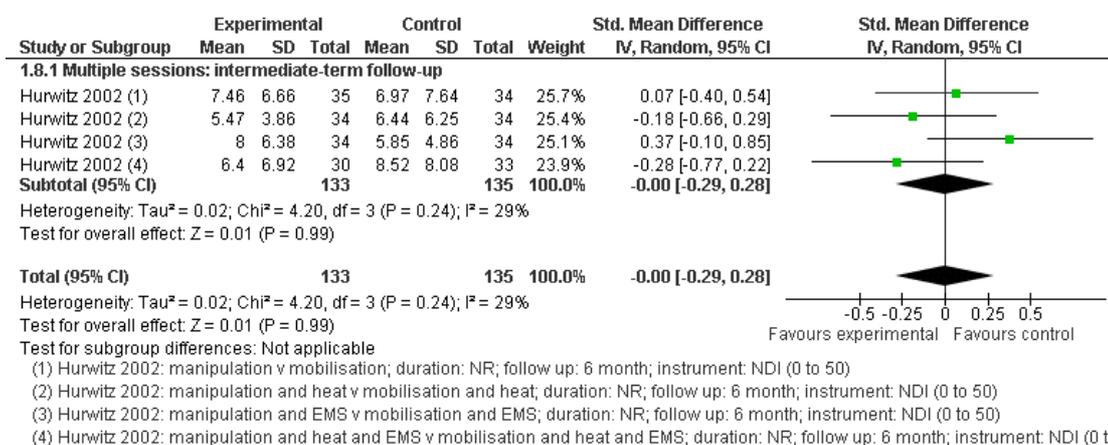
Figure 8. Forest plot of comparison: Cervical Manipulation - multiple sessions - function
 * reported as median +/-SD where SD= SQRT (pi/3)* (4/3IQR)



- (1) Giles 1999: manipulation (manip) vs acupuncture (acup); duration: 3-4 weeks, 6 session; follow up: none; instrument: NDI(0 to 50)*
- (2) Giles 1999: manipulation vs medication; duration: 3-4 weeks, 6 session; follow up: none; instrument: NDI (0 to 50)*
- (3) Strunk 2008: manipulation v combined approach (CTA); duration: 2 weeks, 4 sessions; follow up: none; instrument: VAS (0 to 100)
- (4) Hurwitz 2002: manipulation v mobilisation; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (5) Hurwitz 2002: manipulation and heat (h) v mobilisation and h; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (6) Hurwitz 2002: manipulation and EMS (E) v mobilisation and E; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (7) Hurwitz 2002: manipulation and h and E v mobilisation and h and E; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (8) Hurwitz 2002: manipulation v mobilisation and h; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (9) Hurwitz 2002: manipulation v mobilisation E; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (10) Hurwitz 2002: manipulation v mobilisation and h and E; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (11) Muller 2005: manipulation v medication; duration: max 9 weeks and 18 sessions; follow up: 12 months; instrument: NDI(0 to 50)*
- (12) Muller 2005: manipulation v acupuncture; duration: max 9 weeks and 18 sessions; follow up: 12 months; instrument: NDI(0 to 50)*

- mobilisations [Hurwitz 2002: SMD pooled -0.00 (95% CI: -0.29 to 0.29); heterogeneity: P = 0.23, I²= 30%) (see Figure 9);

Figure 9. Forest plot of comparison: Cervical Manipulation - Manipulation versus Mobilisation (pooled data) - Function



- combined manipulation and muscle energy performed to the thoracic spine and sacroiliac joint (Strunk 2008);
- medication: tenoxicam with ranitidine (Giles 1999); celaconxin, rofecoxib or paracetamol (Muller 2005);
- acupuncture (Muller 2005), low voltage electrical acupuncture (Giles 1999); and
- mobilisation plus heat, mobilisation plus EMS, and mobilisation plus heat and EMS (Hurwitz 2002).

None of the above studies showed a difference between groups in functional improvement at immediate-, short-term and intermediate-term follow-ups for subacute and chronic neck pain.

One small pilot study suggested 12 sessions of manipulation were superior to three for immediate functional improvement in subjects with chronic cervicogenic headache (SMD -1.15 (95%CI:-2.27 to -0.03)) (Haas 2004).

Two trials comparing one manipulation technique to another

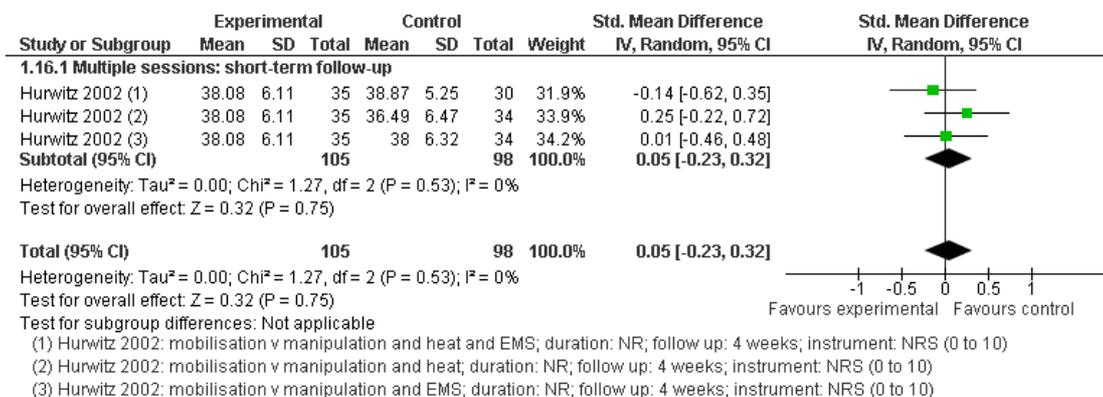
found no difference in functional improvement at short-term follow-up when:

- a rotary break manipulation was compared to a lateral break manipulation for 10 sessions over four weeks for neck pain of undefined duration (van Schalkwyk 2000); and
- instrumental manipulation (Activator) was compared against manual manipulation for eight sessions over four weeks for subacute neck pain (Wood 2001)

Patient Satisfaction

One trial with eight independent arms and 269 participants assessed the effect of 12 sessions of manipulation conducted over six weeks compared to mobilisations (Hurwitz 2002: SMD pooled -0.02 (95% CI: -0.20 to 0.25); heterogeneity: P = 0.54, I² = 0%);Figure 10). It showed no difference in short-term patient satisfaction for those with subacute and chronic neck pain.

Figure 10. Forest plot of comparison: Cervical Mobilisation versus Comparisons: Patient satisfaction.



Hurwitz 2002 also compared the effectiveness of manipulation alone to mobilisation plus heat, mobilisation plus EMS and mobilisation plus heat and EMS. The study showed no significant difference in patient satisfaction between these treatment groups.

Conclusion

There is moderate quality evidence (two trials, 369 participants) that manipulation produces similar changes in pain, function and patient satisfaction when compared to mobilisation for subacute or chronic neck pain at short- and intermediate-term follow-up. There is low quality evidence (three trials, 130 participants) that manipulation alone versus a control may provide immediate- and short-term pain relief following one to four treatment sessions in subjects with acute or chronic neck pain. Low quality evidence from one small (25 participants) dosage trial suggests that nine or 12 sessions of manipulation are superior to three for pain relief at immediate post-treatment follow-up and neck-related disability for chronic cervicogenic headache. Larger dose-finding trials are needed to establish the optimal dose.

There is very low quality evidence at short-term follow-up that:

- one manipulation technique is not superior to another for

pain reduction for subacute neck pain (three trials, 88 participants);

- manipulation is equivalent to certain medication (2 trials, 69 participants), acupuncture (2 trials, 81 participants), certain soft-tissue treatments (1 trial, 53 participants) or certain combined treatments for subacute and chronic neck pain and to some extent improved function; and

- manipulation may be superior to TENS (1 trial, 64 participants) for individuals with chronic cervicogenic headache.

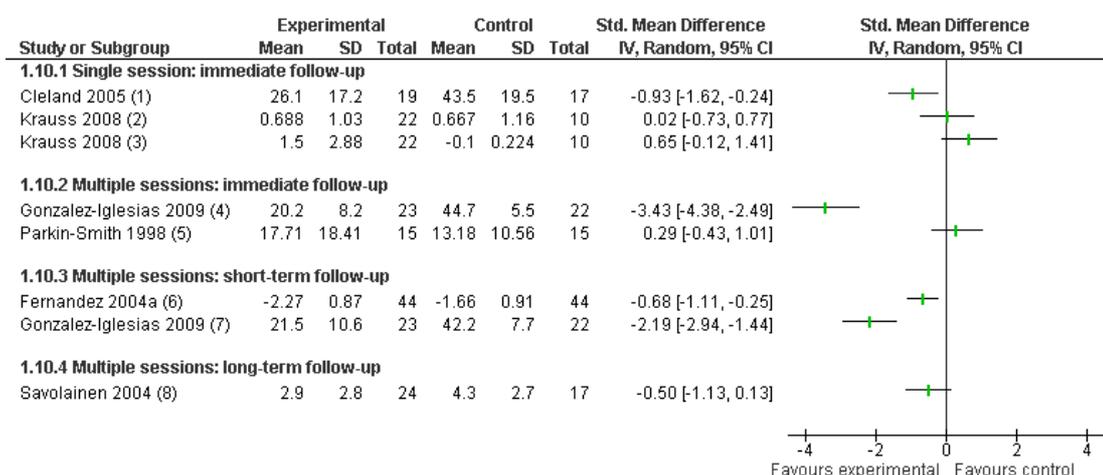
2. Manipulation alone of Thoracic Region

Six trials, one with a low risk of bias (Cleland 2005) and five with a high risk of bias (Fernandez 2004a; Gonzalez-Iglesias 2009; Krauss 2008; Parkin-Smith 1998; Savolainen 2004) met the inclusion criteria for this section.

Pain

Six trials investigated the effects of one to 15 sessions of thoracic manipulations over one day to six weeks against (see Figure 11):

Figure 11. Forest plot of comparison: Thoracic Manipulation - single and multiple sessions - pain
*** pain with left rotation**
**** pain with right rotation**



- (1) Cleland 2005: manipulation v placebo; duration: 1 session; follow up: none; instrument: VAS (0 to 100)
 (2) Krauss 2008: manipulation (TSM) v no treatment; duration: 1 session; follow up: none; instrument: 9 point faces scale *
 (3) Krauss 2008: manipulation (TSM) v no treatment; duration: 1 session; follow up: none; instrument: 9 point faces scale**
 (4) Gonzalez-Iglesias 2009: manipulation v ETT both arms; duration: 3 weeks, 5 sessions; follow up: none; instrument: VAS (0 to 100)
 (5) Parkin-Smith 1998: T/S manipulation v C/S manipulation both arms; duration: 3 weeks, 6 sessions; follow up: none; instrument: NRS101
 (6) Fernandez 2004a: manipulation v PT both arms; duration: 2 weeks, 15 sessions; follow up: none; instrument: VAS (0-10)
 (7) Gonzalez-Iglesias 2009: manipulation v ETT both arms; duration: 3 weeks, 5 sessions; follow up: 4 weeks; instrument: VAS (0 to 100)
 (8) Savolainen 2004: manipulation v instructed exercise; duration: NR; follow up 52 weeks; instrument: VAS - current pain (0 to 10)

- a sham - a flat open hand (Cleland 2005): There was greater pain reduction (NNT 5, 29% treatment advantage) favouring a single thoracic manipulation for chronic neck pain at immediate follow-up;
- no treatment (Krauss 2008): There was no significant difference between the two groups immediately following a single treatment session for non-specific neck pain (duration not reported);
- same treatment carried out in both arms - electrothermal therapy (Gonzalez-Iglesias 2009): five sessions of thoracic manipulation over three weeks produced greater pain reduction (NNT 7; 46.6% treatment advantage) for acute non-specific neck pain at immediate- and short-term follow-ups;
- same treatment carried out in both arms - cervical manipulation (Parkin-Smith 1998): Thoracic manipulation added to cervical manipulation for neck pain of undefined duration resulted in no significant difference in pain relief immediately following treatment;
- same treatment carried out in both arms - individualized physiotherapy care (Fernandez 2004a): Adding two sessions of thoracic manipulation over three weeks to 15 sessions of physiotherapy resulted in a significantly greater reduction of neck pain for patients with acute/subacute WAD, measured

immediately following treatment; and

- exercise (Savolainen 2004): four sessions of thoracic manipulation over four weeks had equivalent pain outcomes when compared to instructed exercise conducted over an undisclosed period of time for patients with neck pain of undefined duration at long-term follow-up.

Function and Disability

One trial (Parkin-Smith 1998) assessed the influence of adding thoracic manipulation to cervical manipulation on function in participants with neck pain of undefined duration. No significant difference in functional improvement was noted immediately following care.

Another trial (Gonzalez-Iglesias 2009) investigated the use of a seated distraction thoracic manipulation as an adjunct to electrothermal therapy. Adding thoracic manipulation to electrothermal therapy resulted in a greater decrease in disability for acute non-specific neck pain at immediate- and short-term follow-ups (NNT 5; 40.6% treatment advantage)

Conclusion

There is low quality evidence (one trial, 45 participants) in support of thoracic manipulation as an adjunct to electrothermal therapy for both pain (NNT 7; 46.6% treatment advantage) and function (NNT 5; 40.6% treatment advantage) for acute neck pain. Very low quality evidence (one trial, 88 participants) supports thoracic manipulation as an adjunct to individualized physiotherapy care for pain reduction for acute/subacute WAD. When thoracic manipulation was added to cervical manipulation alone, there was very low quality evidence suggesting no added benefit for participants with neck pain of undefined duration.

Low quality of evidence (one trial, 36 participants) favoured a single session of thoracic manipulation for immediate pain reduction when compared to a placebo for chronic neck pain (NNT 5, 29% treatment advantage). Alternatively, very low quality evidence found no difference in pain during neck rotation or function when a thoracic manipulation was compared to no treatment (one trial, 30 participants) or exercise (one trial, 41 participants) for neck pain of undefined duration.

3. Mobilisation alone of Cervical Region

Eight trials, five with a low risk of bias (Coppieters 2003; David 1998; Hurwitz 2002, Kanlayanaphotporn 2009; Kanlayanaphotporn 2009a) and two with a high risk of bias (Bitterli 1977; Cassidy 1992; Egwu 2008) met the inclusion criteria.

Pain

One trial with 18 participants reported no additional pain relief when mobilisation was used as an adjunct to manipulation in participants with chronic cervicogenic headache or degenerative changes immediately following the treatment period (Bitterli 1977). One trial with 51 participants suggested no difference in

pain reduction when comparing mobilisation and acupuncture for subacute or chronic neck pain including WAD at long-term follow-up (David 1998).

Hurwitz 2002 compared the effectiveness of mobilisations to manipulation as an adjunct treatment to heat, manipulation plus EMS and manipulation plus heat and EMS. The study showed no significant difference in pain relief between these treatment groups in participants with subacute or chronic neck pain at intermediate-term follow-up. Additionally, Cassidy 1992 compared manipulation to a muscle energy mobilisation technique and reported no difference in pain measures immediately following the treatment period for chronic neck pain.

Coppieters 2003 investigated neural dynamic mobilisation in participants with acute and chronic neck pain and found a non-significant difference in pain reduction when compared to pulsed ultrasound. While the results are not statistically significant, the mean achieved a minimal clinically important difference (suggesting a possible type 2 error).

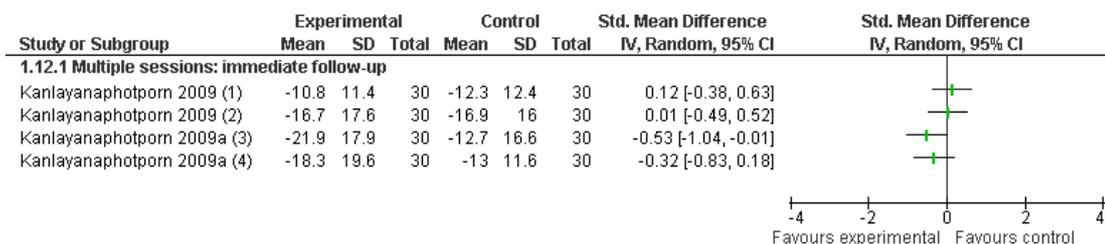
Three studies compared the effectiveness of one mobilisation technique versus another mobilisation technique in individuals with acute or subacute (Egwu 2008) or chronic neck pain (Kanlayanaphotporn 2009; Kanlayanaphotporn 2009a).

- *Posterior Anterior (PA) technique (Maitland):*

One study showed no significant difference in pain reduction when comparing an ipsilateral PA mobilisation to one of three randomly selected mobilisation techniques: ipsilateral PA, central PA or contra-lateral PA (Kanlayanaphotporn 2009). Another study by the same authors demonstrated a positive trend in pain reduction when comparing central PA mobilisation to one of the three random mobilisation techniques (Kanlayanaphotporn 2009a). Although statistically not significant, the mean achieved a minimal clinically important change and post hoc analysis using an interaction plot favoured PA mobilisations over random mobilisation for neck pain during movement (see Figure 12).

Figure 12. Forest plot of comparison: Cervical Mobilisation - multiple sessions, one technique versus another technique - pain
* pain with most painful movement

**** pain at rest**



- (1) Kanlayanaphotporn 2009a: ipsilateral PA v random PA; duration: 1 session; follow up: none; instrument: VAS (0 to 100)**
- (2) Kanlayanaphotporn 2009: ipsilateral PA v random PA; duration: 1 session; follow up: none; instrument: VAS (0 to 100)**
- (3) Kanlayanaphotporn 2009b: central PA v random PA; duration: 1 session; follow up: none; instrument: VAS (0 to 100)**
- (4) Kanlayanaphotporn 2009b : central PA v random PA; duration: 1 session; follow up: none; instrument: VAS (0 to 100)**

- *Anterior Posterior (AP) technique (Maitland):*

One study (Figure 13) showed significantly greater pain reduction in subjects receiving ipsilateral AP mobilisations when compared to transverse oscillatory or cervical oscillatory rotation mobilisations, but no significant difference when compared to ipsilateral PA mobilisations (Egwu 2008).

Figure 13. Forest plot of comparison: Cervical Mobilisation - multiple sessions, one technique versus another technique - pain

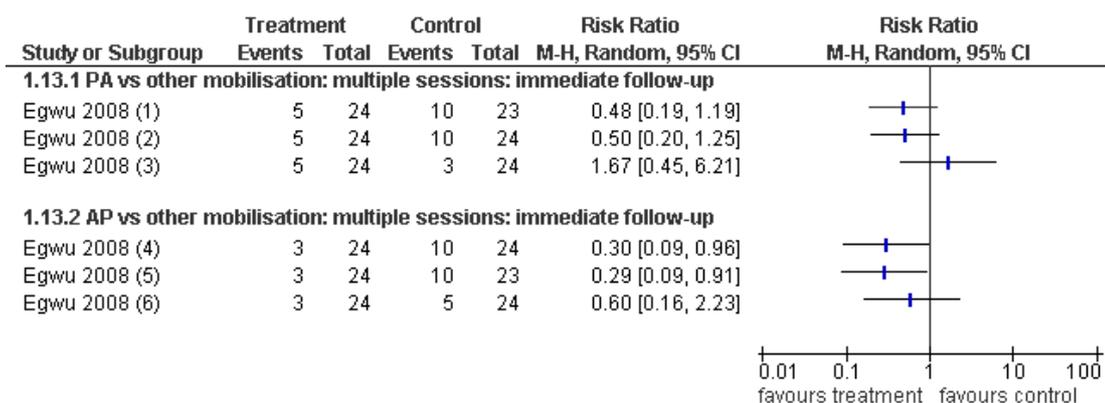
*** 5 categories - pain free to worse**

PAUP = posterior/anterior unilateral pressure

COR = cervical oscillatory rotation

TOP = transverse oscillatory pressure

APUP = anterior/posterior unilateral pressure



- (1) Egwu 2008: PAUP v. COR; duration: max 4 weeks and 12 sessions; follow up: none; instrument: categories*
- (2) Egwu 2008: PAUP v. TOP; duration: max 4 weeks and 12 sessions; follow up: none; instrument: categories*
- (3) Egwu 2008: PAUP v. APUP; duration: max 4 weeks and 12 sessions; follow up: none; instrument: categories*
- (4) Egwu 2008: APUP v TOP; duration: max 4 weeks and 12 sessions; follow up: none; instrument: categories*
- (5) Egwu 2008: APUP v COR; duration: max 4 weeks and 12 sessions; follow up: none; instrument: categories*
- (6) Egwu 2008: APUP v PAUP; duration: max 4 weeks and 12 sessions; follow up: none; instrument: categories*

- *Rotation or Transverse (Maitland):*

As noted above, transverse and cervical rotational oscillatory techniques appeared to be inferior to AP or PA techniques (Egwu 2008).

Function and Disability

One trial comparing mobilisations and acupuncture found no significant difference in function for subacute or chronic neck pain including WAD at long-term follow-up (David 1998).

Hurwitz 2002 compared the effectiveness of mobilisations alone to manipulation plus heat, manipulation plus EMS and manipulation plus heat and EMS. Results showed no significant difference in changes in function between these treatment groups in participants with subacute or chronic neck pain at intermediate-term follow-up.

Global Perceived Effect

Two small trials compared the impact of one mobilisation technique to another on global perceived effect in subjects with chronic neck pain (Kanlayanaphotporn 2009; Kanlayanaphotporn 2009a). Neither study reported significant results.

Patient Satisfaction

Hurwitz 2002 compared the effectiveness of mobilisations alone to manipulation plus heat, manipulation plus EMS and manipulation plus heat and EMS on patient satisfaction. The study showed no significant difference between these treatment groups at short-term follow-up.

Conclusion

One factorial design trial (1 trial, 133 participants) and one comparison trial (1 trial, 100 participants) provided moderate to low quality evidence showing no difference between mobilisation compared to manipulation and other treatments for pain, function and patient satisfaction for subacute/chronic neck pain. There was low quality evidence (one trial, 51 participants) that a combination of Maitland mobilisation techniques was as effective as acupuncture for pain relief and improved function immediately post-treatment for subacute/chronic neck pain. Low quality evidence exists from one small trial (20 participants) suggesting neural dynamic techniques led to statistically insignificant, but clinically important pain reduction immediately post-treatment in participants with neck pain of mixed duration.

Certain mobilisation techniques may be superior to others. Very low quality evidence (one trial, 95 participants) suggests that an anterior-posterior mobilisation was more effective than a transverse oscillatory and rotational mobilisation immediately post-treatment for acute/subacute neck pain. Low quality evidence (two trials, 120 participants) suggests no difference in pain reduction or global perceived effect for chronic neck pain when comparing an ipsilateral posterior-anterior or central posterior-anterior to one of three random posterior-anterior mobilisations.

Other Considerations

Adverse Events

The number of subjects experiencing side effects was reported in 29% (8/27) of trials. Three out of those eight trials reported no side effects and five trials reported benign and transient side effects including radicular symptoms (58/1000 in the treatment group versus 20/1000 in the control group) headache or neck pain (105/1000 in the treatment group versus 52/1000 in the control group) (Carlesso 2009). The rate of rare but serious adverse events such as strokes or serious neurological deficits could not be established from our review.

Cost of Care

No direct measures of the cost of care were reported in the 27 trials included in this review.

DISCUSSION

In our previous systematic reviews:

- up to 1996 (Gross 1996): results remained inconclusive for mobilisation or manipulation as a single intervention and suggested support for combined mobilisation, manipulation and exercise; were only available for the outcome pain in the short-term.
- up to 2003 (Gross 2003): results showed no evidence in support of manipulation alone or mobilisation alone but showed further support to the use of combined mobilisation, manipulation and exercise in achieving clinically important but modest pain reduction, global perceived effect and patient

satisfaction in acute and chronic neck disorder with or without headache. The most common care elements included mobilisation or manipulation plus exercise. There was insufficient evidence available to draw conclusions for neck disorder with radicular findings. Other high quality reviews (Bogduk 2000; Brønfort 1997; Childs 2008; Magee 2000; Spitzer 1995) agreed with these findings.

- this update to July 2009: The 2009 review update investigates the effect of mobilisation or manipulation alone in the treatment of neck pain. The overall methodological quality did not improve in spite of CONSORT guidelines. The evidence suggests some immediate- or short-term pain relief with a course of cervical manipulation or mobilisation alone, but these benefits are not maintained over the long-term. Evidence seems to support the use of thoracic manipulation alone for immediate pain relief or as an adjunct to electrothermal or individualised physiotherapy treatment strategies for pain relief and improvements in function. One dose-response trial and one trial with a low risk of bias that used a factorial design emerged. Certain mobilisation techniques may be superior.

For WAD, our findings differed slightly from Verhagen 2007 because they did not include manipulation of the thoracic spine as a passive treatment of neck pain. We are in concordance with their other findings showing a dearth of evidence for mobilisation or manipulation for WAD. For acute neck disorder that is not whiplash-associated, we also agreed with Vernon 2005, who noted a striking lack of high quality evidence. For chronic non-specific neck pain, we agreed with Brønfort 2004 that trials were sparse and inconclusive for the application of manipulation or mobilisation as a single approach. We were also in agreement with Hurwitz 2008, who found evidence of short-term benefit for mobilisation in comparison to usual GP care, pain medications, or advice to stay active. Our findings were in disagreement with Gemmel 2006, who described five trials with a high risk of bias that showed mixed findings and concluded that no one therapy was more effective than the others. We disagreed with Vernon 2007, who indicated moderate to high quality evidence in support of spinal manipulation or mobilisation for chronic non-specific neck pain. This discordance was not based on new literature but was related to the framing of the systematic review's question and methodology used. Vernon 2007 included cohort studies while our review solely utilized RCT data; they did not calculate SMD from the RCT published data but rather noted the reported direction of effect; these data were not always consistent with the reported direction of effect. There were also differences in interpretation; we suggested that one treatment with only immediate post-treatment outcomes did not denote effectiveness, did not reflect clinical practice and certainly did not give us any indication of either short- or long-term effects. Thus, we suggested the evidence remained unclear. Overall, differences in findings stemmed from differing definitions

or clustering of treatments; from differing disorder subgroup classifications; and from different reported time frames for outcome measures.

How do we as meta-analysts reconcile the various models of care? We noted that the use of unimodal approaches were not common in clinical practice but were an essential element for teasing out which therapeutic item or combination worked best. Typical conservative care takes a more holistic clinical approach and will include a treatment continuum (Jovey 2002) that is physical, psychological, and pharmacological, starting with those that are most available, least expensive, least invasive and with the fewest side effects. Our reviews findings acknowledged these diversities and noted the following immersing questions:

- *How do we know when mobilisations will be effective?* It's still not clear. Meta-analyses, subgroup analyses, and sensitivity analyses were hampered by the wide spectrum of comparisons, treatment characteristics and dosages. Until the quantity of quality studies increases within individual subgroups of neck pain, we will not be able to make any strong conclusions about which groups benefit most from manipulation or mobilisation. Cleland 2007 developed clinical prediction rules for the use of thoracic manipulation in the treatment of neck pain. Similar studies investigating clinical prediction rules for other mobilisations or manipulations in varied neck pain populations would help clinicians to determine when to utilize manual therapy.

- *What is the ideal mobilisation or manipulation?* Our review showed one technique was frequently compared to another as a head-to-head comparison, either as a single technique or as one combined treatment approach compared to another. The answer remains unclear, but some evidence suggests AP or PA mobilisations may be more effective at reducing pain than transverse or rotational mobilisations. We believe it continues to be important to research head-to-head comparisons between the most viable techniques or approaches.

- *What is the optimal "dosage" or are the optimal "clinical parameters" for a given technique category?* We don't know. From the data on pain relief we have to date, the most commonly reported factors were frequency (total number of sessions) and duration (total number of weeks). We noted that the range of these two factors measured at various follow-up periods were as follows: manipulation to cervical region alone (one to 18 sessions; one day to nine weeks); manipulation of thoracic region alone (one to 15 sessions; one day to three weeks); mobilisation of cervical region alone (one to six sessions; one day to six weeks). The ideal dosage for cervical manipulation, thoracic manipulation, or cervical mobilisation for the treatment of cervical pain could not be determined when evaluating existing

controlled trials. Pilot studies of mobilisation and manipulation exploring the minimally effective dose as well as the optimal dose should be conducted prior to doing a larger trial. These pilot studies would serve a purpose similar to the small dose-finding studies conducted in pharmaceutical trials that are used to establish a minimally effective dose. One such pilot study (Haas 2004) demonstrated that there was preliminary support for a larger trial assessing 12 and nine sessions over three sessions of cervical manipulation.

Adverse Events and Cost of Care

We continued to find that adverse events reported from RCTs in this review were benign, transient side effects. Clearly, smaller randomised trials are unlikely to detect rare adverse events. From surveys and review articles, the risk of a serious irreversible complication (e.g. stroke) for cervical manipulations has been reported to vary from one adverse event in 3020 to one in 1,000,000 manipulations (Assendelft 1996; Gross 2002b). Better reporting of adverse events is required. Additionally, new trials are necessary to determine whether there is an economical advantage in using manipulation or mobilisation techniques to treat neck pain.

Risk of bias

We have observed four positive advances in more recent years. Trials were larger, had a lower risk of bias, 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.

Manual therapy could not easily be studied in a double-blinded manner (blinding therapists and patients) in clinical practice. We noted that in our review, placebo trials were scarce and credible placebo treatments that mimic manual therapy were rare. First, one person's sham may be another person's active treatment. The investigators should make a case for their choice of manipulation as the experimental treatment, and the ineffective technique as their control. For example, the investigators in Martinez-Segura 2006 considered manipulation the active ingredient of their treatment and they made a case that testing manipulation against positioning the cervical spine in the manner described could be considered to be a reasonable design to test the efficacy of their intervention. In this way, they could isolate the specific movement of manipulation, while controlling for what they considered to be non-specific factors. We see this as being similar to any study design where one is trying to test the specificity of their intervention. Then, if they find a superior performance for manipulation, they have demonstrated some specificity of effect. Second, it is essential to blind the outcome assessor and the investigator doing the analyses. We noted that a number of new trials recently added to this review continued to have the latter flaw. 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 prior to inclusion into the trial (e.g. How do you expect your neck pain to change because of the following treatments you may receive in the study?). Even though some would suggest modifying the risk of bias 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 methodological quality and resulting strength of the evidence in perspective.

Underpinning the determination of best evidence is the need for manuscripts to report treatment technique and clinical parameters in a transparent, standardized way. Many trials in our review did not report adequate treatment characteristics to allow for replication. Reporting conventions such as those proposed in the CONSORT statement (Altman 2001) for clinical trials generally, or the STRICTA statement (MacPherson 2002) for clinical trials of acupuncture specifically, are needed for manipulation and mobilisation trials to address these limitations in design. We also note that co-interventions, contamination, and compliance are not commonly monitored during the trial. Co-interventions may bias results in favour of a treatment while contamination of the control arm of a study may serve to undermine the treatment effect.

Is the benefit of manual therapy more or less influenced by patient satisfaction compared to exercise, for example? It is difficult to assess to what degree 'hands-on effect', attention, assessment techniques, other forms of feedback, or interaction and communication between manual therapist and the patient are 'unique' traits of those who provide manual therapy. We acknowledge that these effects may play some role in manual therapy treatment methods.

Ongoing Studies

A total of 14 ongoing studies have been recognised in this review from 1995 through 2006. We are tracking three of these studies, but the remaining 11 studies were not located through our literature search. With such a large number of study protocols and pilot studies not reaching publication, we wonder if a publication bias is leading towards publication of only positive results.

AUTHORS' CONCLUSIONS

Implications for practice

Manipulation for acute to chronic neck pain:

- cervical manipulation produces similar pain relief, functional improvements, and patient satisfaction to mobilisation

- cervical manipulation may provide short-term, but not long-term pain relief
- thoracic manipulation used alone or in combination with electrothermal or individualised physiotherapy treatments may improve pain and function

Mobilisation for neck pain of mixed duration:

- cervical mobilisation is similar to manipulation or acupuncture for pain and function
- one mobilisation technique may be superior to another (that is, anterior-posterior mobilisation superior to transverse oscillatory and rotational mobilisation; ipsilateral posterior-anterior or central posterior-anterior better than one of three random posterior-anterior mobilisations).

Implications for research

Meta-analysis of data across trials and sensitivity analysis were 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 to identify the most effective treatment characteristics and dosages. Greater attention to methodological quality continues to be needed.

ACKNOWLEDGEMENTS

We are indebted to the many authors of primary studies for their support in retrieving original research. We thank our volunteers, translators, students, the Cochrane Back Review Group editors, and Lisa Carlesso and Colleen McPhee for early access to their research.

REFERENCES

References to studies included in this review

Bitterli 1977 *{published data only}*

Bitterli J, Graf R, Robert F, Adler R, Mumenthaler M. Zur objectivierung der manualtherapeutischen beeinflussbarkeit des spondylogenen kopfschmerzes. *Nervenarzt* 1977;**48**: 259–62.

Cassidy 1992 *{published data only}*

Cassidy J [letter]. The immediate effect on manipulation vs mobilisation pain and range of motion in the cervical spine: A randomized controlled trial. *Journal of Manipulative and Physiological Therapeutics* 1993;**16**(4):279–80.

* Cassidy JD, Lopes AA, Yong-Hing K. The immediate effect of manipulation versus mobilization on pain and range of motion in the cervical spine: A randomized controlled trial. *Journal of Manipulative and Physiological Therapeutics* 1992;**15**(9):570–5.

Chen 2007 *{published data only}*

Chen L, Zhang XL, Ding H, Tao YQ, Zhan HS. Comparative study on effects of manipulation treatment and transcutaneous electrical nerve stimulation on patients with cervicogenic headache. *Journal of Chinese Integrative Medicine* 2007;**5**(4):403–6.

Cleland 2005 *{published data only}*

Cleland JA, Childs Maj. JD, McRae M, Palmer JA, Stowell T. Immediate effects of a thoracic manipulation in patients with neck pain: A randomized clinical trial. *Manual Therapy* 2005;**10**:127–35.

Coppieters 2003 *{published data only}*

Coppieters MW, Stappaerts KH. The immediate effects of manual therapy in patients with cervicobrachial pain on neural origin: A pilot study. IFOMT 2000: International

Federation of Orthopaedic Manipulative Therapists in conjunction with the 11th biennial conference of the manipulative physiotherapists association of Australia. Perth: The University of Western Australia, 2000:Poster 7. Coppieters MW, Stappaerts KH, Wouters LL, Janssens K. Aberrant protective force generation during neural provocation testing and the effect of treatment in patients with neurogenic cervicogenic pain. *Journal of Orthopaedic Sports Physical Therapy* 2002 (submitted).

* Coppieters MW, Stappaerts KH, Wouters LL, Janssens K. The immediate effects of a cervical lateral glide treatment technique in patients with neurogenic cervicobrachial pain. *Journal of Orthopedic and Sports Physical Therapy* 2003;**33**: 369–78.

David 1998 *{published data only}*

David J, Modi S, Aluko AA, Robertshaw C, Farebrother J. Chronic neck pain: A comparison of acupuncture treatment and physiotherapy. *British Journal of Rheumatology* 1998; **37**:118–22.

Egwu 2008 *{published data only}*

Egwu MO. Relative therapeutic efficacy of some vertebral mobilization techniques in the management of unilateral cervical spondylosis: a comparative study. *Journal of Physical Therapy and Science* 2008;**20**:103–8.

Fernandez 2004a *{published data only}*

Fernandez-de-las-Penas C, Fernandez-Carnero J, Plaza Fernandez A, Lomas-Vega R, Miangolarra-Page JC. Dorsal manipulation in whiplash injury treatment: A randomized controlled trial. *Journal of Whiplash & Related Disorders* 2004;**3**:55–71.

Giles 1999 *{published data only}*

Giles LGF, Muller R. Chronic spinal pain syndromes: A

- clinical pilot trial comparing acupuncture, a nonsteroidal anti-inflammatory drug, and spinal manipulation. *Journal of Manipulative and Physiological Therapeutics* 1999;**22**(6): 376–81.
- Gonzalez-Iglesias 2009** *{published data only}*
Gonzalez-Iglesias J, Fernandez-De-Las-Penas C, Cleland JA, Del Rosario Gutierrez-Vega M. Thoracic spine manipulation for the management of patients with neck pain: a randomized clinical trial. *Journal of Orthopaedic and Sports Physical Therapy* 2009;**39**(1):20–7.
- Haas 2004** *{published data only}*
* Haas M, Group E, Aickin M, Fairweather A, Ganger B, Attwood M, et al. Dose response for chiropractic care of chronic cervicogenic headache and associated neck pain: A randomized pilot study. *Journal of Manipulative and Physiological Therapeutics* 2004;**27**:547–53.
- Howe 1983** *{published data only}*
Howe DH, Newcombe RG, Wade MT. Manipulation of the cervical spine - a pilot study. *Journal of the Royal College of General Practitioners* 1983;**33**:574–9.
- Hurwitz 2002** *{published data only}*
Hurwitz EL, Morgenstern H, Harber P, Kominski GF, Yu F, Adams AH. A randomized trial of chiropractic manipulation and mobilization for patients with neck pain: Clinical outcomes from the UCLA Neck-Pain Study. *Research and Practice* 2002;**92**(10):1634–41.
- Kanlayanaphotporn 2009** *{published data only}*
* Kanlayanaphotporn R, Chiradejnant A, Vachalathiti R. The immediate effects of mobilization technique on pain and range of motion in patients presenting with unilateral neck pain: A randomized controlled trial. *Archives of Physical Medicine and Rehabilitation* 2009;**90**:187–92.
- Kanlayanaphotporn 2009a** *{published data only}*
Kanlayanaphotporn R, Chiradejnant A, Vachalathiti R. Immediate effects of the central posteroanterior mobilization technique on pain and range of motion in patients with mechanical neck pain. *Disability and Rehabilitation* 2009;(In Press).
- Krauss 2008** *{published data only}*
Krauss J, Creighton D, Ely JD, Podlowska-Ely J. The immediate effects of upper thoracic translatoric spinal manipulation on cervical pain and range of motion: a randomized clinical trial. *The Journal of Manual and Manipulative Therapy* 2008;**16**(2):93–9.
- Martinez-Segura 2006** *{published data only}*
Martinez-Segura R, Fernandez-de-las-Penas C, Ruiz-Saez M, Lopez-Jimenez C, Rodriguez-Blanco C. Immediate effects on neck pain and active range of motion after a single cervical high-velocity low amplitude manipulation in subjects presenting with mechanical neck pain: A randomized controlled trial. *Journal of Manipulative and Physiological Therapeutics* 2006;**29**:511–7.
- Muller 2005** *{published data only}*
Muller R, Giles LGF. Long-term follow-up of a randomized clinical trial assessing the efficacy of medication , acupuncture, and spinal manipulation for chronic mechanical spinal pain syndromes. *Journal of Manipulative and Physiological Therapeutics* 2005;**28**:3–11.
- Nilsson 1997** *{published data only}*
Nilsson N. A randomized controlled trial of the effect of spinal manipulation in the treatment of cervicogenic headache. *Journal of Manipulative and Physiological Therapeutics* 1995;**18**(7):435–40.
Nilsson N, Christensen HW, Hartvigsen J. Lasting changes in passive range of motion after spinal manipulation: A randomized, blind, controlled trial. *Journal of Manipulative and Physiological Therapeutics* 1996;**19**(3):165–8.
* Nilsson N, Christensen HW, Hartvigsen J. The effect of spinal manipulation in the treatment of cervicogenic headache. *Journal of Manipulative and Physiological Therapeutics* 1997;**20**(5):326–30.
- Parkin-Smith 1998** *{published data only}*
Parkin-Smith GF, Penter CS. A clinical trial investigating the effect of two manipulative approaches in the treatment of mechanical neck pain: A pilot study. *Journal of the Neuromusculoskeletal System* 1998;**6**(1):6–16.
- Savolainen 2004** *{published data only}*
Savolainen A, Ahlberg J, Nummala H, Nissinen M. Active or passive treatment for neck-shoulder pain in occupational health care? A randomized controlled trial. *Occupational Medicine* 2004;**54**:422–4.
- Sloop 1982** *{published data only}*
Sloop PR, Smith DS, Goldenberg E, Dore C. Manipulation for chronic neck pain: A double-blind controlled study. *Spine* 1982;**7**(6):532–5.
- Strunk 2008** *{published data only}*
Strunk RG, Hondras MA. A feasibility study assessing manual therapies to different regions of the spine for patients with subacute or chronic neck pain. *Journal of chiropractic medicine* 2008;**7**:1–8.
- van Schalkwyk 2000** *{published data only}*
van Schalkwyk R, Parkin-Smith GF. A clinical trial investigating the possible effect of the supine cervical rotatory manipulation and the supine lateral break manipulation in the treatment of mechanical neck pain: A pilot study. *Journal of Manipulative and Physiological Therapeutics* 2000;**23**(5):324–31.
- Vernon 1990** *{published data only}*
Vernon HT, Aker P, Burns S, Viljakaenen S, Short L. Pressure pain threshold evaluation of the effect of spinal manipulation in the treatment of chronic neck pain: A pilot study. *Journal of Manipulative and Physiological Therapeutics* 1990;**13**(1):13–6.
- Wood 2001** *{published data only}*
Wood TG, Colloca CJ, Matthews R. A pilot randomized clinical trial on the relative effect of instrumental (MFMA) versus manual (HVLA) manipulation in the treatment of cervical spine dysfunction. *Journal of Manipulative and Physiological Therapeutics* 2001;**24**(4):260–71.

Yurkiw 1996 {published data only}

Yurkiw D, Mior S. Comparison of two chiropractic techniques on pain and lateral flexion in neck pain patients: a pilot study. *Chiropractic Technique* 1996;**8**(4):155–62.

References to studies excluded from this review**Allan 2003 {published data only}**

Allan M, Brantingham JW, Menezes A. Stretching as an adjunct to chiropractic manipulation of chronic neck pain - before, after, or not at all? A perspective, randomized controlled clinical trial. *European Journal of Chiropractic* 2003;**50**:41–52.

Allan 2003a {published data only}

Allan M, Brantingham JW, Menezes A. Stretching as an adjunct to chiropractic manipulation of chronic neck pain-before, after or not at all? A prospective randomized controlled clinical trial. *European Journal of Chiropractors* 2003;**50**:41–52.

Allison 2002 {published data only}

Allison GT, Nagy BM, Hall T. A randomized clinical trial of manual therapy for cervico-brachial pain syndrome - a pilot study. *Manual Therapy* 2002;**7**(2):95–102.

Bonk 2000 {published data only}

Bonk AD, Ferrari R, Giebel GD, Edelmann M, Huser R. Prospective randomized controlled study of activity versus collar and the natural history for whiplash injury in Germany. *Journal of Musculoskeletal Pain* 2000;**8**(1/2): 123–32.

Briem 2007 {published data only}

Briem K, Huijbregts P, Thorsteinsdottir M. Immediate effects of inhibitive distraction on active range of cervical flexion in patients with neck pain: a pilot study. *The journal of manual and manipulative therapy* 2007;**15**(2):82–92.

Brodin 1985 {published data only}

Brodin H. Cervical pain and mobilization. *International Journal of Rehabilitation Research* 1984;**7**(2):190–1.
Brodin H. Cervical pain and mobilization. *Manual Medicine* 1985;**2**:18–22.

Brønfort 2001 {published data only}

Brønfort G, Evan R, Nelson B, Aker PD, Goldsmith CH, Vernon H. A randomized clinical trial of exercise and spinal manipulation for patients with chronic neck pain. *Spine* 2001;**26**(7):788–99.
Evans R, Brønfort G, Nelson B, Goldsmith C. Two-year follow-up of a randomized clinical trial of spinal manipulation and two types of exercise for patients with chronic neck pain. *Spine* 2002;**27**:2383–9.

Cleland 2009 {published data only}

Cleland JA, Fritz JM, Brennan GP, Jake Magel. Does continuing education improve physical therapists' effectiveness in treating neck pain? A randomized clinical trial. *Physical Therapy* 2009;**89**(1):38–47.

Cunha 2008 {published data only}

Cunha ACV, Burke TN, Franca FJR, Marques AP. Effect of global posture re-education and of static stretching on pain,

range of motion, and quality of life in women with chronic neck pain: a randomized clinical trial. *Clinics* 2008;**63**(6): 763–70.

Donkin 2002 {published data only}

Donkin RD, Parkin-Smith GF, Gomes AN. Possible effect of chiropractic manipulation and combined manual traction and manipulation on tension-type headache: A pilot study. *Journal of the Neuromusculoskeletal System* 2002;**10**(3): 89–97.

Dostal 1997 {published data only}

Dostal C, Pavelka K, Lewit K. Ibuprofen in the treatment of the cervico-cranial syndrome in combination with manipulative therapy. *Fysiatrickay a Reumatologickay Vestnik [Czech]* 1997;**56**:258–63.

Durianova 1977 {published data only}

Durianova J. Functional muscle changes and their influence by physiatric means. *Fysiat Revmatol Vestn [Slovak]* 1977; **55**:16–21.

Dziedzic 2005 {published data only}

Dziedzic K, Hill J, Lewis M, Sim J, Daniels J, Hay E. Effectiveness of manual therapy or pulsed shortwave diathermy in addition to advice and exercise for neck disorders: A pragmatic randomized controlled trial in physical therapy clinics. *American College of Rheumatology* 2005;**53**:214–22.

Fernandez 2004b {published data only}

Fernandez-de-las-Penas C, Fernandez-Carnero J, Palomeque del Cerro L, Miangolarra-Page JC. Manipulative treatment vs. conventional physiotherapy treatment in whiplash injury: A randomized controlled trial. *Journal of Whiplash & Related Disorders* 2004;**3**:73–90.

Fernandez 2008 {published data only}

Fernández-de-Las-Peñas C, Alonso-Blanco C, Cleland JA, Rodríguez-Blanco C, Alburquerque-Sendín F. Changes in pressure pain thresholds over C5-C6 zygapophyseal joint after a cervicothoracic junction manipulation in healthy subjects. *Journal of Manipulative and Physiological Therapeutics* 2008;**31**(5):332–7.

Fitz-Ritson 1994 {published data only}

Fitz-Ritson D. Efficacy of low energy laser therapy for extensor neck muscles and sleep pattern improvement after “whiplash” injury. *Journal of Manipulative and Physiological Therapeutics* 1994;**May 17**(4):277–8.

Giebel 1997 {published data only}

Giebel GD, Edelmann M, Huser R. Die distorsion der halswirbelsaule: Frühfunktionale vs. ruhigstellende behandlung. *Zentralbl Chir* 1997;**122**:517–21.

Giles 2003 {published data only}

* Giles LGF, Muller R. Chronic spinal pain: A randomized clinical trial comparing medication, acupuncture, and spinal manipulation. *Spine* 2003;**28**(14):1490–502.

Goldie 1970 {published data only}

Goldie I, Landquist A. Evaluation of the effects of different forms of physiotherapy in cervical pain. *Scandinavian Journal of Rehabilitation Medicine* 1970;**2**(3):117–21.

Grunnet-Nilsson 1999 {published data only}

Grunnet-Nilsson N, Bove G. Manipulation of episodic neck pain [Manipulationsbehandling af episodisk spaendings-type-hovedpine]. *Ugeskr Laeger* 2000;**162**:174–7.

Gustavsson 2006 {published data only}

* Gustavsson C, von Koch L. Applied relaxation in the treatment of long-lasting neck pain: A randomized controlled pilot study. *J Rehabil Med* 2006;**38**:100–7.

Haas 2003 {published data only}

Haas M, Group E, Panzer D, Parna L, Lumsden S, Aickin M. Efficacy of cervical end-play assessment as an indicator for spinal manipulation. *Spine* 2003;**28**(11):1091–8.

Hakkinen 2007 {published data only}

Hakkinen A, Salo P, Tarvainen U, Wiren K, Ylinen J. Effect of manual therapy and stretching on neck muscle strength and mobility in chronic neck pain. *Journal of Rehabilitation Medicine* 2007;**39**:575–9.

Hemmila 2005 {published data only}

Hemmila HM. Bone setting for prolonged neck pain: A randomized clinical trial. *Journal of Manipulative and Physiological Therapeutics* 2005;**28**:508–15.

Hodgson 2006 {published data only}

Hodgson L, Fryer G. The effect of manual pressure release on myofascial trigger points in the upper trapezius muscle. *International Journal of Osteopathic Medicine* 2006;**9**:27–46.

Hong 2005 {published data only}

Hong ES, Deng MY, Cheng LH, Zhou S, Wang B, Zhang A, et al. Effect of vertebral manipulation therapy on vertebro-basilar blood flow in cervical spondylosis of vertebral artery type. *Zhongguo Zhong Xi Yi Jie He Za Zhi* 2005;**25**(8):742–4.

Hoving 2002 {published data only}

Hoving JL, de Vet HCW, Koes BW, van Mameren H, Deville WJLM, van der Windt DAWM, et al. Manual therapy, physical therapy, or continued care by the general practitioner for patients with neck pain: long-term results from a pragmatic randomized trial. In: Hoving JL editor(s). *thesis*. 1st Edition. Wageningen: Pons & Looijen bv, 2001: 59–73.

Hoving JL, Koes BW, de Vet HCW, van der Windt DAWM, Assendelft WJJ, van Mameren H, et al. Manual therapy, physical therapy, or continued care by a general practitioner for patients with neck pain. *Annals of Internal Medicine* 2002;**136**(10):713–59.

Hoving JL, Koes BW, de Vet HCW, van der Windt DAWM, Assendelft WJJ, van Mameren H, et al. Manual therapy, physical therapy, or continued care by a general practitioner for patients with neck pain: long-term results from a pragmatic randomized clinical trial. *Clinical Journal of Pain* 2006;**22**(4):370–7.

Korthals-de Bos IBC, Hoving JL, van Tulder MW, Rutten-van Molken MPMH, Ader HJ, et al. Cost effectiveness of physiotherapy, manual therapy, and general practitioner care

for neck pain: economic evaluation alongside a randomized controlled trial. *British Medical Journal* 2003;**326**:1–6.

Korthals-de Bos IBC, Hoving JL, van Tulder MW, Rutten-van Molken MPMH, Ader HJ, et al. Manual therapy is more cost-effective than physical therapy and GP care for patients with neck pain. *thesis*. 1st Edition. Wageningen: Pons & Looijen bv, 2001:75–89.

Hurwitz 2005 {published data only}

Hurwitz EL, Morgenstern H, Vassilaki M, Chiang LM. Frequency and clinical predictors of adverse reactions to chiropractic care in the UCLA neck pain study. *Spine* 2005;**30**(13):1477–84.

Hurwitz 2006 {published data only}

Hurwitz EL, Goldstein MS, Morgenstern H, Chiang LM. The impact of psychosocial factors on neck pain and disability outcomes among primary care patients: Results from the UCLA Neck Pain Study. *Disability and Rehabilitation* 2006;**28**(21):1319–29.

Jahanshahi 1991 {published data only}

Jahanshahi M, Sartory G, Marsden CD. EMG biofeedback treatment of torticollis: A controlled outcome study. *Biofeedback and Self Regulation* 1991;**16**:413–48.

Jensen 1990 {published data only}

Jensen OK, Nielsen FF, Vosmar L. An open study comparing manual therapy with the use of cold packs in the treatment of post-traumatic headache. *Cephalgia* 1990;**10**:241–50.

Jensen 1995 {published data only}

Jensen I, Nygren A, Goldie I, Westerholm P, Jonsson E. The role of the psychologist in multidisciplinary treatments for chronic neck and shoulder pain: a controlled cost-effectiveness study. *Scandinavian Journal of Rehabilitation Medicine* 1995;**27**(1):19–26.

Jing 2006 {published data only}

Jing FJ, Zhang J. Clinical effect of Yi-Nao manipulation in the treatment of cervical spondylosis of vertebral artery type. *Chinese Journal of Clinical Rehabilitation* 2006;**10**(39):27–9.

Jordan 1998 {published data only}

Jordan A, Bendix T, Nielsen H, Hansen FR, Host D, Winkel A. Intensive training, physiotherapy, or manipulation for patients with chronic neck pain: A prospective single-blind randomized clinical trial. *Spine* 1998;**23**(3):311–9.

Jull 2001 {unpublished data only}

Jull G, Trott P, Potter H, Zito G, Niere K, Shirley D, et al. A randomized controlled trial of exercise and manipulative therapy for cervicogenic headache. *Spine* 2001;**27**(17):1845–3.

Jull 2007 {published data only}

Jull G, Sterling M, Kenardy J, Beller E. Does the presence of sensory hypersensitivity influence outcomes of physical rehabilitation for chronic whiplash? - A preliminary RCT. *Pain* 2007;**129**:28–34.

Karlberg 1996 {published data only}

Karlberg M, Magnusson M, Eva-Maj M, Melander A, Moritz U. Postural and symptomatic improvement after physiotherapy in patients with dizziness of suspected cervical

origin. *Archives of Physical Medicine and Rehabilitation* 1996;**77**:874–82.

Koes 1992 {published data only}

Koes B, Bouter LM, Knipshild PG. The effectiveness of manual therapy, physiotherapy and continued treatment by general practitioner for chronic nonspecific back and neck complaints. *Journal of Manipulative and Physiological Therapeutics* 1991;**14**:498–502.

Koes BW. *Efficacy of manual therapy and physiotherapy for back and neck complaints (Thesis)*. den Haag. Cip-Gegevens Koninklijke Bibliotheek, 1992a.

Koes BW, Bouter LM, van Mameren H, Esser AH, Verstegen GH, Hofhuizen DM, et al. Randomized clinical trial of manual therapy and physiotherapy for persistent back and neck complaints. *Manual Therapy in the Netherlands* 1992d; **1**:7–12.

Koes BW, Bouter LM, van Mameren H, Esser AH, Verstegen GM, Hofhuizen DM, et al. A blind randomized clinical trial of manual therapy and physiotherapy for chronic back and neck complaints: Physical outcome measures. *Journal of Manipulative Physiological Therapeutics* 1992e;**15**(1):16–23.

Koes BW, Bouter LM, van Mameren H, Esser AH, Verstegen GM, Hofhuizen DM, et al. Randomized clinical trial of manipulative therapy and physiotherapy for persistent back and neck complaints: results of one year follow-up. *British Medical Journal* 1992b;**304**:601–5.

Koes BW, Bouter LM, van Mameren H, Esser AH, Verstegen GJMG, Hofhuizen DM, et al. A randomized clinical trial of manual therapy and physiotherapy for persistent back and neck complaints. Subgroup analysis and relationship between outcomes measure. *Journal of Manipulative and Physiological Therapeutics* 1993;**16**(4): 211–9.

Koes BW, Bouter LM, van Mameren H, Esser AH, Verstegen GM, Hofhuizen DM, et al. The effectiveness of manual therapy, physiotherapy, and treatment by the general practitioner for nonspecific back and neck complaints. *Spine* 1992c;**17**(1):28–35.

Kogstad 1978 {published data only}

Kogstad, OA, Karterud S, Gudmundsen J. Cervicobrachialgia. A controlled trial with conventional treatment and manipulation [Cervicobrachialgi]. *Tidsskr Nor Loegeforen* 1978;**98**(16):845–8.

Kongsted 2007 {published data only}

Kongsted A, Qerama E, Kasch H, Bendix T, Winther F, Korsholm L, et al. Neck collar, “act-as-usual” or active mobilization for whiplash injury?. *Spine* 2007;**32**(6): 618–26.

Leboeuf 1987 {published data only}

Leboeuf C, Grant BR, Maginnes GS. Chiropractic treatment of repetitive stress injuries: A preliminary prospective outcome study of SMT versus SMT combined with massage. *Journal of the Australian Chiropractors' Association* 1987;**17**(1):11–4.

Levoska 1993 {published data only}

Levoska S, Keinänen-Kiukaanneimi S. Active or passive physiotherapy for occupational cervicobrachial disorders? A comparison of two treatment methods with a 1-year follow-up. *Archives of Physical Medicine and Rehabilitation* 1993; **74**:425–30.

Li 2006 {published data only}

Li DJ, Wang J, Gao Q, Hou JS. Interventional effects of cervical local-point traction, manipulation plus silver needle heat conductive treatment for cervical spinal canal stenosis. *Chinese Journal of Clinical Rehabilitation* 2006;**10**(43):7–10.

Lindell 2008 {published data only}

Lindell O, Johansson SE, Strender LE. Subacute and chronic, non-specific back and neck pain: cognitive-behavioural rehabilitation versus primary care. A randomized controlled trial. *BMC Musculoskeletal Disorders* 2008;**9**:59–63.

Linton 2001 {published data only}

Linton SL, Ryberg M. A cognitive-behavioural group intervention as prevention for persistent neck and back pain in a non-patient population: a randomized controlled trial. *Pain* 2001;**90**:83–90.

Manca 2007 {published data only}

Manca A, Dumville JC, Torgerson DJ, Klaber Moffett JA, Mooney MP, Jackson DA, et al. Randomized trial of two physiotherapy interventions for primary care back and neck patients: cost-effectiveness analysis. *Rheumatology* 2007;**46**: 1495–501.

Mansilla-Ferragut 2009 {published data only}

Mansilla-Ferragut P, Fernandez-de-las Penas C, Alburquerque-Sendin F, Cleland JA, Bosca-Gandia JJ. Immediate effects of atlanto-occipital joint manipulation on active mouth opening and pressure pain sensitivity in women with mechanical neck pain. *Journal of Manipulative and Physiological Therapeutics* 2009;**32**:101–6.

McClatchie 2009 {published data only}

McClatchie L, Laprade J, Martis S, Jaglal SD, Richardson D. Mobilizations of the asymptomatic cervical spine can reduce signs of shoulder dysfunction in adults. *Manual Therapy* 2009;**14**(4):369–74.

McKinney 1989 {published data only}

McKinney LA. Early mobilisation and outcome in acute sprains of the neck. *British Medical Journal* 1989b;**299**: 1006–8.

McKinney LA, Dornan JO, Ryan M. The role of physiotherapy in the management of acute neck sprains following road-traffic accidents. *Archives of Emergency Medicine* 1989a;**6**(1):27–33.

McKinney MB. Treatment of dislocations of the cervical vertebrae in so-called “whiplash injuries” [Behandlung der HWS-Distorsionen bei sog “Schleuderverletzungen”]. *Orthopade* 1994;**23**(4):287–90.

McReynolds 2005 {published data only}

McReynolds TM, Sheridan BJ. Intramuscular Ketorolac versus osteopathic manipulative treatment in the management of acute neck pain in the emergency

- department: A randomized clinical trial. *Journal of American Osteopathic Association* 2005;**105**(2):57–68.
- Mealy 1986** *{published data only}*
Mealy K, Brennan H, Fenelon GC. Early mobilisation of acute whiplash injuries. *British Medical Journal* 1986;**92**: 656–7.
- Metcalfe 2006** *{published data only}*
Metcalfe S, Reese H, Sydenham R. Effect of high-velocity low-amplitude manipulation on cervical spin muscle strength: A randomized clinical trial. *Journal of Manual & Manipulative Therapy* 2006;**14**(3):152–8.
- Mezaki 1995** *{published data only}*
Mezaki T, Kaji R, Kimura J, Mannen T. Dose-response relationship in the treatment of cervical dystonia with botulinum toxin type A (AGN 191622): A phase II study. *Brain and Nerve* 1995;**4**:857–62.
Mezaki T, Kaji R, Kimura J, Osame M, Mizuno Y, Hirayama K, et al. The clinical usefulness of botulinum toxin type A for spasmodic torticollis and facial spasm. *Brain and Nerve* 1995;**47**:749–54.
- Moodley 2002** *{published data only}*
Moodley M, Brantingham JW. The relative effectiveness of spinal manipulation and ultrasound in mechanical pain: pilot study. *Journal of Chiropractic Medicine* 2002;**1**(4): 184–8.
- Nordemar 1981** *{published data only}*
Nordemar R, Thorner C. Treatment of acute cervical pain - a comparative group study. *Pain* 1981;**10**:93–101.
- Palmgren 2006** *{published data only}*
Palmgren PJ, Sandstrom PJ, Lundqvist FJ, Heikkila H. Improvement after chiropractic care in cervicocephalic kinesthetic sensibility and subjective pain intensity in patients with nontraumatic chronic neck pain. *Journal of Manipulative and Physiological Therapeutics* 2006;**29**:100–6.
- Persson 2001** *{published data only}*
Persson L, Karlberg M, Magnusson M. Effects of different treatments on postural performance in patients with cervical root compression. A randomized prospective study assessing the importance of the neck in postural control. *Journal of Vestibular Research* 1996;**6**(6):439–53.
Persson LCG, Carlsson CA, Carlsson JY. Long-lasting cervical radicular pain managed with surgery, physiotherapy, or a cervical collar. A prospective, randomized study. *Spine* 1997;**22**(7):751–8.
Persson LCG, Lilja A. Pain, coping, emotional state and physical function in patients with chronic radicular neck pain. A comparison between patients treated with surgery, physiotherapy or neck collar - a blinded, prospective randomized study. *Disability and Rehabilitation* 2001;**23**(8):325–35.
Persson LCG, Moritz U, Brandt L, Carlsson CA. Cervical radiculopathy: pain, muscle weakness and sensory loss in patients with cervical radiculopathy treated with surgery, physiotherapy or cervical collar. A prospective, controlled study. *European Spine Journal* 1994;**6**(4):256–66.
- Provinciali 1996** *{published data only}*
Provinciali L, Baroni M, Illuminati L, Ceravolo MG. Multimodal treatment to prevent the late whiplash syndrome. *Scandinavian Journal of Rehabilitation Medicine* 1996;**28**:105–11.
- Reginiussen 2000** *{published data only}*
Reginiussen T, Johnsen R, Torstensen TA. Efficiency of manual therapy on patients with cervicogenic headache: A randomized single blinded controlled trial. International Federation of Manipulation Therapy, 7th Scientific Conference. Perth: University of Western Australia, 2000: Abstract 105.
- Rupert 2002** *{published data only}*
Rupert R, Xuejun S, Giggelman G, Wang Z. Physiological changes resulting from soft tissue manipulation. Proceedings of the 2002 International Conference on Spinal Manipulation. Toronto, Ontario, Canada: Foundation for Chiropractic Education, 2002.
- Schenk 1994** *{published data only}*
Schenk R, Adelman K, Rousselle J. The effects of muscle energy technique on cervical range of motion. *The Journal of Manual & Manipulative Therapy* 1994;**2**(4):149–55.
- Schwerla 2008** *{published data only}*
Schwerla F, Bischoff A, Nurnberger A, Genter P, Guillaume JP, Resch KL. Osteopathic treatment of patients with chronic non-specific neck pain: a randomised controlled trial of efficacy. *Forsch Komplementmed* 2008;**15**:138–45.
- Skargren 1998** *{published data only}*
Skargren EI, Carlsson PG, Oberg BE. One-year follow-up comparison of the cost and effectiveness of chiropractic and physiotherapy as primary management for back pain. *Spine* 1998;**23**(17):1875–84.
Skargren EI, Oberg BE. Predictive factors for 1-year outcome of low-back and neck pain in patients treated in primary care: comparison between the treatment strategies chiropractic and physiotherapy. *Pain* 1998;**77**:201–7.
Skargren EI, Oberg BE, Carlsson PG, Gade M. Cost and effectiveness analysis of chiropractic and physiotherapy treatment for low back and neck pain, Six-month follow-up. *Spine* 1997;**22**(18):2167–71.
- Snyder 1996** *{published data only}*
Snyder BJ, Sanders GE. Evaluation of the Toftness system of chiropractic adjusting for subjects with chronic back pain, chronic tension headaches, or primary dysmenorrhea. *Chiropractic Technique* 1996;**8**(1):3–9.
- Sterling 2001** *{published data only}*
Sterling M, Jull G, Wright A. Cervical mobilisation: concurrent effects on pain, sympathetic nervous system activity and motor activity. *Manual Therapy* 2001;**6**(2): 72–81.
- Tuchin 2000** *{published data only}*
Tuchin PJ, Pollard H, Bonello P. A randomized controlled trial of chiropractic spinal manipulation therapy for migraines. *Journal of Manipulative and Physiological Therapeutics* 2000;**23**:91–5.

Vasseljen 1995 *{published data only}*

Vasseljen O, Johansen BM, Westgaard RH. The effect of pain reduction on perceived tension and EMG-recorded trapezius muscle activity in workers with shoulder and neck pain. *Scandinavian Journal of Rehabilitation Medicine* 1995; **27**:243–52.

Whittingham 2001 *{published data only}*

Whittingham W, Nilsson N. Active range of motion in the cervical spine increases after spinal manipulation. *Journal of Manipulative and Physiological Therapeutics* 2001; **24**(9): 552–5.

Williams 2003 *{published data only}*

Williams NH, Wilkinson C, Russell I, Edwards RT, Hibbs R, Linck P, et al. Randomized osteopathic manipulation study (ROMANS): pragmatic trial for spinal pain in primary care. *Family Practice* 2003; **20**(6):662–9.

Yin 2006 *{published data only}*

Yin ZJ, Chen XM. Effect of clinostatic manipulation on blood flow velocity of patients with cervical spondylosis of vertebral artery type in supine position. *Chinese Journal of Clinical Rehabilitation* 2006; **10**(35):90–1.

Ylinen 2003 *{published data only}*

Ylinen J, Takala EP, Nykanen M, Hakkinen A, Malkia E, Pohjolainen T, et al. Active Neck Muscle Training in the Treatment of Chronic Neck Pain in Women. *JAMA* 2003; **289**(19):2509–16.

Zaproudina 2007 *{published data only}*

Zaproudina N, Hanninen OOP, Airaksinen O. Effectiveness of traditional bone setting in chronic neck pain: Randomized clinical trial. *Journal of Manipulative and Physiological Therapeutics* 2007; **30**(6):432–7.

Zhi 2008 *{published data only}*

Zhi LX, Feng CW, Tu CY. Controlled randomized clinical trial on the therapeutic effect of acupotomy-injection combined with Feng's spinal manipulation (FSM) for cervical spondylosis radiculopathy. *China Journal of Orthopaedics and Trauma* 2008; **21**(6):421–4.

References to studies awaiting assessment**Escortell 2008** *{published data only}*

Escortell ME, Lebrigo PG, Perez MY, Asunsolo del Barco A, Riesego FR, Saa Requejo C, et al. Randomized clinical trial for primary care patients with neck pain: manual therapy versus electrical stimulation [Ensayo clinico aleatorizado en pacientes con cervicalgia mecanica en atencion primaria: terapia manual frente a electroestimulacion nerviosa transcutanea]. *Atencion Primaria* 2008; **40**(7):337–43.

References to ongoing studies**Brønfort 2000** *{published data only}*

Brønfort G, Garvey T, Transfeldt E, Anderson A, Bittell S. Conservative treatment for neck pain: A pilot study. Proceedings of the 2000 International Conference on Spinal Manipulation. Des Moines, IA, USA: Foundation for Chiropractic Education and Research, 2000:53.

Brønfort 2002 *{unpublished data only}*

Brønfort, G. Chiropractic, medication, and self-care for neck pain. <http://clinicaltrials.gov> January 2002; Vol. National Library of Medicine, issue Study ID Number: 1 R01 AT000707–01.

Evans 2003 *{published data only}*

Evans R, Brønfort G, Bittell S, Anderson AV. A pilot study for a randomized clinical trial assessing chiropractic care, medical care, and self-care education for acute and subacute neck pain patients. *Journal of manipulative and physiological therapeutics* 2003; **26**(7):403–11.

Gudavalli 2006 *{published data only}*

* Gudavalli MR, Cambron J, Long C, McGregor M, Jedlicka J, Keenum M, et al. A randomized clinical trial comparing non-operative conservative medical care, chiropractic cervical distraction, and a combination of both for chronic neck pain. *The Week in Chiropractic* 2005; **11**(37):1.

Guerriero 1997 *{published data only}*

Guerriero D. Comparative effects of manipulation and physical therapy on motion in the cervical spine. Proceedings of the International Conference on Spinal Manipulation [Abstract]. Arlington, Virginia; U.S.A., April 12–13, 1991.

Khoury 2002 *{published data only}*

Khoury MA, Deall AJ. A comparative study to determine the most effective chiropractic treatment protocol in the management of cervicogenic headache. *European Journal of Chiropractic* 2002; **49**:104–5.

Kjellman 1997 *{published data only}*

Kjellman G, Oberg B, Skargren E. Comparison of treatment in neck pain. The Second International Forum for Primary Care Research on Low Back Pain [Abstract]. The Hague, The Netherlands, May 30–31, 1997.

Lamb 2007 *{published data only}*

Lamb SE, Gates S, Underwood MR, Cooke MW, Ashby D, Szczepura A, et al. Managing Injuries of the Neck Trial (MINT): design of a randomized controlled trial of treatments for whiplash associated disorders. *BMC Musculoskeletal Disorders* 2007; **8**(7):1–7.

Nagy 2000 *{published data only}*

Nagy B, Allison GT, Hall T. Randomised placebo controlled trial for cervicobrachial pain syndrome using manual therapy. International Federation of Manipulative Therapy, 7th Scientific Conference. Perth: The University of Western Australia, November 2000:Abstract 72.

Pool 2006 *{published data only}*

Pool JJM, Ostelo RWJG, Koke AJ, Bouter LM, de Vet HCW. Comparison of the effectiveness of a behavioural graded activity program and manual therapy in patients with sub-acute neck pain: Design of a randomized clinical trial. *Manual Therapy* 2006; **11**:297–305.

Scholten-Peeters 2003 *{published data only}*

Scholten-Peeters GGM, Verhagen AP, Neeleman-van der Steen, Hurkmans JCAM, Wams RWA, Oosterdorp RAB.

Randomized clinical trial of conservative treatment for patients with whiplash-associated disorders: Considerations for the design and dynamic treatment protocol. *Journal of Manipulative Physiological Therapeutics* 2003;**26**:412–20.

Scott-Dawkins 1997 {published data only}

Scott-Dawkins C. The comparative effectiveness of adjustments versus mobilisation in chronic mechanical neck pain. Proceedings of the Scientific Symposium. Tokyo, Japan, June 2–8, 1997.

Stokke 1995 {published data only}

Stokke O. A randomized comparison of chiropractic and physiotherapy treatment for neck pain of functional (mechanical) origins: A controlled clinical trial. Conference Proceedings of the Chiropractic Centennial Foundation [Abstract]. July, 1995:372–3.

Tanaka 1995 {published data only}

Tanaka, D. Pilot study of chiropractic therapy compared to medical therapy for chronic cervical pain. Conference Proceedings of the Chiropractic Centennial Foundation [Abstract]. 1995:374–5.

Additional references

Altman 2001

Altman DG, Schulz KF, Moher D, Egger M, Davidoff F, Elbourne D, et al. CONSORT Group (Consolidated Standards of Reporting Trials). The revised CONSORT statement for reporting randomized trials: explanation and elaboration.. *Annals of Internal Medicine* 2001;**134**(8): 663–94.

Assendelft 1996

Assendelft WJ, Bouter LM, Knipschild PG. Complications of spinal manipulation: a comprehensive review of the literature. *Journal of Family Practice* 1996;**42**(5):475–80.

Beattie 2001

Beattie P. Measurement of health outcomes in the clinical setting: Applications to physiotherapy. *Physiotherapy Theory and Practice* 2001;**17**:173–85.

Bogduk 2000

Bogduk N. Whiplash: Why Pay for What does Not Work? . *Journal of Musculoskeletal Pain* 2001;**8**(1/2):29–53.

Borghouts 1998

Borghouts JAJ, Koes BW, Bouter LM. The clinical course and prognostic factors of non-specific neck pain: A systematic review. *Pain* 1998;**77**:1–13.

Borghouts 1999

Borghouts JAJ, Koes BW, Bouter LM. Cost-of-illness in neck pain in the Netherlands in 1996. *Pain* 1999;**80**: 629–36.

Brønfort 1997

Brønfort, G. *Efficacy of spinal manipulation and mobilisation for low back and neck pain: A systematic review and best evidence synthesis*. Amsterdam: Thesis Publishers Amsterdam, 1997.

Brønfort 2004

Brønfort G, Haas M, Evans RL, Bouter LM. Efficacy of manipulation and mobilization for low back pain and neck

pain: a systematic review and best evidence synthesis. *The Spine Journal* 2004;**4**(3):335–56.

Carlesso 2009

Carlesso L. Adverse events associated with cervical manipulation or mobilization for neck pain. Unpublished.

Childs 2008

Childs JD, Cleland JA, Elliott JM, Flynn TW, Teyhen DS, Wainner RS, et al. Neck pain: A clinical practice guideline linked to the International Classification of Function, Disability, and Health from the Orthopaedic Section of the American Physical Therapy Association. *Journal of Orthopaedic and Sports Physical Therapy* 2008;**38**(9):A1–34.

Cicchetti 1976

Cicchetti DV. Assessing inter-rater reliability for rating scales: resolving some basic issues. *British Journal of Psychiatry* 1976;**129**:452–6.

Cleland 2007

Cleland JA, Childs JD, Fritz JM, Whitman JM, Eberhart SL. Development of a clinical prediction rule for guiding treatment of a subgroup of patients with neck pain: Use of thoracic spine manipulation, exercise, and patient education. *Physical Therapy* 2007;**87**(1):9–23.

Cohen 1988

Cohen J. *Statistical power analysis for the behavioural sciences*. Second Edition. Hillsdale, NJ: Lawrence Erlbaum Associates, 1988.

Côté 1998

Côté P, Cassidy D, Corroll L. The Saskatchewan health and back pain survey. The prevalence of neck pain and related disability in Saskatchewan adults. *Spine* 1998;**23** (15):1689–98.

Côté 2008

Côté P, Kristman V, Vidmar M, Van Eerd D, Hogg-Johnson S, Beaton D, et al. The prevalence and incidence of work absenteeism involving neck pain: A cohort of Ontario lost-time claimants. *Spine* 2008;**33**(4 Suppl):S192–8.

D'Sylva 2009

D'Sylva J, Miller J, Gross A, Burnie S, Goldsmith C, Graham N, et al. Multimodal manual therapy: A systematic review. *Manual Therapy* 2009 (submitted).

Dupont 1990

Dupont WD, Plummer WD. Power and sample size calculations: A review and computer program. *Controlled Clinical Trials* 1990;**11**:116–8.

Farrar 2001

Farrar JT, Young JP Jr, LaMooureux L, Worth JL, Poole RM. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical rating scale. *Pain* 2001; **94**:149–58.

Felson 1995

Felson DT, Anderson JJ, Boers M, Bombardier C, Furst D, Goldsmith C, et al. American College of Rheumatology: Preliminary definition of improvement in rheumatoid arthritis. *Arthritis and Rheumatism* 1995;**38**(6):727–35.

Finch 2002

Finch E, Brooks D, Stratford P, Mayo N. Physical rehabilitation outcome measures: A guide to enhanced. *Physical rehabilitation outcome measures: A guide to enhanced clinical decision making*. Second Edition. Lippincott Williams and Wilkins, 2002.

Furlan 2009

Furlan AD, Pennick V, Bombardier C, van Tulder M, Editorial Board, Cochrane Back Review Group. 2009 Updated method guidelines for systematic reviews in the Cochrane Back Review Group. *Spine* 2009;**34**(18): 1929–41.

Gemmel 2006

Gemmel H, Miller B. Comparative effectiveness of manipulation, mobilisation and the Activator instrument in the treatment of non-specific neck pain: A systematic review. *Chiropractic and Osteopathy* 2006;**14**(7):15–21.

Goldsmith 1993

Goldsmith CH, Boers M, Bombardier C, Tugwell P. Criteria for clinically important changes in outcomes. Development, scoring and evaluation of rheumatoid arthritis patients and trial profiles. *Journal of Rheumatology* 1993;**20**(3):561–5.

Gross 2002b

Gross A, Kay T, Kennedy C, Gasner D, Hurley L, Yardley K, et al. Clinical practice guideline on the use of manipulation or mobilization in the treatment of adults with mechanical neck disorder. *Manual Therapy* 2002;**7**(4):193–205.

Gross 2003

Gross A, Goldsmith C, Kay T, Haines T, Peloso P, Kroelinger P, et al. Conservative management of mechanical neck disorders: A series of systematic reviews. Association of Chiropractic Colleges and Research Agenda Conference (ACC-RAC). Davenport, IA: Consortial Center for Chiropractic Research, 2003:29.

Guzman 2008

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. *Spine* 2008;**33**(4S):S14–23.

Higgins 2008

Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.0.1 [updated September 2008]. Available from www.cochrane-handbook.org. The Cochrane Collaboration.

Hogg-Johnson 2008

Hogg-Johnson S, van der Velde G, Carroll LJ, Holm LW, Cassidy JD, Guzman J, et al. The burden and determinants of neck pain in the general population: Results of the Bone and Joint Decade 2000-2010 Task Force on neck pain and its associated disorders. *Spine* 2008;**33**(4S):S39–51.

Hoving 2001

Hoving JL, Gross AR, Gasner D, Kay T, Kennedy C, Hondras MA, et al. A critical appraisal of review articles on

the effectiveness of conservative treatment of neck pain. *Spine* 2001;**26**(2):196–205.

Hurwitz 2008

Hurwitz EL, Carragee JEJ, van der Velde G, Carroll LJ, Nordin M, Guzman J, et al. Treatment of neck pain: Noninvasive interventions: Results of the bone and joint decade 2000-2010 Task Force on Neck Pain and its associated disorders. *Spine* 2008;**33**(4S):S123–52.

Jovey 2002

Jovey RD. General principles of pain management. In: Jovey RD editor(s). *Managing Pain*. 1st Edition. Toronto: Healthcare and Financial Publishing, Rogers Media, 2002: 15–20.

Karlberg 1996

Karlberg M, Magnusson M, Eva-Maj M, Melander A, Moritz U. Postural and symptomatic improvement after physiotherapy in patients with dizziness of suspected cervical origin. *Archives of Physical Medicine and Rehabilitation* 1996;**77**:874–82.

Kendal 1963

Kendal MG, Stuart A. *The advanced theory of statistics*. Second Edition. Vol. 1, New York: Hofner Publishing Co, 1963.

Lee 2001

Lee CE, Simmonds MJ, Novy DM, Jones S. Self-reports and clinician-measured physical function among patients with low back pain: A comparison. *Archives of Physical Medicine and Rehabilitation* 2001;**82**:227–31.

Linton 1998

Linton SJ, Helsing AL, Hallden K. A population-based study of spinal pain among 35-45 year old individuals. Prevalence, sick leave and health care use. *Spine* 1998;**23**(13):1457–63.

Little 1987

Little RJA, Rubin DB. *Statistical analysis with missing data*. Toronto: J Wiley & Sons Inc, 1987.

MacDermid 2009

MacDermid JC, Walton DM, Avery S, Blanchard A, Etruw E, McAlpine C, et al. Measurement properties of the neck disability index: A systematic review. *Journal of Orthopaedic and Sports Physical Therapy* 2009;**39**(5):400–17.

MacPherson 2002

MacPherson H, White A, Cummings M, Jobst KA, Rose K, Niemtzw RC, the STRICTA Group. Standards for Reporting Interventions in Controlled Trials of Acupuncture: the STRICTA recommendations. *Journal of Alternative and Complementary Medicine* 2002;**8**(1):85–9.

Magee 2000

Magee DJ, Oborn-Barret E, Turner S, Fenning N. A systematic overview of the current research evidence on the selected treatment interventions on soft tissue neck injury following trauma. *Physiotherapy Canada* 2000;**52**(2): 111–30.

Miller 2009

Miller J, Gross AR, D'Sylva J, Burnie S, Goldsmith C, Graham N, et al. Manual therapy and exercise for neck pain: A systematic review. *Manual Therapy* 2009 (submitted).

Olesen 1988

Olesen J. Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. *Cephalgia* 1988;**8**(7):61–2.

Olesen 1997

Olesen J, Gobel H. ICD-10 Guide for Headaches. Guide to the classification, diagnosis and assessment of headaches in accordance with the tenth revision of the International classification of diseases and related health problems and its application to neurology. *Cephalgia* 1997;**17**(Suppl 19): 29–30.

Peeters 2001

Peeters GGM, Verhagen AP, deBie RA, Oostendorp RAB. The efficacy of conservative treatment in patients with whiplash injury. *Spine* 2001;**26**(4):E64–73.

Rubinstein 2007

Rubinstein SM, Pool JJM, van Tulder MW, Riphagen II, de Vet HCW. A systematic review of the diagnostic accuracy of provocative tests of the neck for diagnosing cervical radiculopathy. *European Spine Journal* 2007;**16**:307–19.

Schumacher 1993

Schumacher HR, Klippel JH, Koopman WJ (eds). *Primer on the Rheumatic Diseases*. Tenth. Atlanta: Arthritis Foundation, 1993.

Sjaastad 1990

Sjaastad O, Fredriksen TA, Pfaffenrath V. Cervicogenic headache: diagnostic criteria. *Headache* 1990;**30**:725–6.

Souvlis 2004

Souvlis T, Vicenzino B, Wright A. Neurophysiological effects of spinal manual therapy. In: Boyling JD, Jull GA editor(s). *Grieve's Modern Manual Therapy. The Vertebral Column*. 3rd Edition. Edinburgh: Churchill Livingstone, 2004:367–380. [ISBN 0443 071551]

Spitzer 1987

Spitzer WO, Leblanc FE, Dupuis M. Scientific approach to the assessment and management of activity related spinal disorders. *Spine* 1987;**7**:S1–59.

Spitzer 1995

Spitzer WO, Skovron M L, Salmi L R, Cassidy JD, Duranceau J, Suissa S, et al. Scientific monograph of the Quebec Task Force on Whiplash-Associated Disorders: redefining “whiplash” and its management. *Spine* 1995;**20**: S1–73.

Stratford 1999

Stratford PW, Riddle DL, Binkley JM, Spadoni G, Westaway MD, Padfield B. Using the neck disability index to make decisions concerning individual patients. *Physiotherapy Canada* 1999;**Spring**:107–19.

van Tulder 2003

van Tulder MW, Furlan A, Bombardier C, Bouter L, Editorial Board of the Cochrane Collaboration Back Review

Group. Updated Method Guidelines for systematic reviews in the Cochrane Collaboration Back Review Group. *Spine* 2003;**28**(12):1290–9.

Verhagen 2007

Verhagen AP, Scholten-Peeters GGM, van Wijngaarden S, de Bie R, Bierma-Zeinstra SMA. Conservative treatment for whiplash. *Cochrane Database of Systematic Reviews* 2007, Issue 2. [DOI: 10.1002/14651858.CD003338.pub3]

Vernon 2005

Vernon HT, Humphreys BK, Hagino CA. A systematic review of conservative treatments for acute neck pain not due to whiplash. *Journal of Manipulative and Physiological Therapeutics* 2005;**28**:443–8.

Vernon 2006

Vernon H, Humphreys BK, Hagino C. The outcome of control groups in clinical trials of conservative treatments for chronic mechanical neck pain: A systematic review. *BMC Musculoskeletal Disorders* 2006;**7**(58):1–10.

Vernon 2007

Vernon H, Humphreys K, Hagino C. Chronic mechanical neck disorders in adults treated by manual therapy: A systematic review of change scores in randomized clinical trials. *Journal of Manipulative and Physiological Therapeutics* 2007;**30**:215–27.

References to other published versions of this review**Gross 1996**

Gross AR, Aker PD, Goldsmith CH, Peloso P. Conservative management of neck disorders. A systematic overview and meta-analysis. *Online Journal of Current Clinical Trials* 1996:Doc No. 200-201.

Gross 2002a

Gross AR, Kay T, Hondras M, Goldsmith C, Haines T, Peloso P, et al. Manual therapy for mechanical neck disorders: a systematic review. *Manual Therapy* 2002a;**7**(3): 131–49.

Gross 2004a

Gross A, Bronfort G, Hoving J, Goldsmith C, Haines T, Aker P, Cervical Overview Group. Manipulation and mobilisation for mechanical neck disorders. *Cochrane Database of Systematic Reviews* 2004, Issue 1. [DOI: 10.1002/14651858.CD004249.pub2]

Gross 2004b

Gross AR, Hoving JL, Haines TA, Goldsmith CH, Kay T, Aker P, et al. Cervical Overview Group. A Cochrane review of manipulation and mobilization for mechanical neck disorders. *Spine* 2004;**29**(14):1541–8.

Gross 2007

Gross AR, Goldsmith C, Hoving JL, Haines T, Peloso P, Aker P, et al. Cervical Overview Group. Conservative management of mechanical neck disorders: A systematic review. *Journal of Rheumatology* 2007;**34**(5):183–02.

* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Bitterli 1977

Methods	Type of Trial: quasi-RCT Number Analysed/Randomised: 24/30 Intension-to-treat Analysis: calculated Power Analysis: not reported (NR)	
Participants	Chronic neck pain with headache or degenerative changes (spondylogenic)	
Interventions	<p>INDEX TREATMENT</p> <p>Group A (A): technique: manipulation as described by Maigne; frequency: 1 session/week; dose: mean 6.2 manipulations over 3.2 sessions; route: cervical spine</p> <p>Group B (B): technique: manipulation; frequency 1 session/week; dose: mean 7.2 manipulations over 3.8 sessions; route: cervical spine</p> <p>COMPARISON TREATMENT</p> <p>Group C (C): wait list control</p> <p>CO-INTERVENTION: none</p> <p>Duration of treatment: 3 weeks, 3 to 4 sessions</p> <p>Duration of follow-up: 12 weeks</p>	
Outcomes	<p>PAIN (VAS, 0 to 100)</p> <p>Baseline Mean: A 60.50, B 64.40, C 57.60</p> <p>End of Study Mean: A 38.50, B 27.80, C 43.50</p> <p>Absolute Benefit: A 22.0, B 36.6, C 14.1</p> <p>Reported Results: not significant</p> <p>SMD(A v C): -0.18(95%CI:-1.12 to 0.75) [power 10%]</p> <p>SMD(A v B): 0.36(95%CI:-0.58 to 1.30) [power 7%]</p> <p>SMD(B v C): -0.54(95%CI:-1.43 to 0.36) [power 10%]</p> <p>FUNCTION: NR</p> <p>GPE: NR</p> <p>PATIENT SATISFACTION: NR</p> <p>QoL: NR</p> <p>SIDE EFFECTS: manipulation and mobilisation were well tolerated with the customary reaction of minimal benign reaction lasting less than 24 hours; RR: 1.34(95%CI: 0.77 to 2.34)</p> <p>COST OF CARE: NR</p>	
Notes		
Risk of bias		
Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	No	

Bitterli 1977 (Continued)

Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	Yes	
Intention to treat?	No	
Free of selective outcome reporting?	Unclear	No previous protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	No	
Compliance acceptable?	No	
Similar timing of outcome assessment?	Yes	

Cassidy 1992

Methods	Type of Trial: RCT Number Analysed/Randomised: 100/100 Intention-to-treat Analysis: conducted Power Analysis: conducted
Participants	Acute, subacute, chronic neck pain with varied degenerative changes [spondylosis]
Interventions	INDEX TREATMENT Manipulation (Manip): technique: rotation manipulation away from the direction of pain; frequency: 1 session; dose: 1 manipulation; route: cervical spine COMPARISON TREATMENT Mobilisation (Mob): technique: muscle energy technique described by Bourdillon, an isometric contraction localised to the involved level, held for 5 seconds, repeated 4 times with increasing rotation or lateral flexion of the localised levels; frequency: 1 session; route: cervical spine CO-INTERVENTION: none Duration of treatment: 1 session Duration of follow-up: none
Outcomes	PAIN (NRS101) Baseline Mean: manip 37.7, mob 31.0 End of Study Mean: manip 20.4, mob 20.5 Absolute Benefit: manip 17.3, mob 10.5 Reported Results: not significant SMD: 0.00(95%CI:-0.40 to 0.39) [power 16%]

Cassidy 1992 (Continued)

	<p>FUNCTION: NR PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECTS: no complications; 3 subjects in each group reported more pain after intervention; RR: 0.97(95%CI: 0.47 to 2.03) COST OF CARE: NR</p>
--	--

Notes	
-------	--

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	No	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	Yes	
Intention to treat?	Yes	
Free of selective outcome reporting?	Unclear	No previous protocol found
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	Yes	
Compliance acceptable?	Yes	
Similar timing of outcome assessment?	Yes	

Chen 2007

Methods	<p>Type of Trial: Quasi RCT Number Analysed/Randomised: 65/70 Intention-to-treat Analysis: not calculated Power Analysis: NR</p>
Participants	Chronic cervicogenic headache from degenerative changes

Interventions	<p>INDEX TREATMENT Manipulation (manip): technique: manipulation; frequency: 10 session, every other day; dose: 20 to 30 minute treatment, route: cervical spine COMPARISON TREATMENT Transcutaneous Electrical Nerve Stimulation: technique: TENS Perimedic, 10Hz, 250ns; frequency: 10 session every other day; dose: 20 minute duration; route: NR COINTERVENTION: NR Duration of Therapy Period: 10 session Duration of Follow-up: 1 weeks</p>
Outcomes	<p>PAIN (NRS, 0 to 10) Baseline Mean: manip 7.45, TENS 7.86 End of Study Mean: manip 2.31, cntl 5.26 Absolute Benefit: manip 5.41, cntl 2.6 Reported Results: significant favouring manipulation SMD: -1.91 (95%CI: -2.50 to -1.31) FUNCTION: NR PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECTS: none COST OF CARE: NR</p>
Notes	Chinese translation: Kein Trinh

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	No	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	Yes	
Intention to treat?	No	
Free of selective outcome reporting?	Unclear	No previous protocol published
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	Yes	

Chen 2007 (Continued)

Compliance acceptable?	Yes	
Similar timing of outcome assessment?	Yes	

Cleland 2005

Methods	Type of Trial: RCT Number Analysed/Randomised: 36/36 Intention-to-treat Analysis: not applicable (NA) Power Analysis: NR
Participants	Chronic neck pain
Interventions	INDEX TREATMENT Manipulation (manip):technique: thoracic manipulation; frequency: 1 session; dose: 1 to 2 manipulations per segment, average 3.7 manipulations per subject; route: thoracic spine to each restricted segment COMPARISON TREATMENT Placebo Manipulation (cntl): technique: use of flat open hand on subject naive to manipulation; frequency: 1 session; dose: average 3 placebo manipulation per subject; route: thoracic spine COINTERVENTION: NR Duration of Therapy Period: one session Duration of Follow-up: none
Outcomes	PAIN (VAS, 0 to 100) Baseline Mean: manip 41.6, pl 47.7 End of Study Mean: manip 26.1, cntl 43.5 Absolute Benefit: manip 15.5, cntl 4.2 Reported Results: significant favouring manipulation SMD: -0.93 (95%CI: -1.62 to -0.24) FUNCTION: NR PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECTS: none COST OF CARE: NR
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate
Randomization?	Yes	

Cleland 2005 (Continued)

Patient blinding?	Yes	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	Yes	
Intention to treat?	No	
Free of selective outcome reporting?	Yes	Protocol available
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	Yes	
Compliance acceptable?	Yes	
Similar timing of outcome assessment?	Yes	

Coppieters 2003

Methods	Type of Trial: RCT Number Analysed/Randomised: 20/20 Intention-to-treat Analysis: calculated Power Analysis: NR
Participants	Subacute, chronic neck pain
Interventions	INDEX TREATMENT Experimental Group: technique: mobilisations included lateral glide techniques described by Elvey 1986 and Vicenzino et al 1999, the arm is progressively positioned from a unloaded to a preloaded position; frequency: 1 session; dose: mean 4.5 minute treatment duration, session 1 grade 2 technique, session 2 to 3, grade 3 technique; route: C5 and C6 most frequently treated COMPARISON TREATMENT Control Group: pulsed ultrasound CO-INTERVENTION: NR Duration of Therapy Period: one session Duration of Follow-up: none
Outcomes	PAIN (NRS-101) Baseline Mean: experimental 7.3, control 7.7 End of Study Mean: experimental 5.8, control 7.4 Absolute Benefit: experimental 1.5, control 0.3 Reported Results: positive immediate effect favouring mobilisations SMD: -0.78(95%CI:-1.70 to 0.13) [power 58%] FUNCTION: NR PATIENT SATISFACTION: NR

Coppieters 2003 (Continued)

	GPE: NR QoL: NR SIDE EFFECTS: NR COST OF CARE: NR	
Notes		
Risk of bias		
Item	Authors' judgement	Description
Allocation concealment?	Yes	A - yes
Randomization?	Yes	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	Yes	
Dropout acceptable?	Yes	
Intention to treat?	No	
Free of selective outcome reporting?	Unclear	no protocol published
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	Yes	
Compliance acceptable?	Yes	
Similar timing of outcome assessment?	Yes	

David 1998

Methods	Type of Trial: RCT Number Analysed/Randomised: 51/70 Intention-to-treat Analysis: NR Power Analysis: NR
Participants	Subacute, chronic neck pain with degenerative changes [i.e. cervical spondylosis], whiplash associated disorder (WAD)
Interventions	INDEX TREATMENT Physiotherapy group (PT): technique: mobilisation (passive), standard localised mobilisation described by Maitland, rotation, posterior anterior oscillations, longitudinal traction;

David 1998 (Continued)

	<p>frequency: 1 session/week; route: cervical spine COMPARISON TREATMENT: Acupuncture Group (A): technique: local needling of trigger point, regional needling (GB21-supraspinatus tender area), distal needling (LI4-web space between thumb and first finger); frequency: 1 session/week; dose: needle left in situ for 15 minutes, route: as described under technique CO-INTERVENTION: NR Duration of treatment: 6 weeks, 6 sessions maximum Duration of follow-up: 24 weeks</p>	
Outcomes	<p>PAIN (VAS, 0 to 100) Baseline Mean: PT 51, A 51 End of Study Mean: PT 22, A 28 Absolute Benefit: PT 29, A 23 Reported Results: not significant SMD: -0.33(95%CI:-0.88 to 0.23) [power 24%] FUNCTION (NPQ, 0 to 36) Baseline Mean: PT 36, A 36 End of Study Mean: PT 22, A 25 Absolute Benefit: PT 14, A 11 Reported Results: not significant SMD: -0.16(95%CI:-0.72 to 0.39) [power 15%] PATIENT SATISFACTION: NR GPE: NR QoL(GHQ 28, 0 to 28): Reported Results: not significant RR1.07(0.48 to 2.35) SIDE EFFECTS: no side effects occurred for acupuncture COST OF CARE: NR</p>	
Notes		
Risk of bias		
Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	Yes	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	Yes	
Dropout acceptable?	Yes	
Intention to treat?	No	

David 1998 (Continued)

Free of selective outcome reporting?	Unclear	no published protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	Yes	
Compliance acceptable?	No	
Similar timing of outcome assessment?	Yes	

Egwu 2008

Methods	Type of Trial: Quasi RCT Number Analysed/Randomised: 95/96 Intention-to-treat Analysis: not calculated Power Analysis: NR
Participants	Acute or subacute neck pain with degenerative changes - cervical spondylosis of C5/6
Interventions	INDEX TREATMENT GROUPS Posterior-anterior-unilateral pressure (PAUP): technique:posterior-anterior oscillatory pressure on the side of symptoms (Maitland); frequency: 3 times/week; dose: 10 oscillations in 60 seconds; route: transverse processes of C5/6 Anterior-posterior-unilateral pressure (APUP): technique:anterior-posterior oscillatory pressure on the side of symptoms (Maitland); frequency: 3 times/week; dose: 10 oscillations in 60 seconds; route: transverse processes of C5/6 Cervical oscillatory rotation (COR): technique: rotation oscillation by turning head and neck to the opposite side from the pain until pain is just elicited and then oscillations are given (Maitland); frequency: 3 times/week; dose: 10 oscillations in 60 seconds; route: rotation performed with hands on jaw and occiput Transverse oscillatory pressure (TOP): technique: transverse oscillation produced by a push relax sequence on the spinous process using the thumbs to produce the movement (Maitland); frequency: 3 times/week; dose: 10 oscillations in 60 seconds; route: spinous processes of C5/6 CO-INTERVENTION: NR Duration of treatment: 4 weeks or until pain was absent, 12 sessions maximum Duration of follow-up: none
Outcomes	PAIN STATUS (5 categories, pain free to worse) Reported Results: NR RR(APUP v PAUP): 0.60 (95%CI: 0.16 to 2.23) RR(APUP v COR): 0.29 (95%CI: 0.09 to 0.91) RR(APUP v TOP): 0.30 (95%CI: 0.09 to 0.96) RR(PAUP v COR): 0.48 (95%CI: 0.19 to 1.19) RR(PAUP v TOP): 0.50 (95%CI: 0.20 to 1.25) MEAN TREATMENT TIME (minutes) Mean: PAUP 161, APUP 130, COR 201, TOP 221

	Reported Results: not significant RELAPSE AFTER 3 MONTHS (Number reported) PAUP 0, APUP 0, COR 3, TOP 2 Reported Results: NR FUNCTION: NR GPE: NR PATIENT SATISFACTION: NR QoL: NR SIDE EFFECT: NR COST OF CARE: NR	
Notes		
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	No	not possible with consecutive allocation
Randomization?	No	sequential ordering into groups
Patient blinding?	No	not described as blinded
Care provider blinding?	No	not described as blinded
Outcome assessor blinding?	No	not described as blinded
Dropout acceptable?	No	13 dropouts were not described, but table 1 seems to include all subjects
Intention to treat?	Unclear	unclear
Free of selective outcome reporting?	Unclear	no protocol available
Similar groups at baseline?	Unclear	data other than age not given
co-interventions avoided or similar?	Unclear	not stated
Compliance acceptable?	Unclear	not mentioned
Similar timing of outcome assessment?	Unclear	not clear when outcomes were taken

Fernandez 2004a

Methods	Type of Trial: RCT Number Analysed/Randomised: 88/88 Intention-to-treat Analysis: NA Power Analysis: NR
Participants	Acute, subacute neck pain - WAD II or III
Interventions	INDEX TREATMENT Group A: technique: thoracic manipulation and active control (same as comparison treatment) frequency: 15 sessions over 3 weeks - 2 manipulations over 2 weeks, 15 sessions of control; route: thoracic spine COMPARISON TREATMENT Group B (active control): type: ultrasound to neck, active exercises at home, muscle stretching, massage, multimodal care, electrotherapy, manual therapies; frequency: 15 sessions over 3 weeks COINTERVENTION: NR Duration of treatment: 3 weeks, 15 sessions Duration of follow-up: none
Outcomes	PAIN (VAS, 0 to 10) Baseline Mean: NR End of Study Mean: NR Absolute Benefit: A 2.27, B 1.66 Reported Results: significant favouring group A SMD:-0.68(95%CI:-1.11 to -0.25) FUNCTION: NR PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECT: NR COST OF CARE: NR
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	Yes	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	Yes	

Fernandez 2004a (Continued)

Intention to treat?	Yes	
Free of selective outcome reporting?	Unclear	no protocol reported
Similar groups at baseline?	No	
co-interventions avoided or similar?	No	
Compliance acceptable?	Yes	
Similar timing of outcome assessment?	Yes	

Giles 1999

Methods	Type of Trial: RCT Number Analysed/Randomised: 98/157 for all spinal patients; 62/x for neck subgroup Intention-to-treat Analysis: NR Power Analysis: NR
Participants	Chronic neck pain with degenerative changes
Interventions	INDEX TREATMENT Manipulation (manip): technique: high velocity, low amplitude manipulation; frequency: 6 sessions/median 19 days; dose: 15 to 20 minute appointments; route: cervical spine COMPARISON TREATMENT Acupuncture (acup): technique: 8 to 10 needles with low-volt electrical stimulation to tender points; frequency: 6 sessions/median 40 days Medication (med): tenoxicam (NSAID) with ranitidine, median 15 days CO-INTERVENTION: NR Duration of treatment: 3 to 4 weeks Duration of follow-up: none
Outcomes	PAIN (neck pain change scores, VAS 0 to 10) Baseline Median: manip 4.5, acup 2.0, med 4.0 Absolute Benefit: manip 1.5, acup 1.0, med 0.5 Reported Results: not clear SMD(Manip v Med): -0.19 (95% CI: -0.89 to 0.51) SMD(Manip v Acup): -0.13 (95% CI: -0.78 to 0.52) FUNCTION (NDI, 0 to 50) Baseline Median: manip 32, acup 40, med 28 Absolute Benefit: manip 10.0, acup 6.0, med 0.0 Reported Results: not clear SMD(Manip v Med): -0.50 (95% CI: -1.30 to 0.29) SMD(Manip v Acup): -0.18 (95% CI: -0.96 to 0.60) PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECT: no side effects occurred for acupuncture or manipulation

Giles 1999 (Continued)

	COST OF CARE: NR	
Notes		
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Yes	
Randomization?	No	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	No	
Intention to treat?	No	
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	No	
Compliance acceptable?	Yes	
Similar timing of outcome assessment?	Yes	

Gonzalez-Iglesias 2009

Methods	Type of Trial: RCT Number Analysed/Randomised: 45/45 Intention-to-treat Analysis: NA Power Analysis: calculated
Participants	Acute neck pain
Interventions	INDEX TREATMENT Thoracic spine thrust manipulation (TSM): technique: seated distraction manipulation - subject has arms across chest, therapist gently flexes the thoracic spine until tension is felt and then a distraction thrust manipulation is applied. If no pop was heard, a second attempt was made ; frequency: 1 session/week; dose: grade 5 manipulation; route: thoracic spine Electrothermal therapy (ETT): type: infrared lamp and TENS; frequency: 2 sessions/week; dose: Infrared 250W for 15 minutes, TENS 100Hz for 20 minutes; route: infrared lamp

Gonzalez-Iglesias 2009 (Continued)

	<p>50cm from the subject's neck, TENS applied to each side of C7 COMPARISON TREATMENT Electrothermal therapy (ETT): Type: infrared lamp and TENS; frequency: 2 sessions/week; dose: Infrared 250W for 15 minutes, TENS 100Hz for 20 minutes; route: infrared lamp 50cm from the subject's neck, TENS applied to each side of C7 CO-INTERVENTION: NR Duration of treatment: 3 weeks, 5 sessions Duration of follow-up: 4 weeks</p>	
Outcomes	<p>PAIN (intensity at rest change score, VAS, 0 to 100) Baseline Mean: TSM + ETT 54.7, ETT 52.7 Final Treatment Mean: TSM + ETT 20.2, ETT 44.7 2 week follow-up Mean: TSM + ETT 26.4, ETT 41.2 4 week follow-up Mean: TSM + ETT 21.5 ETT 42.2 Reported results: significant for comparisons at all time points Final Treatment SMD(TSM + ETT v ETT): -3.43 (95%CI:-4.38 to -2.49) 4 week follow up SMD(TSM + ETT v ETT): -2.19 (95%CI:-2.94 to -1.44) FUNCTION (Northwich Pain Questionnaire, 0 to 36) Baseline Mean: TSM + ETT 27.9, ETT 27.0 Final Treatment Mean: TSM + ETT 15.2, ETT 23.1 2 week follow-up Mean: TSM + ETT 14.7, ETT 21.8 Reported results: significant for comparisons at all time points Final treatment SMD(TSM + ETT v ETT): -2.17 (95%CI:-2.92 to -1.42) 2 week follow up SMD(TSM + ETT v ETT) : -2.28 (95%CI:-3.05 to -1.52) GPE: NR PATIENT SATISFACTION: NR QoL: NR SIDE EFFECT: NR COST OF CARE: NR</p>	
Notes		
Risk of bias		
Item	Authors' judgement	Description
Allocation concealment?	Yes	
Randomization?	Yes	
Patient blinding?	No	patients in control did not receive sham or placebo
Care provider blinding?	No	not possible due to intervention
Outcome assessor blinding?	No	not possible as patient is assessor of pain
Dropout acceptable?	Yes	no dropouts

Gonzalez-Iglesias 2009 (Continued)

Intention to treat?	Yes	no dropouts
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	No	not mentioned
Compliance acceptable?	No	not mentioned
Similar timing of outcome assessment?	Yes	

Haas 2004

Methods	Type of Trial: RCT Number Analysed/Randomised: 25/26 Intention-to-treat Analysis: calculated Power Analysis: NR
Participants	Chronic neck pain with headache
Interventions	INDEX TREATMENT Group 3s/w (9s): technique: manipulation: high velocity, low amplitude manipulation, heat, soft tissue therapy with massage, trigger point therapy, education (modification of ADL), rehabilitation exercises; frequency: 3 session/week; route: cervical spine Group 4s/w (12s): technique: manipulation: high velocity, low amplitude manipulation, heat, soft tissue therapy with massage, trigger point therapy, education (modification of ADL), rehabilitation exercises; frequency: 4 session/week; route: cervical spine COMPARISON TREATMENT Group 1s/w (3s): Manipulation: high velocity, low amplitude manipulation, heat, soft tissue therapy with massage, trigger point therapy, education (modification of ADL), rehabilitation exercises; frequency: 1/week; route: cervical spine COINTERVENTION: heat, soft tissue therapy with massage, trigger point therapy, education (modification of ADL), rehabilitation exercises received in both groups Duration of treatment: 3 weeks, 9 to 12 sessions Duration of follow-up: 1 week post treatment, 11 weeks post treatment
Outcomes	PAIN (neck pain modified vonKorff scale, average 3 scales, 0 to 100) Baseline Mean: 12s 49.6, 9s 58.7, 3s 61.0 Absolute Benefit: 12s 18.8, 9s 31.7, 3s 18.6 Reported Results: findings give preliminary support for larger doses 9 to 12 sessions SMD(12s v 3s): -0.48(95%CI:-1.51 to 0.56) [power 64%] SMD(12s v 9s): 0.17(95%CI:-0.81 to 1.16) [power 60%] SMD(9s v 3s): -0.90(95%CI:-1.98 to 0.18) [power 69%] FUNCTION (neck disability modified von Korff scale, average 3 scales, 0 to 100) Baseline Mean: 12s 33.8, 9s 35.7, 3s 46.7 Absolute Benefit: 12s 20.1, 9s 22.5, 3s 13.4 Reported Results: findings give preliminary support for larger doses 9 to 12 sessions

Haas 2004 (Continued)

	<p>SMD(12s v 3s): -1.15(95%CI:-2.27 to -0.03) SMD(12s v 9s):-0.03(95%CI:-1.01 to 0.95) [power 56%] SMD(9s v 3s): -1.47(95%CI:-2.65 to -0.28) PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECT: none COST OF CARE: NR</p>
--	---

Notes

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate
Randomization?	Yes	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	Yes	
Intention to treat?	Yes	
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	No	
Compliance acceptable?	Yes	
Similar timing of outcome assessment?	Yes	

Howe 1983

Methods	<p>Type of Trial: RCT Number Analysed/Randomised: 44/52 Intention-to-treat Analysis: calculated Power Analysis: NR</p>
Participants	Subacute, chronic neck pain with radicular findings and headache

Howe 1983 (Continued)

Interventions	<p>INDEX TREATMENT Manipulation Group (manip): technique: manipulation and azapropazone; frequency: 1 session; dose: up to 3 manipulations; route: cervical spine COMPARISON TREATMENTS Control Group (med): type: azapropazone; dose: NR CO-INTERVENTION: 2 subjects had lignocaine-hydrocortisone injections in manipulation group Duration of treatment: 1 session Duration of follow-up: 3 weeks</p>	
Outcomes	<p>PAIN (count, neck/shoulder/arm/hand pain and headache present) Baseline Mean: NR Reported Results: significant favouring manipulation RR: 0.56(95%CI: 0.19 to 1.68) [power 18%] FUNCTION: NR PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECT: NR COST OF CARE: NR</p>	
Notes		
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Yes	B - Unclear
Randomization?	Yes	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	Yes	
Dropout acceptable?	No	
Intention to treat?	No	
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	No	
co-interventions avoided or similar?	No	
Compliance acceptable?	Yes	

Howe 1983 (Continued)

Similar timing of outcome assessment?	No
---------------------------------------	----

Hurwitz 2002

Methods	Type of Trial: RCT (2x2x2 factorial design) Number Analysed/Randomised: 269/336 Intention-to-treat Analysis: done by design Power Analysis: NR
Participants	Subacute, chronic neck pain with or without radicular symptoms and headache
Interventions	<p>INDEX TREATMENTS</p> <p>Manipulation (Manip): technique: controlled, dynamic thrust applied with high velocity low amplitude force with minimal extension and rotation; frequency: NR; dose: at least 1 manipulation; route: directed at 1 or more restricted upper thoracic or cervical spine joint segments</p> <p>Manipulation with heat (Manip/Heat): 10-minute moist heat application before manipulation</p> <p>Manipulation with electrical muscle stimulation (Manip/EMS): 10-minute application of this modality before manipulation; parameters NR</p> <p>Mobilisation (Mob): technique: low velocity, variable amplitude movements applied within the patient's passive range of motion directed to 1 or more restricted upper thoracic or cervical spine joint segments; frequency: NR; route: cervical spine</p> <p>Mobilisation with heat (Mob/Heat): 10-minute moist heat application before mobilisation</p> <p>Mobilisation with EMS (Mob/EMS): 10-minute application of this modality before mobilisation; parameters NR</p> <p>COMPARISON TREATMENTS</p> <p>Any of the above noted treatment combinations</p> <p>CO-INTERVENTION: All participants received information on posture and body mechanics and one or more of the following: stretching, flexibility, or strengthening exercises and advice about ergonomic and workplace modifications</p> <p>Duration of treatment: NR</p> <p>Duration of follow-up: 6 months</p>
Outcomes	<p>PAIN INTENSITY (average pain during previous week, most severe pain, NRS 0 to 10)</p> <p>Baseline Mean: NR for each subgroup</p> <p>End of Study Mean: NR for each subgroup</p> <p>Reported Results: no significant difference, heat therapies condition improved slightly more; the differences were clinically negligible</p> <p>SMD(manip v mob): 0.15(95%CI:-0.32 to 0.61) [power 66%]</p> <p>SMD(manip+heat+EMS v mob):-0.28(95%CI:-0.77 to 0.21) [power 67%]</p> <p>SMD(mod+heat+EMS v manip): 0.24(95%CI:-0.24 to 0.71) [power 65%]</p> <p>RR(heat v no heat): 1.14(95%CI Mixed: 0.95 to 1.37)</p> <p>RR(EMS v no EMS): 0.90(95%CI Mixed: 0.73 to 1.13)</p> <p>FUNCTION (NDI, 0 to 50)</p> <p>Baseline Mean: NR for each subgroup</p> <p>End of Study Mean: NR for each subgroup</p> <p>Reported Results: no significant difference</p>

Hurwitz 2002 (Continued)

	<p>SMD(manip v mob): 0.07(95%CI:-0.40 to 0.54) [power 66%] SMD(manip+heat+EMS v mob):-0.08(95%CI:-0.56 to 0.41) SMD(mod+heat+EMS v manip): 0.14(95%CI:-0.33 to 0.62) RR(heat v no heat) 1.14 (95%CI Mixed: 0.94 to 1.38) RR(EMS v no EMS) 0.87 (95%CI Mixed: 0.69 to 1.10) SATISFACTION (10-50 scale; at 4w of care) SMD(manip v mob): 0.11(95%CI:-0.35 to 0.58) SMD(manip+heat+EMS v mob): 0.14(95%CI:-0.35 to 0.62) SMD(mod+heat+EMS v manip): -0.12(95%CI:-0.59 to 0.36) GPE: NR QoL: NR SIDE EFFECTS: interviewed at 4 weeks of care, no known study related adverse events; manipulation group had statistically significant more transient minor discomfort (16%) v mobilisation group (8.7%) COST OF CARE: number of disability days were not significantly different between groups</p>	
Notes		
Risk of bias		
Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate
Randomization?	Yes	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	Yes	
Intention to treat?	Yes	
Free of selective outcome reporting?	Yes	
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	Yes	
Compliance acceptable?	No	
Similar timing of outcome assessment?	Yes	

Kanlayanaphotporn 2009

Methods	Type of Trial: RCT Number Analysed/Randomised: 60/60 Intention-to-treat Analysis: NA Power Analysis: NR	
Participants	Chronic neck pain	
Interventions	<p>INDEX TREATMENT Preferred Mobilisation (PMob): technique:posterior-anterior pressure on the side of symptoms ; frequency: 1 session; dose: 2 X 1 minute mobilisations graded 1 to 2 for pain and 3 to 4 for stiffness; route: articular processes of cervical spine</p> <p>COMPARISON TREATMENT Random Mobilisation (RMob): technique: 1 of 3 techniques selected i) central posterior-anterior pressure ii) ipsilateral posterior-anterior pressure iii) contralateral posterior-anterior pressure; frequency: 1 session; dose 2X1 minute mobilisations; route: articular processes of cervical spine</p> <p>CO-INTERVENTION: NR Duration of treatment: 1 session Duration of follow-up: none</p>	
Outcomes	<p>PAIN (intensity at rest change score, VAS, 0 to 100) Baseline Mean: PMob 47.4, RMob 48.3 Absolute Benefit: PMob 10.8 RMob 12.3 Reported Results: not significant SMD(PMob v RMob): -0.01 (95%CI: -0.52 to 0.49)</p> <p>PAIN (intensity with most painful movement change score, VAS, 0 to 100) Baseline Mean: PMob 59.5, RMob 61.6 Absolute Benefit: PMob 16.7 RMob 16.9 Reported Results: not significant SMD(PMob v RMob): -0.12 (95%CI: -0.63 to 0.38)</p> <p>FUNCTION: NR GPE (1 to 7) Reported Results: not significant RR(PMob v RMob): 1.12 (95%CI: 0.74 to 1.69)</p> <p>PATIENT SATISFACTION: NR QoL: NR SIDE EFFECT: NR COST OF CARE: NR</p>	
Notes		
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Yes	
Randomization?	Yes	

Kanlayanaphotporn 2009 (Continued)

Patient blinding?	Yes	treatments were not perceptually different to patients
Care provider blinding?	No	not possible due to design
Outcome assessor blinding?	Yes	patient is the assessor and blinded
Dropout acceptable?	Yes	no dropouts
Intention to treat?	Yes	pre-post design
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	Yes	pre-post design
Compliance acceptable?	Yes	pre-post design
Similar timing of outcome assessment?	Yes	pre-post design

Kanlayanaphotporn 2009a

Methods	Type of Trial: RCT Number Analysed/Randomised: 60/60 Intention-to-treat Analysis: NA Power Analysis: NR
Participants	Chronic neck pain
Interventions	INDEX TREATMENT Central Posterior-Anterior Mobilisation (PAMob): technique:posterior-anterior pressure over the spinous process of restricted segments; frequency: 1 session; dose: 2 X 1 minute mobilisations graded 1 to 2 for pain and 3 to 4 for stiffness; route: spinous processes of cervical spine COMPARISON TREATMENT Random Mobilisation (RMob): technique: 1 of 3 techniques selected i) central posterior-anterior pressure ii) ipsilateral posterior-anterior pressure iii) contralateral posterior-anterior pressure; frequency: 1 session; dose: 2X1 minute mobilisations; route: articular processes of cervical spine CO-INTERVENTION: NR Duration of treatment: 1 session Duration of follow-up: none
Outcomes	PAIN (intensity at rest change score, VAS, 0 to 100) Baseline Mean: PAMob 50.2, RMob 47.3 Absolute Benefit: PAMob 18.3 RMob 13.0

Kanlayanaphotporn 2009a (Continued)

	<p>Reported Results: not significant SMD(PAMob v RMob): 0.32 (95%CI: -0.18 to 0.83) PAIN (intensity with most painful movement change score, VAS, 0 to 100) Baseline Mean: PAMob 60.8, RMob 59.8 Absolute Benefit: PAMob 21.9 RMob 12.7 Reported Results: not significant SMD(PAMob v RMob): 0.53 (95%CI: 0.01 to 1.04) FUNCTION: NR GPE (1 to 7) Reported Results: not significant RR(PAMob v RMob): 0.90 (95%CI: 0.63 to 1.30) PATIENT SATISFACTION: NR QoL: NR SIDE EFFECT: NR COST OF CARE: NR</p>	
Notes		
Risk of bias		
Item	Authors' judgement	Description
Allocation concealment?	Yes	
Randomization?	Yes	
Patient blinding?	Yes	treatments were not perceptually different to patients
Care provider blinding?	No	not possible due to design
Outcome assessor blinding?	Yes	patient is the assessor and blinded
Dropout acceptable?	Yes	no dropouts
Intention to treat?	Yes	pre-post design
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	Yes	pre-post design
Compliance acceptable?	Yes	pre-post design
Similar timing of outcome assessment?	Yes	pre-post design

Krauss 2008

Methods	Type of Trial: RCT Number Analysed/Randomised: 32/32 Intention-to-treat Analysis: NA Power Analysis: NR
Participants	neck pain (duration of symptoms NR)
Interventions	INDEX TREATMENT Thoracic spine manipulation (TSM): technique: bilateral translatoric facet joint traction manipulation to the upper thoracic intervertebral segment performed; frequency: 1 session; dose: grade 5 manipulation; route: thoracic spine COMPARISON TREATMENT No treatment (NT): no treatment provided CO-INTERVENTION: NR Duration of treatment: 1 session Duration of follow-up: no follow up
Outcomes	PAIN (intensity with left rotation, 9 point faces pain scale) Baseline mean: TSM 3.73, NT 2.50 Absolute Benefit: TSM 0.688 NT 0.667 Reported Results: not significant SMD(TSM v NT): 0.02 (95%CI: -0.73 to 0.77) PAIN (intensity with right rotation, 9 point faces pain scale) Baseline mean: TSM 2.75, NT 2.80 Absolute Benefit: TSM 1.5, NT -0.1 Reported Results: not significant SMD(TSM v NT): 0.65 (95%CI: -0.12 to 1.41) FUNCTION: NR GPE: NR PATIENT SATISFACTION: NR QoL: NR SIDE EFFECT: NR COST OF CARE: NR
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	No	unsure if envelopes were opaque, questions about allocation numbers
Randomization?	No	stated randomisation, but unsure how allocation became 22:10
Patient blinding?	No	not possible due to intervention
Care provider blinding?	No	not possible due to intervention

Krauss 2008 (Continued)

Outcome assessor blinding?	No	not possible due to intervention
Dropout acceptable?	Yes	pre-post design
Intention to treat?	Yes	pre-post design
Free of selective outcome reporting?	Unclear	no protocol reported
Similar groups at baseline?	No	not enough baseline data available
co-interventions avoided or similar?	Yes	pre-post design
Compliance acceptable?	Yes	pre-post design
Similar timing of outcome assessment?	Yes	pre-post design

Martinez-Segura 2006

Methods	Type of Trial: RCT Number Analysed/Randomised: 71/71 Intention-to-treat Analysis: NR Power Analysis: NR
Participants	Subacute, chronic neck pain, no radiculopathy
Interventions	INDEX TREATMENT Cervical high velocity low amplitude technique group (manip): technique: manipulation ipsilateral side flexion, contralateral rotation; frequency: 1 session; route: cervical spine COMPARISON TREATMENT Sham/Control Group (cntl): technique: neck positioned into ipsilateral side flexion, contralateral rotation, position held for 30 second, the side of manual contact was randomised; frequency: 1 session CO-INTERVENTION: NR Duration of treatment: 1 session Duration of follow-up: none
Outcomes	PAIN INTENSITY (VAS, 0 to 10cm) Baseline Mean: manip 5.7, cntl 5.5 End of Study Mean: manip 2.2, cntl 5.1 Absolute Benefit: manip 3.5, cntl 0.4 Reported Results: significant favouring manipulation SMD: -1.67(95%CI:-2.21 to -1.12) FUNCTION: NR PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECT: NR

Martinez-Segura 2006 (Continued)

	COST OF CARE: NR	
Notes		
Risk of bias		
Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	Yes	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	Yes	
Intention to treat?	Yes	
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	No	
Compliance acceptable?	Yes	
Similar timing of outcome assessment?	Yes	

Muller 2005

Methods	Type of Trial: RCT Number Analysed/Randomised: 69/115 Intention-to-treat Analysis: calculated Power Analysis: NR
Participants	Chronic neck pain
Interventions	INDEX TREATMENT Spinal manipulation (SM): technique: high velocity low amplitude thrust on the level of involvement; frequency: 2 sessions/week; dose: grade 5 manipulation, 20 minute visits; route: affected segments of cervical spine COMPARISON TREATMENT Medication (Med): type: Celebrex-celacoxin (27 subjects), Vioxx-rofecoxib (11 subjects), paracetamol (5 subjects); frequency: fortnightly 20 minute office visits until asymptomatic

Muller 2005 (Continued)

	<p>or sufficient pain relief achieved; dose celebrex-celacoxin 200-400 mg/day, vioxx-rofecoxib 12.5-25mg/day, paracetamol 1000-3000mg/day ; route: oral Acupuncture (AP): technique: 8-10 needles placed in local paraspinal and intramuscular pain areas. 5 needles placed in distal point meridians; frequency: 2 sessions/week until asymptomatic or acceptable pain relief achieved; dose: 20 minutes with turning or flicking needles every 5 minutes if tolerated; route: sterile HWATO Chinese acupuncture guide tube needles (50 mm length, 0.25 mm gauge) CO-INTERVENTION: not avoided Duration of treatment: 9-weeks or until asymptomatic, maximum 18 sessions Duration of follow-up: 12 months</p>	
Outcomes	<p>PAIN (intensity, VAS, 0 to 10) Baseline Median: SM 6, Med 4, AP 7 12 months Median: SM 2.8, Med 4.7, AP 2.5 Reported Results: significance between groups NR, significant for SM and AP within group data SMD(SM v Med): -0.24 (95%CI: -0.85 to 0.37) SMD(SM v AP): 0.04 (95% CI:-0.56 to 0.64) PAIN (frequency, days/week) Baseline Median: SM 4, Med 2, AP 4 12 months Median: SM 2, Med 4, AP 3 Reported Results: significance between groups NR, significant within the SM group only SMD(SM v Med):-0.55 (95% CI: -1.17 to 0.07) SMD(SM v AP): -0.22 (95% CI: -0.82 to 0.38) FUNCTION: (NDI, 0 to 50) Baseline Median: SM 28, Med 42, AP 36 12 months Median: SM 20, Med 36, AP 24 Reported Results: significance between groups NR, significant within the SM and AP groups SMD (SM v Med): -0.36 (95% CI: -0.97 to 0.25) SMD (SM v AP): -0.09 (95% CI:-0.69 to 0.51) GPE: NR PATIENT SATISFACTION: NR QoL: NR for neck group alone SIDE EFFECT: NR COST OF CARE: NR</p>	
Notes		
Risk of bias		
Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	No	
Patient blinding?	No	

Muller 2005 (Continued)

Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	No	
Intention to treat?	No	
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	No	
co-interventions avoided or similar?	Yes	
Compliance acceptable?	No	
Similar timing of outcome assessment?	Yes	

Nilsson 1997

Methods	Type of Trial: RCT Number Analysed/Randomised: 53/54 Intention-to-treat Analysis: NR Power Analysis: calculated
Participants	Chronic neck pain with headache
Interventions	INDEX TREATMENT Manipulation Group (manip): technique: manipulation- toggle recoil for upper cervical spine, diversified technique for mid- and lower cervical spine; high velocity, low amplitude thrust at the end point of passive range of motion; frequency: 2 sessions/week; dose: 12 toggle recoil, 10 diversified manipulation; route: cervical spine COMPARISON TREATMENT Soft Tissue Group (ST): technique: massage, deep frictions and trigger point treatment of posterior muscles of shoulder girdle, upper thoracic and lower cervical and placebo laser applied to the upper cervical region; frequency: 2 session/week; route: cervical and thoracic spine CO-INTERVENTION: NR Duration of treatment: 3 weeks, 6 sessions Duration of follow-up: 1 week
Outcomes	PAIN (headache intensity per episode; VAS, 0 to 100) Baseline Median: manip 48, ST 37 End of Study Median: manip 15, ST 6 Absolute Benefit: manip 33, ST 31 Reported Results: significant favouring manipulation SMD: -0.45(95%CI:-0.99 to 0.10) [power 16%]

Nilsson 1997 (Continued)

	FUNCTION: NR PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECTS: NR COST OF CARE: NR	
Notes		
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	No	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	Yes	
Intention to treat?	Yes	
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	No	
Compliance acceptable?	No	
Similar timing of outcome assessment?	Yes	

Parkin-Smith 1998

Methods	Type of Trial: RCT Number Analysed/Randomised: 30/30 Intention-to-treat Analysis: not calculated Power Analysis: calculated
Participants	neck pain, duration NR

Parkin-Smith 1998 (Continued)

Interventions	<p>INDEX TREATMENT: Group A: technique: manipulation; route: cervical spine COMPARISON TREATMENT: Group B: technique: manipulation; route: cervical and thoracic spine CO-INTERVENTION: not specified Duration of treatment: 3 weeks, 6 sessions Duration of follow-up: none</p>	
Outcomes	<p>PAIN INTENSITY (NRS-101) Baseline Mean: A 33.89, B 33.00 End of Study Mean: A 17.17, B 13.18 Absolute Benefit: A 16.72, B 19.82 Reported Results: not significant SMD: 0.29(95%CI:-0.43 to 1.01) [power 94%] FUNCTION (NDI, 0 to 50) Baseline Mean: A 18.24, B 17.64 End of Study Mean: A 6.89, B 4.71 Absolute Benefit: A 11.35, B 12.93 Reported Results: not significant SMD: 0.30(95%CI:-0.42 to 1.02) [power 100%] PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECTS: NR COST OF CARE: NR</p>	
Notes		
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	No	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	No	
Intention to treat?	No	
Free of selective outcome reporting?	Unclear	no reported protocol

Parkin-Smith 1998 (Continued)

Similar groups at baseline?	Yes	
co-interventions avoided or similar?	No	
Compliance acceptable?	No	
Similar timing of outcome assessment?	Yes	

Savolainen 2004

Methods	Type of Trial: RCT Number Analysed/Randomised: 41/75 Intention-to-treat Analysis: NR Power Analysis: NR
Participants	neck pain, duration NR
Interventions	INDEX TREATMENT Thoracic manipulation (manip): technique: manipulation- upper thoracic spine by a physiatrist; frequency: 1 session/week; dose: four manipulations; route: thoracic spine COMPARISON TREATMENT Instructed exercise (ex): duration unclear COINTERVENTION: NR Duration of treatment: 4 weeks for manipulation group, unknown for control group Duration of follow-up: 52 weeks
Outcomes	PAIN [neck pain intensity (pain right now); VAS, 0 to 10] Baseline Mean: Manip 3.7, ex 3.8 Absolute Benefit: Manip 0.8, ex -0.5 Results: significant favouring thoracic manipulation for perceived worst pain, no other significant results between groups for pain right now and average pain SMD (pain right now):-0.50(-1.13, 0.13) [power 69%] FUNCTION: NR PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECTS: NR COST OF CARE: NR
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	No	

Savolainen 2004 (Continued)

Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	No	
Intention to treat?	No	
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	No	
Compliance acceptable?	No	
Similar timing of outcome assessment?	Yes	

Sloop 1982

Methods	Type of Trial: RCT crossover design Number Analysed/Randomised: 39/39 Intention-to-treat Analysis: calculated Power Analysis: NR
Participants	Subacute, chronic neck pain with variable degenerative changes (cervical spondylosis)
Interventions	INDEX TREATMENT Manipulation Group (manip): technique: manipulation described by Cyriax, Maigne, Maitland, Matthews, muscle relaxant; frequency: 1 session; route: cervical spine COMPARISON TREATMENT: Control Treatment (cntl): muscle relaxant CO-INTERVENTION: "other medical management was not restricted during the study" Duration of treatment: 1 session Duration of follow-up: 3 weeks (then crossover occurs)
Outcomes	PAIN (neck pain intensity; VAS, 0 to 100) Baseline: NR Absolute Benefit: manip 18, cntl 5 Reported Results: not significant SMD: 0.40(95%CI:-1.04 to 0.23) [power 5%] FUNCTION (selected daily activities; VAS, 0 to 100) Baseline: NR Reported Results: not significant PATIENT SATISFACTION: NR

Sloop 1982 (Continued)

	<p>QoL: NR GPE [patient perceived effect, 0 (completely well) to 8 (worst possible) collapsed to dichotomous response (improved/not improved)] Reported Results: not significant RR: 0.59(95%CI: 0.34 to 1.05) SIDE EFFECTS: 2 people had superficial phlebitis following diazepam injection and recovered uneventfully; 2 people in manipulation group reported a new discomfort in their necks followed by improvement in their chronic neck pain RR: 1.0(95%CI: 0.4 to 2.4) COST OF CARE: NR</p>	
Notes		
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Yes	
Randomization?	Yes	
Patient blinding?	Yes	
Care provider blinding?	No	
Outcome assessor blinding?	Yes	
Dropout acceptable?	Yes	
Intention to treat?	Yes	
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	No	
Compliance acceptable?	Yes	
Similar timing of outcome assessment?	Yes	

Strunk 2008

Methods	Type of Trial: RCT Number Analysed/Randomised: 5/6 Intention-to-treat Analysis: calculated Power Analysis: NR
Participants	Subacute or chronic neck pain
Interventions	<p>INDEX TREATMENT</p> <p>Combined therapeutic approach (CTA): thoracic spine and sacroiliac joint manipulation and muscle energy techniques</p> <p>Thoracic spine and sacroiliac joint manipulation: technique: high velocity low amplitude spinal manipulation to thoracic spine and sacroiliac joint; frequency: 2 sessions/week; dose: grade 5 manipulation; route: thoracic spine and sacroiliac joint</p> <p>Muscle energy: technique: post isometric relaxation technique to hypertonic muscles according to Lewis Procedures; frequency: 2 sessions/week; dose: 2 sets of 3 repetitions; route: left or right scalenes, upper fibres of trapezius, levator scapulae, suboccipital muscles based on assessment findings</p> <p>COMPARISON TREATMENT</p> <p>Cervical high velocity, low amplitude manipulation (CHVLA): Technique: high velocity, low amplitude manipulation of the hypomobile segment of the cervical spine; frequency: 2 sessions/week; dose: grade 5 manipulation; route: hypomobile segments identified from C0 to C7</p> <p>CO-INTERVENTION: NR</p> <p>Duration of treatment: 2 weeks, 4 sessions</p> <p>Duration of follow-up: no follow up</p>
Outcomes	<p>PAIN (intensity, VAS, 0 to 100)</p> <p>Baseline median: CTA 35, CHVLA 29</p> <p>2 weeks median: CTA 65, CHVLA 27</p> <p>Reported Results: NR</p> <p>SMD (CTA v CHVLA):-0.99 (95%CI:-2.85 to 0.88)</p> <p>FUNCTION (NDI, 0 to 100%)</p> <p>Baseline median: CTA 34, CHVLA 24</p> <p>2 weeks median: CTA 26, CHVLA 20</p> <p>Reported Results: NR</p> <p>SMD (CTA v CHVLA):-0.48 (95% CI: -2.15 to 1.19)</p> <p>GPE: NR</p> <p>PATIENT SATISFACTION: NR</p> <p>QoL: NR</p> <p>SIDE EFFECTS:</p> <p>discomfort: CTA and cervical HVLA combined 3/5</p> <p>neck pain/stiffness (lasting <10 minutes): CTA 0/3, Cervical HVLA 1/2</p> <p>dizziness/imbalance: CTA 0/3, cervical HVLA 1/2</p> <p>neck pain/stiffness (onset >24 hours post treatment, duration >24 hours) CTA 1/3, cervical HVLA 0/2</p> <p>COST OF CARE: NR</p>
Notes	

Risk of bias

Strunk 2008 (Continued)

Item	Authors' judgement	Description
Allocation concealment?	Yes	
Randomization?	Yes	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	Yes	
Intention to treat?	Yes	
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	No	
co-interventions avoided or similar?	No	
Compliance acceptable?	Yes	
Similar timing of outcome assessment?	Yes	

van Schalkwyk 2000

Methods	Type of Trial: quasi-RCT Number Analysed/Randomised: 30/30 Intention-to-treat Analysis: NR Power Analysis: calculated
Participants	neck pain, duration NR
Interventions	INDEX TREATMENT Group A: technique: cervical rotary break manipulation with contact taken on the ipsilateral side, described by Szaraz; frequency: 10 sessions over 4 weeks; route: cervical spine COMPARISON TREATMENT Group B: technique: lateral break manipulation with contact taken on the contralateral side, described by Szaraz; frequency: 10 sessions over 4 weeks; route: cervical spine CO-INTERVENTION: NR Duration of treatment: 4 weeks, 10 sessions Duration of follow-up: 4 weeks
Outcomes	PAIN INTENSITY (NRS-101) Baseline Mean: Group A 38.28, Group B 33.25

van Schalkwyk 2000 (Continued)

End of Study Mean: Group A 9.40, Group B 17.54
 Absolute Benefit: Group A 28.88, Group B 15.71
 Reported Results: not significant; however our calculations show the difference to favour Group A
 SMD -0.82(95%CI:-1.57 to -0.07) [power 96%]
 FUNCTION (NDI, 0 to 50)
 Baseline Mean: Group A 22.53, Group B 16.4
 End of Study Mean: Group A 6.00, Group B 6.13
 Absolute Benefit: Group A 16.53, Group B 10.27
 Reported Results: not significant [power 34%]
 SMD -0.01(95%CI:-0.72 to 0.71)
 PATIENT SATISFACTION: NR
 GPE: NR
 QoL: NR
 SIDE EFFECTS: NR
 COST OF CARE: NR

Notes

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	No	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	Yes	
Intention to treat?	Yes	
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	No	
Compliance acceptable?	No	
Similar timing of outcome assessment?	Yes	

Vernon 1990

Methods	Type of Trial: RCT Number Analysed/Randomised: 9/9 Intention-to-treat Analysis: conducted Power Analysis: NR	
Participants	Acute, subacute, chronic neck pain	
Interventions	INDEX TREATMENT Manipulation (M): technique: manipulation- rotational, high velocity, low-amplitude thrust; frequency: 1 session; route: cervical spine COMPARISON TREATMENT: Sham/Mobilisation (S): technique: rotational mobilisation with gentle oscillations into elastic barrier; technique described by Sandoz; frequency: 1 session; route: cervical spine CO-INTERVENTION: NR Duration of treatment: 1 session Duration of follow-Up: none	
Outcomes	PAIN [pain pressure threshold, algometer (kg/cm)] Baseline Mean: M 3.4, S 2.3 End of Study Mean: M 4.8, S 2.3 Absolute Benefit: M 1.4, S 0.0 Reported Results: significant favouring manipulation when assessed by ANOVA SMD(point 2): -1.15(95%CI:-2.65 to 0.34) [power 5%] FUNCTION: NR PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECTS: no complications COST OF CARE: NR	
Notes		
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	Yes	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	Yes	
Dropout acceptable?	Yes	
Intention to treat?	Yes	

Vernon 1990 (Continued)

Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	No	
co-interventions avoided or similar?	Yes	
Compliance acceptable?	Yes	
Similar timing of outcome assessment?	Yes	

Wood 2001

Methods	Type of Trial: Quasi-RCT Number Analysed/Randomised: 30/30 Intention-to-treat Analysis: calculated Power Analysis: reported
Participants	Subacute neck pain
Interventions	INDEX TREATMENT Group A: technique: manipulation using Activator II Adjusting Instrument, mechanical force, manually assisted; frequency: 2 to 3 sessions/week; route: cervical spine COMPARISON: Group B: technique: manual manipulation, high velocity, low amplitude manual adjustment; frequency: 2 to 3 sessions/week; route: cervical spine CO-INTERVENTION: no medication for at least one month, no other treatment modalities, exercises, or education was prescribed Duration of treatment: 8 sessions, 4 weeks Duration of follow-up: 4 weeks
Outcomes	PAIN INTENSITY (NRS-101) Baseline Mean: Group A 52.5, Group B 48.0 End of Study Mean: Group A 23.5, Group B 18.7 Absolute Benefit: Group A 29.0, Group B 29.3 Reported Results: no significant difference SMD: 0.29(95%CI:-0.43 to 1.01) [power 99%] FUNCTION (NDI, 0 to 50) Baseline Mean: Group A 31.8, Group B 26.8 End of Study Mean: Group A 13.5, Group B 11.0 Absolute Benefit: Group A 18.3, Group B 15.8 Reported Results: no significant difference SMD: 0.23(95% CI:-0.48 to 0.95) [power 96%] PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECTS: NR COST OF CARE: NR

Wood 2001 (Continued)

Notes		
Risk of bias		
Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	No	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	No	
Dropout acceptable?	Yes	
Intention to treat?	Yes	
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	Yes	
co-interventions avoided or similar?	Yes	
Compliance acceptable?	No	
Similar timing of outcome assessment?	Yes	

Yurkiw 1996

Methods	Type of Trial: RCT Number Analysed/Randomised: 28/28 Intention-to-treat Analysis: NA Power Analysis: NR
Participants	Subacute neck pain
Interventions	INDEX TREATMENT Mechanically assisted device (MAD): frequency: manipulation using Activator Adjusting Instrument, Technique described by Petterson, patient in prone position, instrument in the "2 ring" setting, applied to posterior pillar of the restricted lower cervical vertebrae, one click application was given; frequency: 1 session; route: cervical spine COMPARISON: Spinal Manipulation Therapy (SMT): technique: manipulation, high velocity, low amplitude manual adjustment described by Haldeman 1992 - Diversified techniques, applied

Yurkiw 1996 (Continued)

	one technique to lower cervical vertebrae (C3 to C7); frequency 1 session; route: cervical spine CO-INTERVENTION: avoided Duration of treatment: 1 session Duration of follow-up: none	
Outcomes	PAIN INTENSITY (VAS, 10cm) Baseline Mean: MAD 32.9, SMT 32.9 End of Study Mean: MAD 20.4, SMT 21.9 Absolute Benefit: MAD 12.5, SMT 11.0 Reported Results: no significant difference SMD: -0.07(95%CI:-0.81 to 0.67) [power 61%] FUNCTION: NR PATIENT SATISFACTION: NR GPE: NR QoL: NR SIDE EFFECTS: NR COST OF CARE: NR	
Notes		
Risk of bias		
Item	Authors' judgement	Description
Allocation concealment?	No	
Randomization?	Yes	
Patient blinding?	No	
Care provider blinding?	No	
Outcome assessor blinding?	Yes	
Dropout acceptable?	Yes	
Intention to treat?	Yes	
Free of selective outcome reporting?	Unclear	no reported protocol
Similar groups at baseline?	No	
co-interventions avoided or similar?	No	
Compliance acceptable?	Yes	
Similar timing of outcome assessment?	Yes	

1. Record of Personal Communications / Unpublished data:

- a) Allison 2001 provided an early manuscript and data clarification
- b) Brodin et al provided additional raw data to facilitate study selection and the calculation of effect measures.
- c) Bronfort 2000 provided his manuscript prior to publication in Spine and provided raw data on range, muscle strength and endurance.
- d) Coppieter 2001 provided two early manuscripts and raw data
- e) Hoving 2002 provided an early manuscript and clarification of data
- f) Hurwitz 2002 provided an early manuscript
- g) Jull 2001 provided an early manuscript and additional unpublished data
- h) Koes 1992 provided additional raw data on the neck disorder subgroup to facilitate the calculation of effect measures.
- i) Sloop 1982 communicated that additional information on raw data was not available

2. Definitions of terms

2.1 Acute = <30 days [1 month, 4 weeks]

Subacute = 30 days [1 month, 4 weeks] to 90 days [3 months, 12 weeks]

Chronic = > 90 days [3 months, 12 weeks]

2.2 immediate follow-up < 1 day

short-term (ST) follow-up <3 months

intermediate-term (IT) follow-up > 3 months < 1 year

long-term (LT) follow-up > 1 year

2.3 w-cntl = wait list control

o-cntl = other treatment control

n-cntl = no treatment control

pl = placebo control

sham = sham control

3.0 Short forms commonly used in text:

3.1 Clinical terms

MT = manual therapy

PMM = physical medicine methods

ED = education

DT = drug therapy

TENS = transcutaneous electrical nerve stimulation

ETT = electrothermal therapy

PEMT = pulsed electromagnetic therapy

US = ultrasound

PSWD = pulsed short wave diathermy

W = watts

AROM = active range of motion

PROM = passive range of motion

3.2 Outcome measures

GPE = global perceived effect

QoL = Quality of Life Measures

WHYMPI = West Haven-Yale Multidimensional Pain Inventory [sub scale pain severity]

SF-12 = short-form 12, short-form with 12 questions, yielding an 8-scale health profile

SF-36 = short-form 36, short-form with 36 questions yielding an 8-scale health profile

EuroQ = Euro Quality of Life scale, 0 to 100 point scale

NDI = neck disability index

VAS = visual analogue scale

NRS-101 = numeric rating scale 101, 0 to 100 point scale

NPQ = Northwick Park neck pain questionnaire

PPT = pain pressure threshold, measured by algometre

GHQ 28 = general health questionnaire 28

QoL = quality of life

3.3 Statistical Terms

ANOVA = analysis of variance
 MONOVA = multiple analysis of variance
 ANCOVA = analysis of covariance
 95% CI = 95% confidence interval
 IQR = inner quartile range
 SD = standard deviation
 3.3 Other
 v = versus
 w = weeks
 m = months
 y = years
 NR = not reported
 RCT = randomised controlled trial

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Allan 2003	Manipulation received in all arms
Allan 2003a	Intervention: manipulation was included in all arms
Allison 2002	Multimodal approach
Bonk 2000	Multimodal approach
Briem 2007	Intervention: intervention technique was not a mobilisation or manipulation
Brodin 1985	Multimodal approach
Brønfort 2001	Multimodal approach
Cleland 2009	Intervention: aimed at therapist not study population
Cunha 2008	Both groups underwent manual therapy
Donkin 2002	Population: Tension-type headache
Dostal 1997	Intervention: manipulation was used in combination with ibuprofen as a control
Durianova 1977	Outcome: the outcome measure used was not clearly stated
Dziedzic 2005	Multimodal approach
Fernandez 2004b	Multimodal approach
Fernandez 2008	Population: asymptomatic individuals

(Continued)

Fitz-Ritson 1994	Population: unsure, sample not adequately described [query whiplash associated neck disorder]
Giebel 1997	Multimodal approach
Giles 2003	Population: unable to split spinal data. Attempts at contacting the author were made but no response was received
Goldie 1970	Intervention: Manual therapy in active and control group.
Grunnet-Nilsson 1999	Population: did not meet reviews inclusion criteria
Gustavsson 2006	Intervention: The control treatment was individualized care (acupuncture, massage, mobs, hot pack, TENS, US, exercise) and we were not able to elucidate the exact treatment mix for the “treat as usual ” group
Haas 2003	phase IV diagnostic trial, not an efficacy trial
Hakkinen 2007	Multimodal approach
Hemmila 2005	Multimodal approach
Hodgson 2006	Intervention: did not consist of a mobilisation or manipulation
Hong 2005	Outcome: included only measures of blood flow
Hoving 2002	Multimodal approach
Hurwitz 2005	Excluded based on outcomes
Hurwitz 2006	Outcome: psychosocial outcome measure
Jahanshahi 1991	Population: no sample with neck disorder meeting inclusion criteria [torticollis]
Jensen 1990	Multimodal approach
Jensen 1995	Intervention: no manual therapy intervention
Jing 2006	Intervention: shiatsu type of manipulation
Jordan 1998	Multimodal approach
Jull 2001	Multimodal approach
Jull 2007	Multimodal approach
Karlberg 1996	Multimodal approach
Koes 1992	Multimodal approach

(Continued)

Kogstad 1978	Multimodal approach
Kongsted 2007	Interventions: no manual therapy
Leboeuf 1987	Population: no sample with neck disorder meeting inclusion criteria [repetitive strain injury of upper limb]
Levoska 1993	Intervention: Manual therapy in treatment and control group.
Li 2006	Population: canal spinal stenosis unclear long tract signs Intervention: local point traction manipulation
Lindell 2008	Population: unable to split data into neck pain only group
Linton 2001	Population: unable to split data into neck pain only group
Manca 2007	Intervention: no manual therapy included
Mansilla-Ferragut 2009	Outcomes: reported outcomes related to temporomandibular joint not cervical spine
McClatchie 2009	Population: asymptomatic cervical spine; outcomes: no outcomes measuring the cervical spine or related disability
McKinney 1989	Multimodal approach
McReynolds 2005	Multimodal approach
Mealy 1986	Multimodal approach
Metcalf 2006	Outcome: muscle strength measure was not part of our inclusion outcomes
Mezaki 1995	Design: unsure RCT Population: no subjects with neck disorder meeting inclusion criteria [spasmodic torticollis]
Moodley 2002	Multimodal approach
Nordemar 1981	Multimodal approach
Palmgren 2006	Multimodal approach
Persson 2001	Multimodal approach
Provinciali 1996	Multimodal approach
Reginiussen 2000	Multimodal approach
Rupert 2002	Population: rat study; not human

(Continued)

Schenk 1994	Population: no sample with neck disorder meeting inclusion criteria [normal cervical spine]
Schwerla 2008	Multimodal approach
Skargren 1998	Multimodal approach
Snyder 1996	Population: study population did not meet inclusion criteria for review
Sterling 2001	Design: a mechanistic trial
Tuchin 2000	Population: migraines
Vasseljen 1995	Multimodal approach
Whittingham 2001	Outcome: range of motion data only; does not meet our inclusion criteria
Williams 2003	Outcome: outcomes for neck and back pain combined
Yin 2006	Intervention: injection type manipulation
Ylinen 2003	Multimodal approach
Zaproudina 2007	Multimodal approach - traditional bone setting - mobilisation and manipulation
Zhi 2008	Intervention: acupuncture

Characteristics of studies awaiting assessment *[ordered by study ID]*

Escortell 2008

Methods	RCT
Participants	neck pain
Interventions	manual therapy
Outcomes	?
Notes	Spanish - awaiting translation and assessment

Characteristics of ongoing studies *[ordered by study ID]*

Brønfort 2000

Trial name or title	Manipulation, Exercise and Self-care for Neck Pain R18 HP 10013 Health Resources and Services Administration (HRSA) Role: Principal investigator
Methods	
Participants	chronic neck pain
Interventions	manipulation exercise self-care
Outcomes	patient rated outcomes
Starting date	09/01/00 to 08/31/06 This study is currently in manuscript phase
Contact information	Dr Gert Brønfort Northern Health Sciences University, Bloomington, Minnesota, 55432, United States 612-885-8413 gbronfort@nwhealth.edu
Notes	The major goal of this study is to examine the relative efficacy of three interventions in terms of patient-rated outcomes in the short and long term for chronic neck pain

Brønfort 2002

Trial name or title	Chiropractic, Medication, and Self-care for Neck Pain Phase II trial RO1 AT 000707 National Institutes of Health (NIH)
Methods	
Participants	neck pain sufferers, acute/subacute (<12 weeks duration); age 18 to 65 years, both genders; total n = 270 2. Exclusion Criteria: pregnant women
Interventions	1. chiropractic spinal manipulation 2. prescription medication: acetaminophen, tylenol with codeine, NSAIDS 3. self-care advice
Outcomes	patient rated neck pain, patient rated disability, general health, improvement, satisfaction with care, fear avoidance, over-the-counter medication use, spinal motion

Bronfort 2002 (Continued)

Starting date	09/24/01 to 05/31/07 This study is currently in manuscript phase
Contact information	Dr Gert Bronfort Northern Health Sciences University, Bloomington, Minnesota, 55432, United States 612-885-8413 gbronfort@nwhealth.edu
Notes	The major goals of this randomized, observer-blinded clinical trial are to identify effective therapies for neck pain sufferers and to increase our understanding of neck pain conditions. Role: Principal investigator

Evans 2003

Trial name or title	
Methods	Type of Trial: RCT Number Analysed/Randomised: 27/28 Intention-to-treat Analysis: NR Power Analysis: NR
Participants	Subacute neck pain
Interventions	INDEX TREATMENT Chiropractic care (Chiro): technique: spinal manipulation and light massage and activity modifications indicated by chiropractic assessment; frequency: mean 8 visits over a maximum 12 week period; dose: grade 5 manipulation, mean number of manipulations 20.5; route: affected muscles and segments of cervical spine identified by chiropractic assessment COMPARISON TREATMENT Medication (Med): Types: acetaminophen, NSAIDS, mild narcotics, activity modification as necessary; frequency: mean 5 visits over maximum 12 week period; dose: NR; route: oral and education Self care (SC): Technique: class and booklet regarding self care measures and ergonomics relative to work and ADL; frequency: 2 sessions total; dose: 90 minutes of education; route: classes and booklet CO-INTERVENTION: NR Duration of treatment: maximum 12 weeks, mean 8 sessions Duration of follow-up: no follow up
Outcomes	PAIN (intensity, NPRS, 0 to 10) Baseline Mean: all groups combined 5.8 3 weeks: all groups combined 2.2 12 weeks: all groups combined 3.0 Reported Results: significance NR FUNCTION (NDI, 0 to 100) Baseline Mean: all groups combined 36.8 3 weeks: all groups combined 7.9 12 weeks: all groups combined 10.0 Reported Results: significance NR TIME OFF WORK/SCHOOL (days)

Evans 2003 (Continued)

	<p>Baseline mean: all groups combined 0.9 3 weeks: all groups combined 0.68 12 weeks: all groups combined 0.75 Reported Results: significance NR CUT BACK ON ACTIVITES (days) Baseline mean: all groups combined 4.0 3 weeks: all groups combined 2.6 12 weeks: all groups combined 2.9 Reported Results: significance NR DAYS IN BED Baseline mean: all groups combined 0.66 3 weeks: all groups combined 0.53 12 weeks: all groups combined 0.38 Reported Results: significance NR GPE (100% improvement to 100% worse) Reported Results: significance NR PATIENT SATISFACTION: (completely dissatisfied - completely satisfied) Reported Results: significance NR QoL: NR for subjects with neck disorders alone SIDE EFFECTS: Muscle soreness: Chiro 7/10, Med 0/9, SC 0/9 Neck Stiffness: Chiro 2/10, Med 0/9, SC 0/9 Headache: Chiro 1/10, Med 0/9, SC 0/9 Dizziness: Chiro 1/10, Med 0/9, SC 0/9 Neck Pain: Chiro 1/10, Med 0/9, SC 1/9 Arm tingling: Chiro 1/10, Med 0/9, SC 1/9 low-back pain: Chiro 0/10, Med 0/9, SC 1/9 Rash: Chiro 0/10, Med 1/9, SC 0/9 Heartburn: Chiro 0/10, Med 1/9, SC 0/9 GI distress: Chiro 0/10, Med 2/9, SC 0/9 Drowsiness: 0/10, Med 1/9, SC 0/9 COST OF CARE: NR</p>
Starting date	
Contact information	
Notes	

Gudavalli 2006

Trial name or title	A randomised clinical trial comparing non-operative conservative medical care, chiropractic cervical distraction, and a combination of both for chronic neck pain Health Resources and Services Administration Grant # R18 HP 10001
Methods	
Participants	chronic neck pain with or without associated arm symptoms or headache

Gudavalli 2006 (Continued)

Interventions	1. non-operative conservative medical care - active exercise program to stabilize neck muscles and decrease anterior head carriage 2. application of flexion and traction applied to specific regions in the cervical spine on a specifically designed table in prone lying 3. combination therapy of both care processes noted above
Outcomes	NDI, VAS pain intensity over the last week
Starting date	This study is currently in manuscript phase
Contact information	Palmer Center for Chiropractic Research
Notes	

Guerrero 1997

Trial name or title	Comparative effects of manipulation and physical therapy on motion in the cervical spine
Methods	
Participants	chronic neck pain
Interventions	cervical spine manipulation v sham treatment v cervical spine manipulation, ischemic compression of myofascial trigger points , PNF, interferential therapy
Outcomes	cervical ROM
Starting date	
Contact information	Palmer Institute of Graduate Studies and Research, Davenport, Iowa
Notes	

Khoury 2002

Trial name or title	A comparative study to determine the most effective chiropractic treatment protocol in the management of cervicogenic headache
Methods	
Participants	18 to 65 year old patients with cervicogenic headaches
Interventions	Bilateral mobilisation of the hip joints and pelvic biomechanical blocking in the prone position. 10 consultations over 6 weeks
Outcomes	ROM, Vernon-Mior Neck Disability Index, NPRS 101

Khoury 2002 (Continued)

Starting date	
Contact information	Technikon Witwatersrand, South Africa drmkhoury@mweb.co.za
Notes	

Kjellman 1997

Trial name or title	Comparison of treatment of neck pain
Methods	
Participants	neck pain
Interventions	not specified
Outcomes	not specified
Starting date	
Contact information	Department of Neuroscience and Locomotion, Physiotherapy, Faculty of Health Sciences, Linkopings Universitet, Sweden
Notes	

Lamb 2007

Trial name or title	Managing injuries of the neck trial (MINT): design of a randomised controlled trial of treatments for whiplash associated disorders
Methods	RCT
Participants	WAD
Interventions	WAD book vs advice
Outcomes	NDI, QoL
Starting date	Oct 2006
Contact information	Sarah E Lamb; sallie.lamb@orh.nhs.uk Warwick Clinical Trials Unit, Warwick Medical School, University of Warwick
Notes	

Nagy 2000

Trial name or title	Randomised placebo controlled trial for cervico brachial pain syndrome using manual therapy
Methods	
Participants	cervicobrachial pain syndrome
Interventions	manipulative therapy versus placebo physiotherapy versus control
Outcomes	EMG muscle onset, pain, functional disability
Starting date	
Contact information	B Nagy, The Centre for Musculoskeletal Studies, University Department of Surgery, The University of Western Australia, Australia. email: gta@cms.uwa.edu.au
Notes	

Pool 2006

Trial name or title	Comparison of effectiveness of a behavioural graded activity program and manual therapy in patients with sub-acute neck pain: Design of a randomised clinical trial
Methods	RCT
Participants	subacute neck pain
Interventions	manual therapy and behavioural therapy
Outcomes	pain, GPE, Function
Starting date	2006
Contact information	j.pool@vumc.nl
Notes	

Scholten-Peeters 2003

Trial name or title	Randomised clinical trial of conservative treatment for patients with whiplash-associated disorders: considerations for the design and dynamic treatment protocol
Methods	
Participants	whiplash associated disorders

Scholten-Peeters 2003 (Continued)

Interventions	dynamic treatment protocol
Outcomes	pain, disability
Starting date	
Contact information	G Scholten-Peeters, Dutch National Institute of allied Health Professions, Amersfoort, The Netherlands
Notes	

Scott-Dawkins 1997

Trial name or title	The comparative effectiveness of adjustments versus mobilisation in chronic mechanical neck pain
Methods	
Participants	chronic mechanical neck pain
Interventions	adjustments (diversified) v mobilisation (muscle energy technique)
Outcomes	cervical ROM, NRS, short form McGill Pain questionnaire, NDI
Starting date	
Contact information	Technikon Natal College of Chiropractic, Durban, South Africa
Notes	

Stokke 1995

Trial name or title	A randomised comparison of chiropractic and physiotherapy treatment for neck pain of functional (mechanical) origins. A controlled clinical trial
Methods	
Participants	neck pain, neck and head pain, neck and shoulder pain
Interventions	chiropractic spinal manipulation v physiotherapy v medication
Outcomes	NDI, pain intensity VAS
Starting date	
Contact information	Institute of Community Medicine, School of Medicine, University of Tromso, 9037 Tromso, Norway
Notes	

Tanaka 1995

Trial name or title	Chiropractic therapy compared to medical therapy for chronic cervical pain
Methods	
Participants	chronic cervical spine pain
Interventions	chiropractic care: (lateral flexion) manipulation, exercise plus heat v medical care: heat, exercise, acetaminophen
Outcomes	McGill Pain questionnaire, NDI, cervical ROM, cervical muscle strength (Cybex), SF-36
Starting date	start: Nov 1994 complete: June 1995
Contact information	Colorado Prevention Centre, Denver, Colorado, USA
Notes	

We have attempted to find the majority of these authors over the Internet; however, have not been able to make contact with many, especially for the older trials.

DATA AND ANALYSES

Comparison 1. SINGLE CARE

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Cervical Manipulation vs Cntl or varied comparisons: PAIN - Single Session	3		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
1.1 Single session: immediate or short-term follow-up	3		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
2 Cervical Manipulation vs Cntl or varied comparisons: PAIN - Low dose trials	3		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
2.1 Low Dosage: immediate follow-up	1		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
2.2 Low Dosage: short-term follow-up	2		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
3 Cervical Manipulation vs Cntl or varied comparisons: PAIN - Multiple Session	7		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
3.1 Multiple sessions: immediate follow-up	2		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
3.2 Multiple sessions: short-term follow-up	3		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
3.3 Multiple sessions: intermediate-term follow-up - manipulations v mobilisations/comparison	1		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
3.4 Multiple sessions: intermediate-term follow-up - manipulations v other treatment	1		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
3.5 Multiple sessions: long-term follow-up	1		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
4 Cervical Manipulation vs Mobilisation: PAIN	1	269	Std. Mean Difference (IV, Random, 95% CI)	-0.07 [-0.47, 0.32]
4.1 Multiple sessions: Intermediate-term follow-up	1	269	Std. Mean Difference (IV, Random, 95% CI)	-0.07 [-0.47, 0.32]
5 Cervical Manipulation vs same treatment in both arms: PAIN Intensity	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
5.1 Single session: short-term follow-up	1		Risk Ratio (M-H, Random, 95% CI)	Not estimable
6 Cervical Manipulation vs Placebo: PAIN PRESSURE	1		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
6.1 Single session: immediate follow-up	1		Std. Mean Difference (IV, Random, 95% CI)	Not estimable

7	Cervical Manipulation vs Cntl or varied comparisons: FUNCTION	4		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
	7.1 Multiple sessions: immediate follow-up	2		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
	7.2 Multiple sessions: intermediate-term follow-up - manipulations v mobilisations	1		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
	7.3 Multiple sessions: intermediate-term follow-up - manipulations v other treatment	1		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
	7.4 Multiple sessions: long-term follow-up	1		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
8	Cervical Manipulation vs Mobilisation/comparison: FUNCTION - Manipulation vs Mobilisation - short term follow-up	1	268	Std. Mean Difference (IV, Random, 95% CI)	-0.00 [-0.29, 0.28]
	8.1 Multiple sessions: intermediate-term follow-up	1	268	Std. Mean Difference (IV, Random, 95% CI)	-0.00 [-0.29, 0.28]
9	Cervical Manipulation vs Mobilisation/comparison: PATIENT SATISFACTION	1	537	Std. Mean Difference (IV, Random, 95% CI)	0.07 [-0.10, 0.24]
	9.1 Multiple sessions: short-term follow-up - manipulation v mobilisation	1	303	Std. Mean Difference (IV, Random, 95% CI)	0.02 [-0.21, 0.24]
	9.2 Multiple sessions: short-term follow-up - manipulation v other treatment	1	234	Std. Mean Difference (IV, Random, 95% CI)	0.14 [-0.12, 0.40]
10	Thoracic Manipulation vs Cntl: PAIN	6		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
	10.1 Single session: immediate follow-up	2		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
	10.2 Multiple sessions: immediate follow-up	2		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
	10.3 Multiple sessions: short-term follow-up	2		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
	10.4 Multiple sessions: long-term follow-up	1		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
11	Cervical Mobilisation vs Comparison: PAIN	4		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
	11.1 Multiple sessions: immediate follow-up	1		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
	11.2 Multiple sessions: short-term follow-up	1		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
	11.3 Multiple sessions: intermediate-term follow-up	2		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
12	Cervical Mobilisation one technique vs another technique: PAIN	2		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected

12.1 Multiple sessions: immediate follow-up	2		Std. Mean Difference (IV, Random, 95% CI)	Not estimable
13 Cervical Mobilisation one technique vs another technique: PAIN	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
13.1 PA vs other mobilisation: multiple sessions: immediate follow-up	1		Risk Ratio (M-H, Random, 95% CI)	Not estimable
13.2 AP vs other mobilisation: multiple sessions: immediate follow-up	1		Risk Ratio (M-H, Random, 95% CI)	Not estimable
14 Cervical Mobilisation vs Comparison: FUNCTION	1	203	Std. Mean Difference (IV, Random, 95% CI)	0.06 [-0.22, 0.33]
14.1 Multiple sessions: intermediate-term follow-up	1	203	Std. Mean Difference (IV, Random, 95% CI)	0.06 [-0.22, 0.33]
15 Cervical Mobilisation one technique vs another technique: GLOBAL PERCIEVED EFFECT	2		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
15.1 Single session: immediate follow-up	2		Risk Ratio (M-H, Random, 95% CI)	Not estimable
16 Cervical Mobilisation vs Comparison: PATIENT SATISFACTION	1	203	Std. Mean Difference (IV, Random, 95% CI)	0.05 [-0.23, 0.32]
16.1 Multiple sessions: short-term follow-up	1	203	Std. Mean Difference (IV, Random, 95% CI)	0.05 [-0.23, 0.32]

Analysis 1.1. Comparison 1 SINGLE CARE, Outcome 1 Cervical Manipulation vs Cntl or varied comparisons: PAIN - Single Session.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: 1 SINGLE CARE

Outcome: 1 Cervical Manipulation vs Cntl or varied comparisons: PAIN - Single Session

Study or subgroup	Favours experimental		Control		Std. Mean Difference IV,Random,95% CI	Std. Mean Difference IV,Random,95% CI
	N	Mean(SD)	N	Mean(SD)		
I Single session: immediate or short-term follow-up						
Sloop 1982 (1)	21	-18 (31)	18	-5 (32)		-0.40 [-1.04, 0.23]
Cassidy 1992 (2)	52	20.4 (21.2)	48	20.5 (21)		0.00 [-0.40, 0.39]
Martinez-Segura 2006 (3)	34	2.2 (1.5)	37	5.1 (1.9)		-1.67 [-2.21, -1.12]

-4 -2 0 2 4
Favours experimental Favours control

(1) Sloop 1982: manipulation (manip) v medication in both arms (cntl); duration: 1 session; follow up: 3 weeks; instrument: VAS (0 to 100)

(2) Cassidy 1992: manipulation (manip) v mobilisation (mob); duration: 1 session; follow up: none; instrument: NRS 101

(3) Martinez-Segura 2006: manipulation (manip) v placebo (cntl); duration: 1 session; follow up: none; instrument: VAS (0 to 10)

Analysis 1.2. Comparison 1 SINGLE CARE, Outcome 2 Cervical Manipulation vs Cntl or varied comparisons: PAIN - Low dose trials.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: 1 SINGLE CARE

Outcome: 2 Cervical Manipulation vs Cntl or varied comparisons: PAIN - Low dose trials

Study or subgroup	Experimental		Control		Std. Mean Difference IV,Random,95% CI	Std. Mean Difference IV,Random,95% CI
	N	Mean(SD)	N	Mean(SD)		
1 Low Dosage: immediate follow-up						
Martinez-Segura 2006 (1)	34	2.2 (1.5)	37	5.1 (1.9)		-1.67 [-2.21, -1.12]
2 Low Dosage: short-term follow-up						
Bitterli 1977 (2)	10	27.8 (30.37)	10	43.5 (25.42)		-0.54 [-1.43, 0.36]
Sloop 1982 (3)	21	-18 (31)	18	-5 (32)		-0.40 [-1.04, 0.23]

(1) Martinez-Segura 2006: manipulation (manip) v placebo (cntl); duration: 1 session; follow up: none; instrument: VAS (0 to10)

(2) Bitterli 1977: manipulation (B) v w-cntl (C); duration: 3 weeks, 3 to 4 sessions; follow up: 12 weeks; instrument: VAS (0 to100)

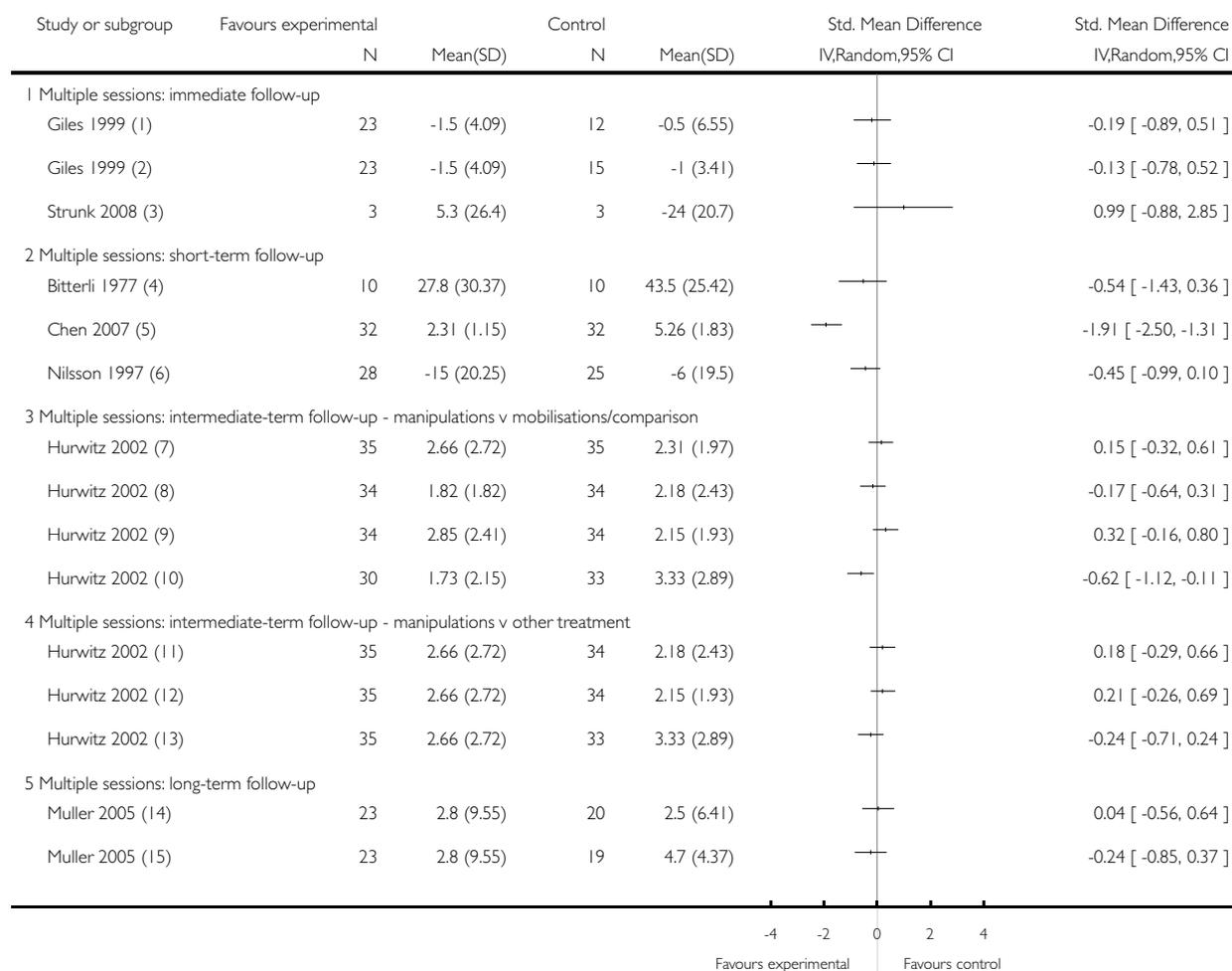
(3) Sloop 1982: manipulation (manip) v medication in both arms (cntl); duration: 1 session; follow up: 3 weeks; instrument: VAS (0 to100)

Analysis 1.3. Comparison 1 SINGLE CARE, Outcome 3 Cervical Manipulation vs Cntl or varied comparisons: PAIN - Multiple Session.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: 1 SINGLE CARE

Outcome: 3 Cervical Manipulation vs Cntl or varied comparisons: PAIN - Multiple Session



(1) Giles 1999: manipulation vs medication; duration: 3-4 weeks, 6 session; follow up: none; instrument: VAS (0 to 10)*

(2) Giles 1999: manipulation vs acupuncture; duration: 3-4 weeks, 6 session; follow up: none; instrument: VAS (0 to 10)*

(9) Hurwitz 2002: manipulation and EMS (E) v mobilisation and E; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

(10) Hurwitz 2002: manipulation and h and E v mobilisation and h and E; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

(11) Hurwitz 2002: manipulation v mobilisation and h; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

(12) Hurwitz 2002: manipulation v mobilisation and E; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

(13) Hurwitz 2002: manipulation v mobilisation and h and E; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

(14) Muller 2005: manipulation v acupuncture; duration: max 9 weeks and 18 sessions; follow up: 12 months; instrument: VAS(0 to 10)*

(15) Muller 2005: manipulation v medication; duration: max 9 weeks, max 18 sessions; follow up: 12 months; instrument: VAS(0 to 10)*

(Continued . . .)

(... Continued)

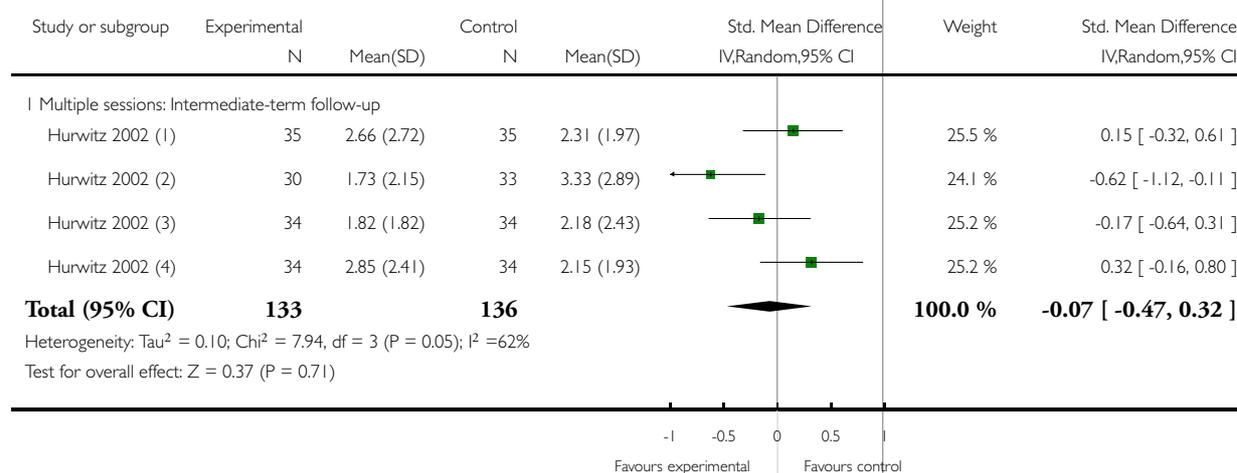
Study or subgroup	Favours experimental		Control		Std. Mean Difference IV,Random,95% CI	Std. Mean Difference IV,Random,95% CI
	N	Mean(SD)	N	Mean(SD)		
(3) Strunk 2008: manipulation v combined approach (CTA); duration: 2 weeks, 4 sessions; follow up: none; instrument: VAS (0 to 100)						
(4) Bitterli 1977: manipulation (B) v w-cntl (C); duration: 3 weeks, 3 to 4 sessions; follow up: 12 weeks; instrument: VAS (0 to 100)						
(5) Chen 2007: manipulation v TENS; duration: 3 weeks, 10 sessions; follow up: 1 weeks; instrument: NRS (0 to 10)						
(6) Nilsson 1997: manipulation v soft tissue techniques; duration: 3 weeks, 6 sessions; follow up: 1 week; instrument: VAS (0 to 100)**						
(7) Hurwitz 2002: manipulation v mobilisation; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)						
(8) Hurwitz 2002: manipulation and heat (h) v mobilisation and h; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)						
(9) Hurwitz 2002: manipulation and EMS (E) v mobilisation and E; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)						
(10) Hurwitz 2002: manipulation and h and E v mobilisation and h and E; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)						
(11) Hurwitz 2002: manipulation v mobilisation and h; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)						
(12) Hurwitz 2002: manipulation v mobilisation and E; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)						
(13) Hurwitz 2002: manipulation v mobilisation and h and E; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)						
(14) Muller 2005: manipulation v acupuncture; duration: max 9 weeks and 18 sessions; follow up: 12 months; instrument: VAS(0 to 10)*						
(15) Muller 2005: manipulation v medication; duration: max 9 weeks, max 18 sessions; follow up: 12 months; instrument: VAS(0 to 10)*						

Analysis 1.4. Comparison 1 SINGLE CARE, Outcome 4 Cervical Manipulation vs Mobilisation: PAIN.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: 1 SINGLE CARE

Outcome: 4 Cervical Manipulation vs Mobilisation: PAIN



(1) Hurwitz 2002: manipulation v mobilisation; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

(2) Hurwitz 2002: manipulation and heat and EMS v mobilisation and heat and EMS; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

(3) Hurwitz 2002: manipulation and heat v mobilisation and heat; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

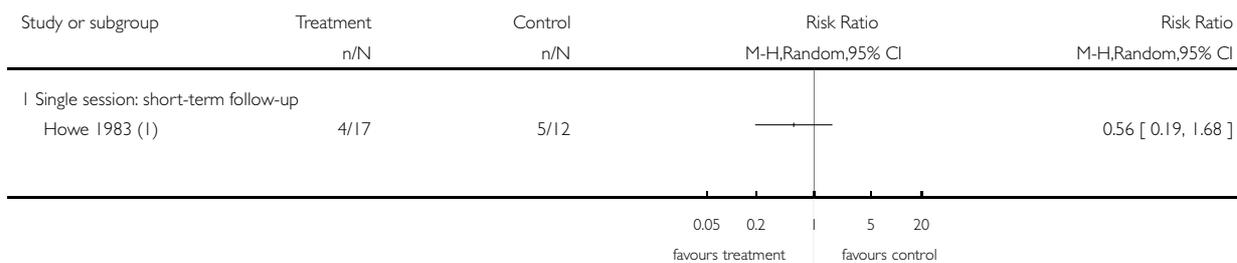
(4) Hurwitz 2002: manipulation and EMS v mobilisation and EMS; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

Analysis I.5. Comparison I SINGLE CARE, Outcome 5 Cervical Manipulation vs same treatment in both arms: PAIN Intensity.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: I SINGLE CARE

Outcome: 5 Cervical Manipulation vs same treatment in both arms: PAIN Intensity



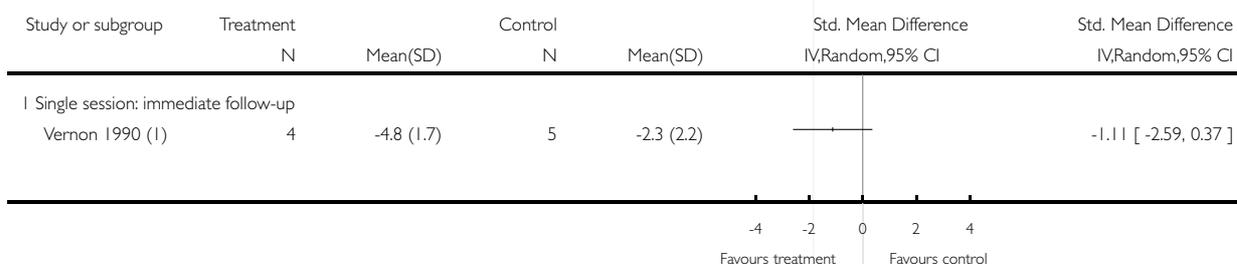
(1) Howe 1983: manipulation v same treatment in both arms (medication); duration: 1 session; follow up: 3 weeks; instrument: total subjects

Analysis I.6. Comparison I SINGLE CARE, Outcome 6 Cervical Manipulation vs Placebo: PAIN PRESSURE.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: I SINGLE CARE

Outcome: 6 Cervical Manipulation vs Placebo: PAIN PRESSURE



(1) Vernon 1990: manipulation (M) v placebo (S); duration: 1 session; follow-up: none; instrument: algometer (kg/cm)

Analysis 1.7. Comparison 1 SINGLE CARE, Outcome 7 Cervical Manipulation vs Cntl or varied comparisons: FUNCTION.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: 1 SINGLE CARE

Outcome: 7 Cervical Manipulation vs Cntl or varied comparisons: FUNCTION

Study or subgroup	Favours experimental		Control		Std. Mean Difference IV,Random,95% CI	Std. Mean Difference IV,Random,95% CI
	N	Mean(SD)	N	Mean(SD)		
1 Multiple sessions: immediate follow-up						
Giles 1999 (1)	21	-10 (19.1)	9	-6 (26.61)		-0.18 [-0.96, 0.60]
Giles 1999 (2)	21	-10 (19.1)	9	0 (19.78)		-0.50 [-1.30, 0.29]
Strunk 2008 (3)	3	17.3 (4.6)	3	21.7 (9.3)		-0.48 [-2.15, 1.19]
2 Multiple sessions: intermediate-term follow-up - manipulations v mobilisations						
Hurwitz 2002 (4)	35	7.46 (6.66)	34	6.97 (7.64)		0.07 [-0.40, 0.54]
Hurwitz 2002 (5)	34	5.47 (3.86)	34	6.44 (6.25)		-0.18 [-0.66, 0.29]
Hurwitz 2002 (6)	34	8 (6.38)	34	5.85 (4.86)		0.37 [-0.10, 0.85]
Hurwitz 2002 (7)	30	6.4 (6.92)	33	8.52 (8.08)		-0.28 [-0.77, 0.22]
3 Multiple sessions: intermediate-term follow-up - manipulations v other treatment						
Hurwitz 2002 (8)	35	7.46 (6.66)	33	6.44 (6.25)		0.16 [-0.32, 0.63]
Hurwitz 2002 (9)	35	7.46 (6.66)	34	5.85 (4.86)		0.27 [-0.20, 0.75]
Hurwitz 2002 (10)	35	7.46 (6.66)	33	8.52 (8.08)		-0.14 [-0.62, 0.33]
4 Multiple sessions: long-term follow-up						
Muller 2005 (11)	23	20 (43.67)	19	36 (43.67)		-0.36 [-0.97, 0.25]
Muller 2005 (12)	23	20 (43.67)	20	24 (46.39)		-0.09 [-0.69, 0.51]

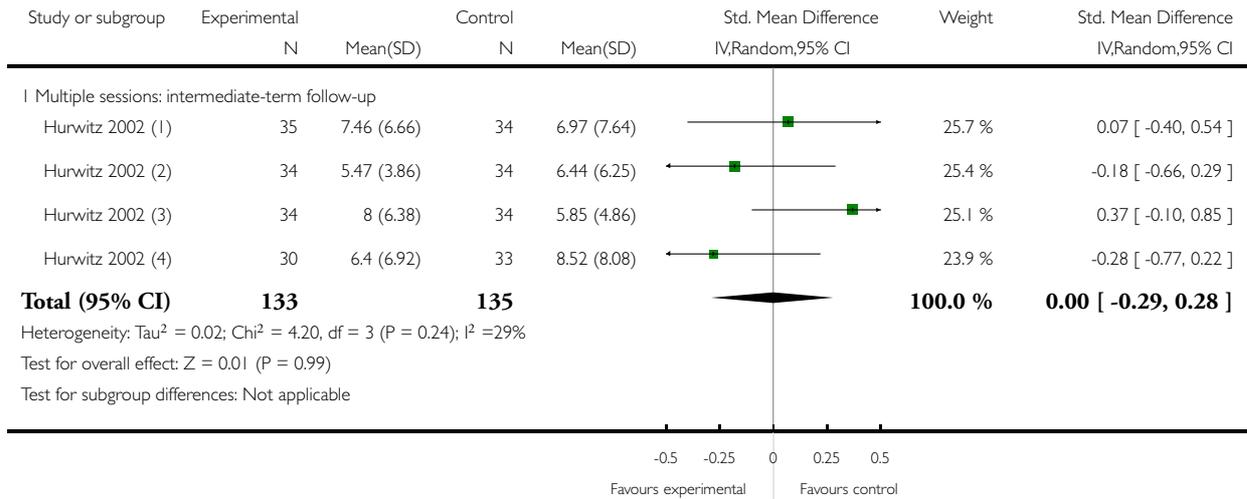
- (1) Giles 1999: manipulation (manip) vs acupuncture (acup); duration: 3-4 weeks, 6 session; follow up: none; instrument: NDI(0 to 50)*
- (2) Giles 1999: manipulation vs medication; duration: 3-4 weeks, 6 session; follow up: none; instrument: NDI (0 to 50)*
- (3) Strunk 2008: manipulation v combined approach (CTA); duration: 2 weeks, 4 sessions; follow up: none; instrument: VAS (0 to 100)
- (4) Hurwitz 2002: manipulation v mobilisation; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (5) Hurwitz 2002: manipulation and heat (h) v mobilisation and h; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (6) Hurwitz 2002: manipulation and EMS (E) v mobilisation and E; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (7) Hurwitz 2002: manipulation and h and E v mobilisation and h and E; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (8) Hurwitz 2002: manipulation v mobilisation and h; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (9) Hurwitz 2002: manipulation v mobilisation E; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (10) Hurwitz 2002: manipulation v mobilisation and h and E; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)
- (11) Muller 2005: manipulation v medication; duration: max 9 weeks and 18 sessions; follow up: 12 months; instrument: NDI(0 to 50)*
- (12) Muller 2005: manipulation v acupuncture; duration: max 9 weeks and 18 sessions; follow up: 12 months; instrument: NDI(0 to 50)*

Analysis 1.8. Comparison 1 SINGLE CARE, Outcome 8 Cervical Manipulation vs Mobilisation/comparison: FUNCTION - Manipulation vs Mobilisation - short term follow-up.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: 1 SINGLE CARE

Outcome: 8 Cervical Manipulation vs Mobilisation/comparison: FUNCTION - Manipulation vs Mobilisation - short term follow-up



(1) Hurwitz 2002: manipulation v mobilisation; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)

(2) Hurwitz 2002: manipulation and heat v mobilisation and heat; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)

(3) Hurwitz 2002: manipulation and EMS v mobilisation and EMS; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)

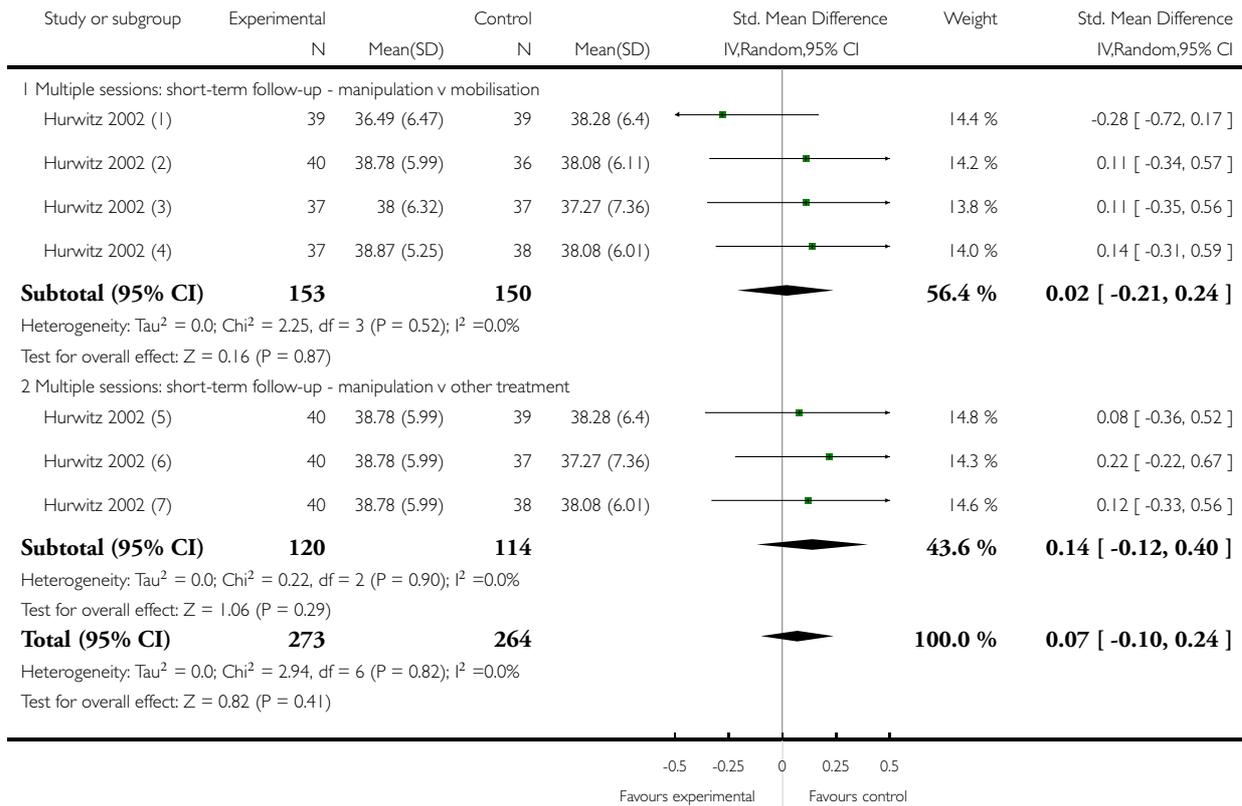
(4) Hurwitz 2002: manipulation and heat and EMS v mobilisation and heat and EMS; duration: NR; follow up: 6 month; instrument: NDI (0 to 50)

Analysis 1.9. Comparison 1 SINGLE CARE, Outcome 9 Cervical Manipulation vs Mobilisation/comparison: PATIENT SATISFACTION.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: 1 SINGLE CARE

Outcome: 9 Cervical Manipulation vs Mobilisation/comparison: PATIENT SATISFACTION



(1) Hurwitz 2002: manipulation and heat v mobilisation and heat; duration: NR; follow up: 4 weeks; instrument: patient satisfaction (10 to 50)

(2) Hurwitz 2002: manipulation v mobilisation; duration: NR; follow up: 4 weeks; instrument: patient satisfaction (10 to 50)

(3) Hurwitz 2002: manipulation and EMS v mobilisation and EMS; duration: NR; follow up: 4 weeks; instrument: patient satisfaction (10 to 50)

(4) Hurwitz 2002: manipulation and heat and EMS v mobilisation and heat and EMS; duration: NR; follow up: 4 weeks; instrument: patient satisfaction (10 to 50)

(5) Hurwitz 2002: manipulation v mobilisation and heat; duration: NR; follow up: 4 weeks; instrument: patient satisfaction (10 to 50)

(6) Hurwitz 2002: manipulation v mobilisation and EMS; duration: NR; follow up: 4 weeks; instrument: patient satisfaction (10 to 50)

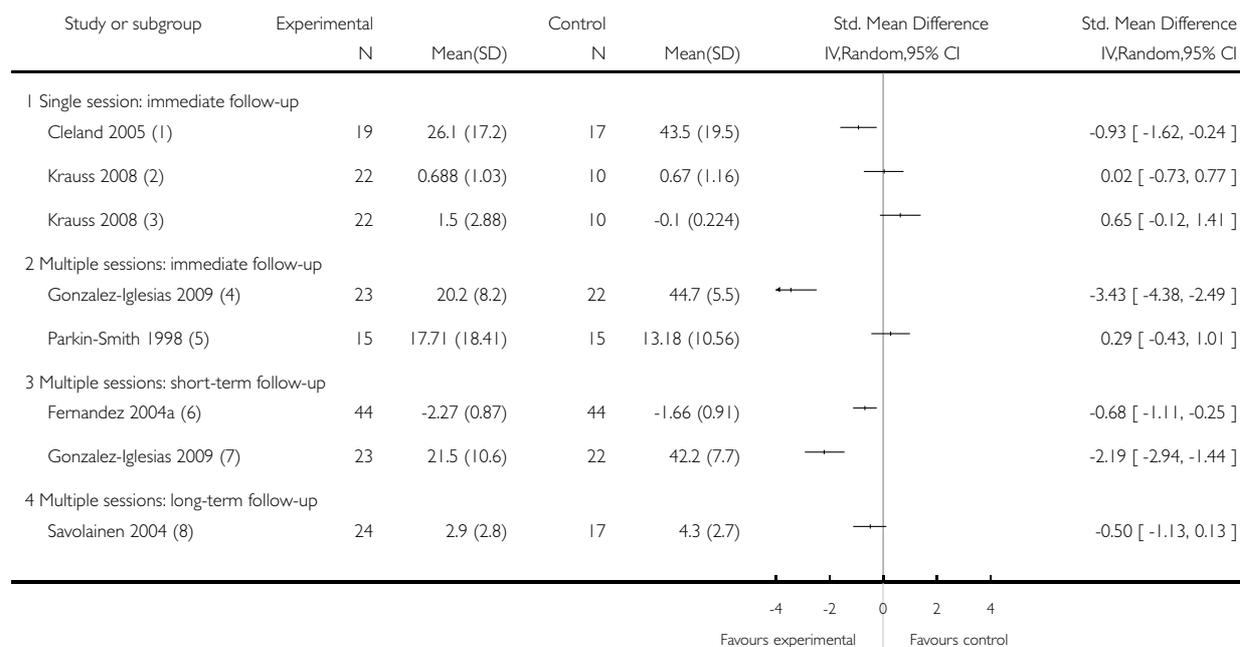
(7) Hurwitz 2002: manipulation v mobilisation and heat and EMS; duration: NR; follow up: 4 weeks; instrument: patient satisfaction (10 to 50)

Analysis 1.10. Comparison 1 SINGLE CARE, Outcome 10 Thoracic Manipulation vs Cntl: PAIN.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: 1 SINGLE CARE

Outcome: 10 Thoracic Manipulation vs Cntl: PAIN



(1) Cleland 2005: manipulation v placebo; duration: 1 session; follow up: none; instrument: VAS (0 to 100)

(2) Krauss 2008: manipulation (TSM) v no treatment; duration: 1 session; follow up: none; instrument: 9 point faces scale *

(3) Krauss 2008: manipulation (TSM) v no treatment; duration: 1 session; follow up: none; instrument: 9 point faces scale**

(4) Gonzalez-Iglesias 2009: manipulation v ETT both arms; duration: 3 weeks, 5 sessions; follow up: none; instrument: VAS (0 to 100)

(5) Parkin-Smith 1998: T/S manipulation v C/S manipulation both arms; duration: 3 weeks, 6 sessions; follow up: none; instrument: NRS 101

(6) Fernandez 2004a: manipulation v PT both arms; duration: 2 weeks, 15 sessions; follow up: none; instrument: VAS (0-10)

(7) Gonzalez-Iglesias 2009: manipulation v ETT both arms; duration: 3 weeks, 5 sessions; follow up: 4 weeks; instrument: VAS (0 to 100)

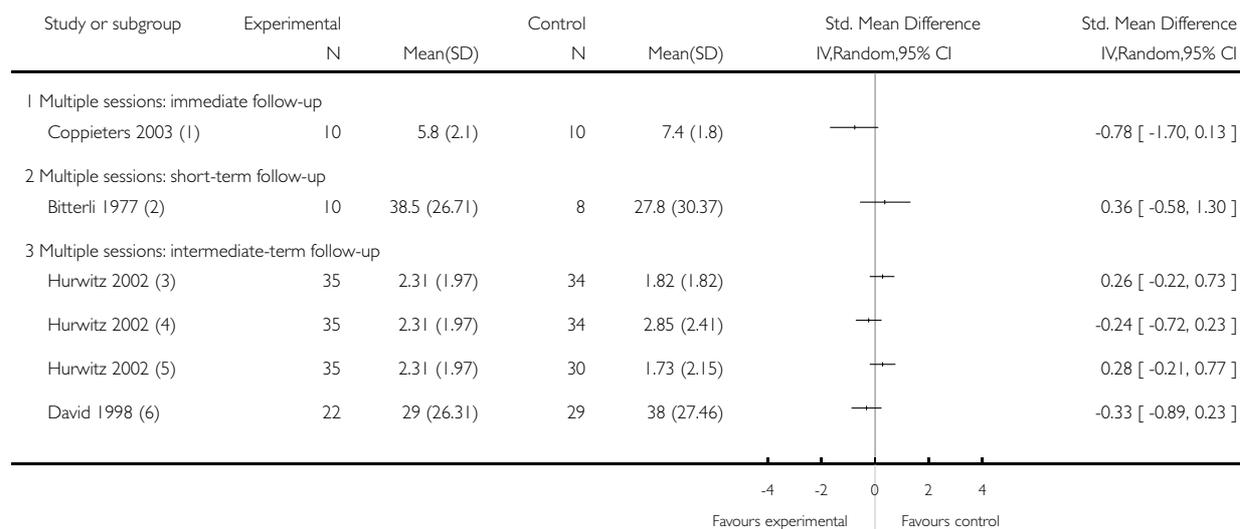
(8) Savolainen 2004: manipulation v instructed exercise; duration: NR; follow up 52 weeks; instrument: VAS - current pain (0 to 10)

Analysis 1.11. Comparison 1 SINGLE CARE, Outcome 11 Cervical Mobilisation vs Comparison: PAIN.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: 1 SINGLE CARE

Outcome: 11 Cervical Mobilisation vs Comparison: PAIN



(1) Coppieters 2003: mobilisation (neural dynamic mobilisation) v pulsed ultrasound; duration: 1 session; follow up: none; instrument: NRS-101

(2) Bitterli 1977: manipulation and mobilisation (A) v manipulation (B); duration: 3 weeks, 3 to 4 sessions; follow up: 12 weeks; instrument: VAS (0 to 100)

(3) Hurwitz 2002: mobilisation v manipulation and heat; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

(4) Hurwitz 2002: mobilisation v manipulation and EMS; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

(5) Hurwitz 2002: mobilisation v manipulation and heat and EMS; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

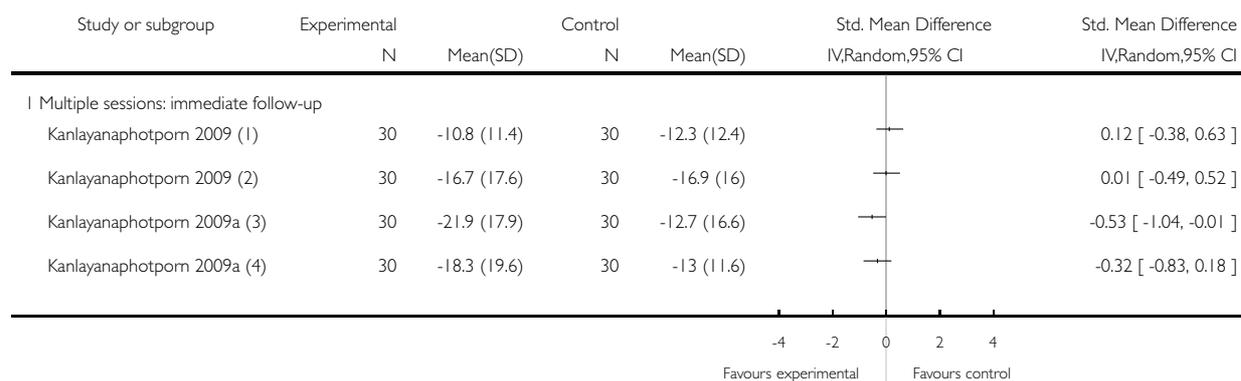
(6) David 1998: mobilisations (PT) v acupuncture (A); duration: 6 weeks, 6 sessions; follow up: 24 weeks; instrument: VAS (0 to 100)

Analysis 1.12. Comparison 1 SINGLE CARE, Outcome 12 Cervical Mobilisation one technique vs another technique: PAIN.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: 1 SINGLE CARE

Outcome: 12 Cervical Mobilisation one technique vs another technique: PAIN



(1) Kanlayanaphotpom 2009a: ipsilateral PA v random PA; duration: 1 session; follow up: none; instrument: VAS (0 to 100)**

(2) Kanlayanaphotpom 2009: ipsilateral PA v random PA; duration: 1 session; follow up: none; instrument: VAS (0 to 100)*

(3) Kanlayanaphotpom 2009b: central PA v random PA; duration: 1 session; follow up: none; instrument: VAS (0 to 100)*

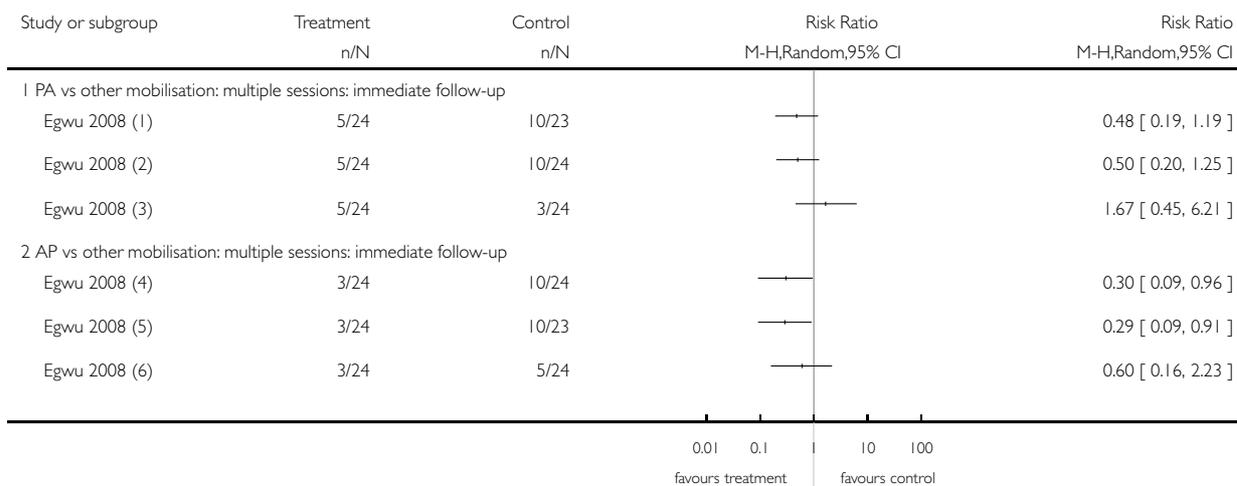
(4) Kanlayanaphotpom 2009b : central PA v random PA; duration: 1 session; follow up: none; instrument: VAS (0 to 100)**

Analysis 1.13. Comparison 1 SINGLE CARE, Outcome 13 Cervical Mobilisation one technique vs another technique: PAIN.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: 1 SINGLE CARE

Outcome: 13 Cervical Mobilisation one technique vs another technique: PAIN



(1) Egwu 2008: PAUP v. COR; duration: max 4 weeks and 12 sessions; follow up: none; instrument: categories*

(2) Egwu 2008: PAUP v. TOP; duration: max 4 weeks and 12 sessions; follow up: none; instrument: categories*

(3) Egwu 2008: PAUP v. APUP; duration: max 4 weeks and 12 sessions; follow up: none; instrument: categories*

(4) Egwu 2008: APUP v TOP; duration: max 4 weeks and 12 sessions; follow up: none; instrument:categories*

(5) Egwu 2008: APUP v COR; duration: max 4 weeks and 12 sessions; follow up: none; instrument: categories*

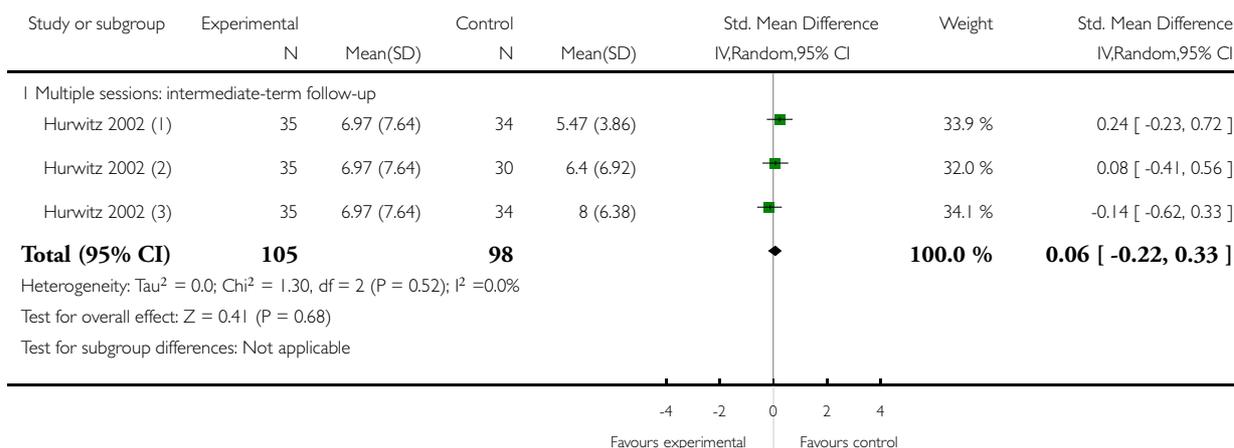
(6) Egwu 2008: APUP v PAUP; duration: max 4 weeks and 12 sessions; follow up: none; instrument: categories*

Analysis I.14. Comparison I SINGLE CARE, Outcome I4 Cervical Mobilisation vs Comparison: FUNCTION.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: I SINGLE CARE

Outcome: I4 Cervical Mobilisation vs Comparison: FUNCTION



(1) Hurwitz 2002: mobilisation v manipulation and heat; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

(2) Hurwitz 2002: mobilisation v manipulation and heat and EMS; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

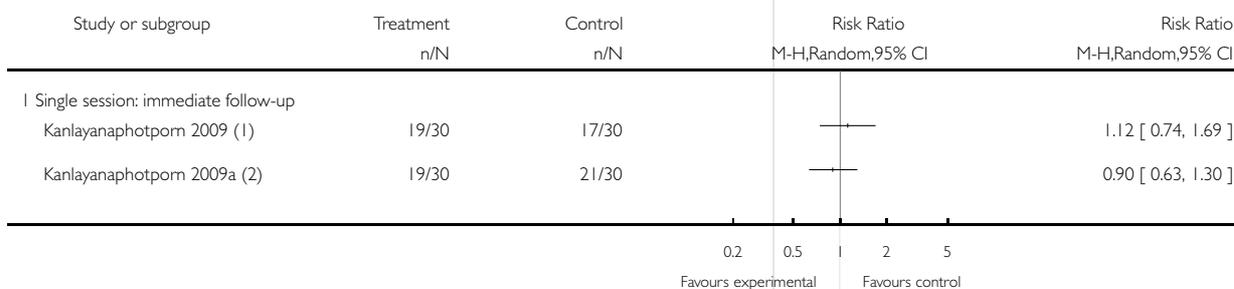
(3) Hurwitz 2002: mobilisation v manipulation and EMS; duration: NR; follow up: 6 month; instrument: NRS (0 to 10)

Analysis I.15. Comparison I SINGLE CARE, Outcome I5 Cervical Mobilisation one technique vs another technique: GLOBAL PERCIEVED EFFECT.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: I SINGLE CARE

Outcome: I5 Cervical Mobilisation one technique vs another technique: GLOBAL PERCIEVED EFFECT



(1) Kanlayanaphotpom 2009: ipsilateral posterior/anterior v random posterior/anterior; duration: I session; follow up: none; instrument: GPE

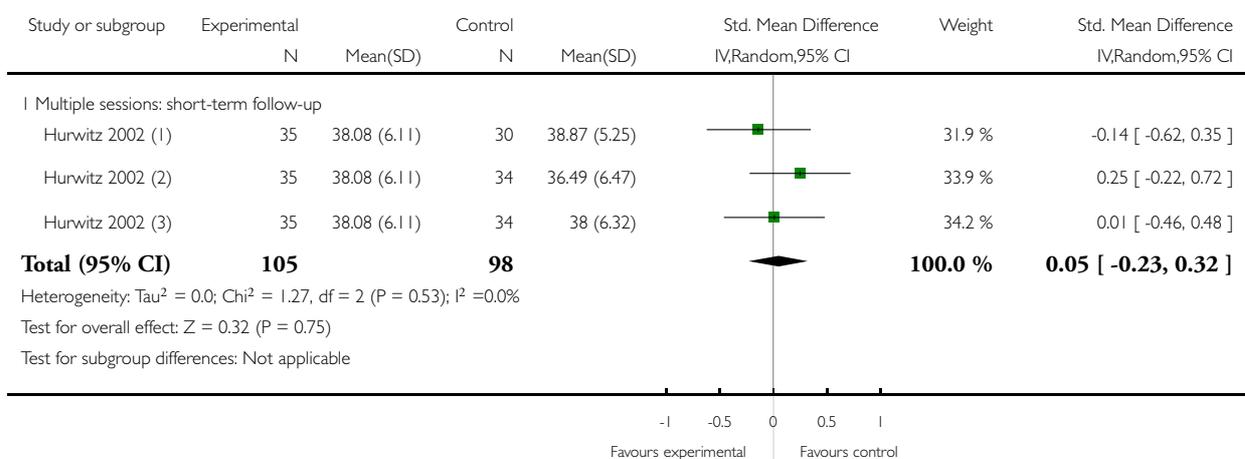
(2) Kanlayanaphotpom (2009b) 2009:central posterior/anterior (PAMob) v random posterior/anterior (RMob); duration: I session; follow up: none; instrument: GPE

Analysis 1.16. Comparison 1 SINGLE CARE, Outcome 16 Cervical Mobilisation vs Comparison: PATIENT SATISFACTION.

Review: Manipulation or Mobilisation for Neck Pain

Comparison: 1 SINGLE CARE

Outcome: 16 Cervical Mobilisation vs Comparison: PATIENT SATISFACTION



(1) Hurwitz 2002: mobilisation v manipulation and heat and EMS; duration: NR; follow up: 4 weeks; instrument: NRS (0 to 10)

(2) Hurwitz 2002: mobilisation v manipulation and heat; duration: NR; follow up: 4 weeks; instrument: NRS (0 to 10)

(3) Hurwitz 2002: mobilisation v manipulation and EMS; duration: NR; follow up: 4 weeks; instrument: NRS (0 to 10)

ADDITIONAL TABLES

Table 1. Calculations for Treatment Advantage and Number-needed-to-treat

Term	Definiton
Percent Treatment Advantage (%)	<p>Calculation of the clinically important difference or change on a percent scale was estimated as follows. Karlberg 1996 data are used in this example:</p> <p>The assumption made was that a positive mean/median value is improvement and a negative value is deterioration.</p> <p>Treatment/Control Mean/Median; Mean/Median; Mean/Median; Mean/Median Baseline [SD]; Final [SD]; Baseline [SD]; Final [SD] 54[23]; 31[10]; 56[1]; 55[20]</p>

Table 1. Calculations for Treatment Advantage and Number-needed-to-treat (Continued)

	<p>% Improvement [treatment] equals the difference between the change in the treatment group [23] divided by the treatment baseline [54] which equals 42.6%</p> <p>% Improvement [control] equals the difference between the change in the control group [1] divided by the control baseline [56] which equals 1.8%</p> <p>Treatment advantage = 42.6% - 1.8% = 40.8%.</p>
Number-needed-to-treat (NNT)	<p>For this example, Karlberg 1996 outcomes measured at short term follow-up are used to derive the data</p> <p><i>Number-needed-to-treat</i> is the number of patients a clinician needs to treat to achieve a clinically important improvement in one. If we assume the minimal clinically important difference to be 10% of the baseline mean in the control group, and the control group mean at baseline is 56, then 10% of 56 is 5.6</p> <p>The effect is baseline - final value, therefore</p> <ul style="list-style-type: none"> • For the experimental group, the effect is 54.0 - 31.0 = -23.0; and • for the control group, the effect is 56.0 - 55.0 = 1.0 <p>Converting these to standard normal values means that</p> <ul style="list-style-type: none"> • for the experimental group $z = (-5.6 + 23.0)/10.0$ equals 17.4/10.0 equals 1.74 which gives an area under the normal curve of 0.9591. • for the control group: $z = (-5.6 + 1.0)/20.0$ equals -4.6/20.0 equals -0.23 which gives an area under the normal curve of 0.4090. <p>NNT = 1 divided by the difference of the areas under the normal curve (experimental group - control group)</p> <ul style="list-style-type: none"> • 0.9591 - 0.4090 = 0.5500 • therefore, NNT equals 1 divided by 0.5500 = 1.81 or 2 when grown to the lowest integer.

Table 2. NNT & Treatment Advantage

Author/Comparison	NNT	Advantage (%)
Martinez-Segura 2006, outcome: pain	2 [clinically important pain reduction]	54%
Cleland 2005 outcome: pain	5 [clinically important pain reduction]	29%
Fernandez 2004a outcome: pain	unable to calculate because baseline data not reported (author was unable to provide these data)	
Gonzalez-Iglesias 2009 outcome: pain	7 [clinically important pain reduction]	46.6%
Gonzalez-Iglesias 2009 outcome: function	5 [clinically important functional improvements]	40.6%
Martinez-Segura 2006 outcome: pain	2 [clinically important pain reduction]	54.0%

APPENDICES

Appendix 1. MEDLINE search strategy

1. neck/ or neck muscles/ or exp cervical plexus/ or exp cervical vertebrae/ or Atlanto-Axial Joint/ or atlanto-occipital joint/ or axis/ or atlas/ or spinal nerve roots/ or exp brachial plexus/
2. (odontoid or cervical or occip: or atlant:).tw.
3. 1 or 2
4. exp arthritis/ or exp myofascial pain syndromes/ or fibromyalgia/ or spondylitis/ or exp spinal osteophytosis/ or spondylolisthesis/
5. exp headache/ and cervic:.tw.
6. whiplash injuries/ or cervical rib syndrome/ or torticollis/ or cervico-brachial neuralgia.ti,ab,sh. or exp radiculitis/ or polyradiculitis/ or polyradiculoneuritis/ or thoracic outlet syndrome/
7. (monoradicul: or monoradicl:).tw.
8. 4 or 5 or 6 or 7
9. random:.ti,ab,sh.
10. randomised controlled trial.pt.
11. double-blind method/
12. single blind method/
13. placebos/
14. clinical trial.pt.
15. exp clinical trials/
16. controlled clinical trial.pt.
17. (clin\$ adj25 trial\$).ti,ab.
18. ((singl\$ or doubl\$ or trebl\$) adj25 (blind\$ or mask\$)).ti,ab.
19. placebo\$.ti,ab.
20. or/9-19
21. exp arthritis/rh,th or exp myofascial pain syndromes/rh,th or fibromyalgia/rh,th or spondylitis/rh,th or exp spinal osteophytosis/ rh,th or spondylosis/rh,th or spondylolisthesis/rh,th
22. exp headache/rh,th and cervic:.tw.
23. whiplash injuries/rh,th or cervical rib syndrome/rh,th or thoracic outlet syndrome/rh,th or torticollis/rh,th or cervico-brachial neuralgia/rh,th or exp radiculitis/rh,th or polyradiculitis/rh,th or polyradiculoneuritis/rh,th
24. or/21-23
25. exp alternative medicine/ or chiropractic/
26. (acupuncture or biofeedback or chiropract: or electric stimulation therapy or kinesiology or massage or traditional medicine or relaxation or therapeutic touch).tw.
27. or/25-26
28. 3 and 24
29. 3 and 8 and 27
30. 28 or 29
31. 20 and 30

Appendix 2. Criteria for a judgment of yes for the sources of risk of bias

1. Was the method of randomisation adequate?

A random (unpredictable) assignment sequence. Examples of adequate methods are coin toss (for studies with two groups), rolling a dice (for studies with two or more groups), drawing of balls of different colours, drawing of ballots with the study group labels from a dark bag, computer-generated random sequence, pre-ordered sealed envelopes, sequentially-ordered vials, telephone call to a central office, and pre-ordered list of treatment assignments

Examples of inadequate methods are: alternation, birth date, social insurance/security number, date in which they are invited to participate in the study, and hospital registration number

2. Was the treatment allocation concealed?

Assignment generated by an independent person not responsible for determining the eligibility of the patients. This person has no information about the persons included in the trial and has no influence on the assignment sequence or on the decision about eligibility of the patient.

Was knowledge of the allocated interventions adequately prevented during the study?

3. *Was the patient blinded to the intervention?*

This item should be scored “yes” if the index and control groups are indistinguishable for the patients or if the success of blinding was tested among the patients and it was successful.

4. *Was the care provider blinded to the intervention?*

This item should be scored “yes” if the index and control groups are indistinguishable for the care providers or if the success of blinding was tested among the care providers and it was successful

5. *Was the outcome assessor blinded to the intervention?*

Adequacy of blinding should be assessed for the primary outcomes. This item should be scored “yes” if the success of blinding was tested among the outcome assessors and it was successful or:

- **for patient-reported outcomes** in which the patient is the outcome assessor (e.g., pain, disability): the blinding procedure is adequate for outcome assessors if participant blinding is scored “yes”
- **for outcome criteria assessed during scheduled visit and that supposes a contact between participants and outcome assessors** (e.g., clinical examination): the blinding procedure is adequate if patients are blinded, and the treatment or adverse effects of the treatment cannot be noticed during clinical examination
- **for outcome criteria that do not suppose a contact with participants** (e.g., radiography, magnetic resonance imaging): the blinding procedure is adequate if the treatment or adverse effects of the treatment cannot be noticed when assessing the main outcome
- **for outcome criteria that are clinical or therapeutic events** that will be determined by the interaction between patients and care providers (e.g., co-interventions, hospitalization length, treatment failure), in which the care provider is the outcome assessor: the blinding procedure is adequate for outcome assessors if the item for care-providers is scored “yes”
- **for outcome criteria that are assessed from data of the medical forms:** the blinding procedure is adequate if the treatment or adverse effects of the treatment cannot be noticed on the extracted data

Were incomplete outcome data adequately addressed?

6. *Was the drop-out rate described and acceptable?*

The number of participants who were included in the study but did not complete the observation period or were not included in the analysis must be described and reasons given. If the percentage of withdrawals and drop-outs does not exceed 20% for short-term follow-up and 30% for long-term follow-up and does not lead to substantial bias a ‘yes’ is scored. (N.B. these percentages are arbitrary, not supported by literature).

7. *Were all randomized participants analysed in the group to which they were allocated?*

All randomized patients are reported/analyzed in the group they were allocated to by randomization for the most important moments of effect measurement (minus missing values) irrespective of non-compliance and co-interventions.

8. *Are reports of the study free of suggestion of selective outcome reporting?*

In order to receive a ‘yes’, the review author determines if all the results from all pre-specified outcomes have been adequately reported in the published report of the trial. This information is either obtained by comparing the protocol and the report, or in the absence of the protocol, assessing that the published report includes enough information to make this judgment.

Other sources of potential bias:

9. *Were the groups similar at baseline regarding the most important prognostic indicators?*

In order to receive a “yes”, groups have to be similar at baseline regarding demographic factors, duration and severity of complaints, percentage of patients with neurological symptoms, and value of main outcome measure(s).

10. *Were co-interventions avoided or similar?*

This item should be scored “yes” if there were no co-interventions or they were similar between the index and control groups.

11. *Was the compliance acceptable in all groups?*

The reviewer determines if the compliance with the interventions is acceptable, based on the reported intensity, duration, number and frequency of sessions for both the index intervention and control intervention(s). For example, physiotherapy treatment is usually administered over several sessions; therefore it is necessary to assess how many sessions each patient attended. For single-session interventions (for ex: surgery), this item is irrelevant.

12. *Was the timing of the outcome assessment similar in all groups?*

Timing of outcome assessment should be identical for all intervention groups and for all important outcome assessments.
 Note: These instructions are adapted from [van Tulder 2003](#) and the Cochrane Handbook 2008 of Systematic Reviews of Interventions.

Appendix 3. Data imputation rules

The preliminary assumption made for imputation of missing values was that data were missing completely at random ([Little 1987](#)). In other words, it was assumed that data were not missing due to some factors confounded with the treatment effect.

[Sloop 1982](#)

Since information was solely available on change scores:

- change score treatment (T) is the difference between follow-up treatment pain score (mFT) and baseline treatment pain score (mBT);
- change score control (C) is the difference between follow-up control pain score (mFC) and pre-baseline-control pain score (mBC).

	Baseline	Follow-up	Difference
Treatment	mBT	mFT	$T = mFT - mBT$
Control	mBC	mFC	$C = mFC - mBC$
	$EB = mBT - mBC$	$EF = mFT - mFC$	$E = T - C$

If $EB=0$ then EF is equal to E .

The mean difference was calculated with the assumption that there were no baseline differences in scores ($EB = 00$). For the conversion, the mean post-score difference was assumed to be due to a difference in post-score values (EF), which then equals the post-follow-up difference (E).

Appendix 4. Grading the quality of evidence - definition of domains

Study Design refers to type of study (i.e. randomised, observational study)

Limitations in Design (Quality) refers to the 12 risk of bias criteria noted in [Appendix 2](#).

Consistency refers to the similarity of results across studies. When all studies are included in the meta-analysis, 'consistency' is defined as absence of statistical heterogeneity. In the case that not all studies are combined in a meta-analysis, 'consistency' is defined when all studies for the specific outcome lead to the same decision or recommendation, and 'inconsistency' is present if the results of two or more studies lead to clinically different decisions or recommendations. Review authors use their judgment to decide if there is inconsistency when only one study leads to clinically different decision or recommendation.

Directness (generalizability) refers to the extent to which the people, interventions and outcome measures are similar to those of interest.

Precision of the evidence relates to the number of studies, patients and events for each outcome. Imprecise data is defined as:

- Only one study for an outcome, regardless of the sample size or the confidence interval
- Multiple studies combined in a meta-analysis: the confidence interval is sufficiently wide that the estimate is consistent with conflicting recommendations. For rare events one should consider the confidence interval around the risk difference rather than the confidence interval around the relative risk
- Multiple studies not combined in a meta-analysis: the total sample size is underpowered to detect a clinically significant difference between those who received the index intervention compared to those who received the control intervention. In this case, a post-hoc sample size calculation should be performed to determine the adequate sample size for each outcome

Reporting (Publication) bias should only be considered present if there is actual evidence of reporting bias rather than only speculation about reporting bias. The Cochrane Reporting Bias Methods Group describes the following types of Reporting Bias and Definitions:

- Publication Bias: the publication or non publication of research findings, depending on the nature and direction of the results.

- Time Lag Bias: the rapid or delayed publication of research findings, depending on the nature and direction of the results.
- Language Bias: the publication of research findings in a particular language, depending on the nature and direction of the results.
- Funding Bias: the reporting of research findings, depending on how the results accord with the aspirations of the funding body.
- Outcome Variable Selection Bias: the selective reporting of some outcomes but not others, depending on the nature and direction of the research findings.
- Developed Country Biases: the non publication or non indication of findings, depending on whether the authors were based in developed or in developing countries.

WHAT'S NEW

Last assessed as up-to-date: 7 July 2009.

Date	Event	Description
6 April 2010	Amended	new references added to 'other references' (Karlberg 1996; Souvlis 2004) and NNT definition clarified.

HISTORY

Protocol first published: Issue 1, 2003

Review first published: Issue 2, 2003

Date	Event	Description
11 November 2009	New citation required and conclusions have changed	Conclusions were changed because they only dealt with the results from trials that examined the effects of single modalities
8 July 2009	New search has been performed	The literature search was updated and the scope was changed to only include trials with manipulation or mobilisation as single modalities. 32 publications, reporting on 27 trials were included in this update
25 November 2006	New citation required and conclusions have changed	The evidence did not favour a course of manipulation or mobilisation done alone or in combination with various other physical medicine agents for pain, function, and global perceived effect. However, the combined effect of manipulation, mobilisation or soft tissue work may be beneficial for global perceived effect and patient satisfaction, at least in the short term. Mobilisation or manipulation combined with exercise, delivered as part of a program, had lasting and clinically important benefit for pain relief, function improvement and global perceived effect in subacute/chronic mechanical neck disorder with or without headache. The addition of thoracic manipulation may be benefi-

(Continued)

		cial for neck pain relief in (sub)acute whiplash-associated disorders. It was not possible to determine which technique or dosage was most beneficial or if certain subgroups benefited more from one form of care than another. There was insufficient evidence to draw conclusions for neck disorder with radicular findings
25 November 2006	New search has been performed	15 new RCTs have been added since the last review was published in 2004

CONTRIBUTIONS OF AUTHORS

This is one review of a series conducted by the Cervical Overview Group: Bronfort G, Burnie SJ, Cameron ID, Eddy A, Ezzo J, Goldsmith CH, Graham N, Gross A, Haines T, Haraldsson B, Hoving J, Kay T, Kroeling P, Morien A, Peloso P, Radylovick Z, Santaguida P, Trinh K, Wang E

Gross A, Hoving J, Haines T, Burnie SJ - reviewers

Goldsmith CH - statistician

Gross A - COG coordinator, manuscript, publication

Goldsmith CH, Trinh K, Haines T, Burnie SJ, Peloso P - methodological quality assessment

Graham N, Gross A, Haraldsson B, Haines T - study selection

Hoving J, Gross A, Burnie SJ - data abstraction

Hoving J, Bronfort G, Burnie SJ, Gross A, Haines T, Kay T - synthesis, recommendations

Gross A, Graham N, Santaguida L - grant writing

Gross A, Bronfort G, Hoving J, Burnie SJ - conference presentation

Eady A - research librarian

DECLARATIONS OF INTEREST

Two of our review authors are authors of included studies. Although Gert Brønfort and Jan Hoving were review authors, they were not involved in decisions about the inclusion, risk of bias assessment or data extraction of their studies.

SOURCES OF SUPPORT

Internal sources

- McMaster University, Department of Clinical Epidemiology and Biostatistics; School of Rehabilitation Sciences; Occupational Health Program, Canada.
- LifeMark Health, Canada.
- Vrije Universiteit Amsterdam, Academic Medical Centre, Coronel Institute of Occupational Health, Netherlands.
- Sunnybrook & Women's College Health Sciences Centre, Physiotherapy Department, Canada.
- LAMP Occupational Health Program, Canada.
- Northwestern Health Sciences University, Minnesota, USA.
- Royal Canadian Chiropractic College, Canada.

External sources

- Problem-based Research Award; Sunnybrook and Women's College Health Sciences Foundation, Canada.
- Consortial Center for Chiropractic Research - National Institutes of Health, Bethesda, MD, USA.
- Hamilton Hospital Association, Canada.
- University of Saskatchewan, Clinical Teaching and Research Award, Canada.
- Hamilton Health Sciences Corporation, Chedoke-McMaster Foundation, Canada.

INDEX TERMS

Medical Subject Headings (MeSH)

Acute Disease; Chronic Disease; Manipulation, Orthopedic [adverse effects; * methods]; Neck; Neck Pain [* rehabilitation]; Randomized Controlled Trials as Topic; Recovery of Function; Thorax

MeSH check words

Humans