



The Spine Journal 16 (2016) 1598-1630



Review Article

Are manual therapies, passive physical modalities, or acupuncture effective for the management of patients with whiplash-associated disorders or neck pain and associated disorders? An update of the Bone and Joint Decade Task Force on Neck Pain and Its Associated Disorders by the OPTIMa collaboration

Jessica J. Wong, BSc, DC, FCCS(C)^{a,b,*}, Heather M. Shearer, DC, MSc, FCCS(C)^{a,c}, Silvano Mior, DC, PhD^c, Craig Jacobs, BFA, DC, MSc, FCCS(C)^{a,d}, Pierre Côté, DC, PhD^{a,e,f}, Kristi Randhawa, BHSc, MPH^{a,d}, Hainan Yu, MBBS, MSc^{a,d}, Danielle Southerst, BScH, DC, FCCS(C)^{a,g}, Sharanya Varatharajan, BSc, MSc^{a,d}, Deborah Sutton, BScOT, MEd, MSc^{a,d}, Gabrielle van der Velde, DC, PhD^{h,i,j}, Linda J. Carroll, PhD^k, Arthur Ameis, FRCPC, DESS, FAAPM&R¹, Carlo Ammendolia, DC, PhD^{j,m}, Robert Brison, MD, MPH^{n,o}, Margareta Nordin, Dr Med Sci^p, Maja Stupar, DC, PhD^a, Anne Taylor-Vaisey, MLS^a ^aUOIT-CMCC Centre for the Study of Disability Prevention and Rehabilitation, University of Ontario Institute of Technology (UOIT) and Canadian Memorial Chiropractic College (CMCC) ^bDepartment of Graduate Studies, Canadian Memorial Chiropractic College ^cDivision of Graduate Education and Research Programs, Canadian Memorial Chiropractic College (CMCC) ^dDivision of Clinical Education, Canadian Memorial Chiropractic College, Canada ^eCanada Research Chair in Disability Prevention and Rehabilitation, University of Ontario Institute of Technology (UOIT) ^fFaculty of Health Sciences, University of Ontario Institute of Technology (UOIT) ^gRebecca MacDonald Centre for Arthritis and Autoimmune Disease, Mount Sinai Hospital

^hToronto Health Economics and Technology Assessment (THETA) Collaborative

ⁱLeslie Dan Faculty of Pharmacy, University of Toronto

^jInstitute for Work and Health

^kAlberta Centre for Injury Control and Research and School of Public Health, University of Alberta

¹Certification Program in Insurance Medicine and Medico-legal Expertise, Faculty of Medicine, University of Montreal

^mInstitute for Health Policy, Management and Evaluation, University of Toronto

ⁿClinical Research, Kingston General Hospital

°Department of Emergency Medicine, School of Medicine, Queen's University

PDepartments of Orthopedic Surgery and Environmental Medicine, Occupational and Industrial Orthopedic Center, NYU School of Medicine,

New York University

Received 14 November 2014; revised 5 June 2015; accepted 11 August 2015

FDA device/drug status: Not applicable.

Systematic Review Registration Numbers: CRD42013004372, CRD42013005167, CRD42013004301, CRD42013004395.

* Corresponding author. UOIT-CMCC Centre for the Study of Disability Prevention and Rehabilitation, University of Ontario Institute of Technology (UOIT) and Canadian Memorial Chiropractic College (CMCC), 6100 Leslie St, Toronto, Ontario, Canada M2H 3J1. Tel.: +1 (416) 482-2340 ext. 170.

E-mail address: jessica.wong@uoit.ca (J.J. Wong)

Author disclosures: *JJW*: Nothing to disclose. *HMS*: Nothing to disclose. *SM*: Nothing to disclose. *CJ*: Nothing to disclose. *PC*: Nothing to disclose. *KR*: Nothing to disclose. *HY*: Nothing to disclose. *DS*: Nothing to disclose. *SV*: Nothing to disclose. *DS*: Nothing to disclose. *GvdV*: Nothing to disclose. *LJC*: Nothing to disclose. *AA*: Nothing to disclose. *CA*: Nothing to disclose. *RB*: Nothing to disclose. *MN*: Nothing to disclose. *MS*: Nothing to disclose.

AbstractBACKGROUND CONTEXT: In 2008, the Bone and Joint Decade 2000–2010 Task Force on Neck
Pain and Its Associated Disorders (Neck Pain Task Force) found limited evidence on the effective-
ness of manual therapies, passive physical modalities, or acupuncture for the management of whiplash-
associated disorders (WAD) or neck pain and associated disorders (NAD).

PURPOSE: This review aimed to update the findings of the Neck Pain Task Force, which examined the effectiveness of manual therapies, passive physical modalities, and acupuncture for the management of WAD or NAD.

STUDY DESIGN/SETTING: This is a systematic review and best evidence synthesis.

SAMPLE: The sample includes randomized controlled trials, cohort studies, and case-control studies comparing manual therapies, passive physical modalities, or acupuncture with other interventions, placebo or sham, or no intervention.

OUTCOME MEASURES: The outcome measures were self-rated or functional recovery, pain intensity, health-related quality of life, psychological outcomes, or adverse events.

METHODS: We systematically searched five databases from 2000 to 2014. Random pairs of independent reviewers critically appraised eligible studies using the Scottish Intercollegiate Guidelines Network criteria. Studies with a low risk of bias were stratified by the intervention's stage of development (exploratory vs. evaluation) and synthesized following best evidence synthesis principles. Funding was provided by the Ministry of Finance.

RESULTS: We screened 8,551 citations, and 38 studies were relevant and 22 had a low risk of bias. Evidence from seven exploratory studies suggests that (1) for recent but not persistent NAD grades I–II, thoracic manipulation offers short-term benefits; (2) for persistent NAD grades I–II, technical parameters of cervical mobilization (eg, direction or site of manual contact) do not impact outcomes, whereas one session of cervical manipulation is similar to Kinesio Taping; and (3) for NAD grades I–II, strain-counterstrain treatment is no better than placebo. Evidence from 15 evaluation studies suggests that (1) for recent NAD grades I–II, cervical and thoracic manipulation provides no additional benefit to high-dose supervised exercises, and Swedish or clinical massage adds benefit to self-care advice; (2) for persistent NAD grades I–II, home-based cupping massage has similar outcomes to home-based muscle relaxation, low-level laser therapy (LLLT) does not offer benefits, Western acupuncture provides similar outcomes to sham-penetrating acupuncture; (3) for WAD grades I–II, needle electroacupuncture offers similar outcomes as simulated electroacupuncture; and (4) for recent NAD grades III, a semi-rigid cervical collar with rest and graded strengthening exercises lead to similar outcomes, and LLLT does not offer benefits.

CONCLUSIONS: Our review adds new evidence to the Neck Pain Task Force and suggests that mobilization, manipulation, and clinical massage are effective interventions for the management of neck pain. It also suggests that electroacupuncture, strain-counterstrain, relaxation massage, and some passive physical modalities (heat, cold, diathermy, hydrotherapy, and ultrasound) are not effective and should not be used to manage neck pain. © 2015 Elsevier Inc. All rights reserved.

Keywords:

Acupuncture; Manual therapy; Neck pain and associated disorders; Passive physical modalities; Systematic review; Whiplash-associated disorders

Introduction

Neck pain is a public health problem associated with disability, reduced health-related quality of life, and substantial health-care system costs [1-3]. Numerous treatments, including manual therapies, passive physical modalities, and acupuncture, are commonly used to treat neck pain [4,5]. However, few interventions have been demonstrated to be effective and most are associated with short-term benefits [5].

Findings of the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders (Neck Pain Task Force)

In 2008, the Neck Pain Task Force synthesized evidence on the effectiveness of manual therapies, passive physical modalities, and acupuncture for the management of whiplashassociated disorders (WAD) and neck pain and associated disorders (NAD) (Table 1) [5,6].

For manual therapies, the Neck Pain Task Force [5] found the following:

- 1. Manipulation and mobilization had similar effectiveness.
- Manipulation and mobilization led to similar outcomes as other conservative interventions (exercise, lowlevel laser therapy [LLLT]) for subacute and chronic neck pain.
- Western massage was equivalent to sham acupuncture but less effective than acupuncture for chronic neck pain.

Table	1
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Summary of the findings from the Neck Pain Task Force	e on the effectiveness of manual therapies	, passive physical modalities,	and acupuncture for the man-
agement of neck pain and associated disorders and whi	plash-associated disorders [6]*		

Origin/Grade	Duration	Intervention and comparison	Outcome/Follow-up
WAD grades I–II	Recent	Pulsed electromagnetic therapy > sham	Pain/short term
-		Collars, heat, cold \leq other interventions	Pain/short term
NAD or WAD grades I-II	Recent/persistent/variable	Manipulation = mobilization	Pain or disability/short term
_	Recent and persistent	Manipulation/mobilization = other conservative interventions	Pain or disability/short term
NAD grades I–II	Persistent	Low-level laser therapy > sham	Pain/short term
		Western massage < acupuncture	Pain/short term
		Western massage = sham acupuncture	Pain/short term
	Recent/persistent/variable	Cervical collar, TENS, ultrasound, heat therapy, electrical muscle stimulation ≤ other interventions	Pain/short term
		Magnetic necklace = sham	Pain/short term
	Recent/persistent/variable	Acupuncture [†]	Pain, disability, or global improvement/short term

NAD, neck pain and associated disorders; WAD, whiplash-associated disorders; transcutaneous electrical nerve stimulation.

* There was insufficient evidence to make a determination on all interventions for the management of WAD or NAD grade III.

[†] The Neck Pain Task Force reported that acupuncture may be effective, but this was based on inconsistent evidence.

4. The risk of serious adverse events associated with manipulation was extremely low.

For passive physical modalities, the Neck Pain Task Force [5] found the following:

- 1. Low-level laser therapy was efficacious for shortterm improvement of subacute or chronic neck pain.
- 2. Pulsed electromagnetic therapy was more effective than placebo.
- 3. Magnetic necklaces led to similar outcomes as placebo.
- Collars, transcutaneous electrical nerve stimulation (TENS), ultrasound, heat, and electrical muscle stimulation were equally or less effective than other interventions.

Finally, the Neck Pain Task Force reported that acupuncture may be effective for treating neck pain [5].

The Neck Pain Task Force identified important gaps in the literature and outlined research priorities. These priorities included trials comparing cervical manipulation, thoracic manipulation, and traction for WAD, and trials examining the effectiveness of conservative interventions for cervical radiculopathy [7].

In 2008, the Neck Pain Task Force did not organize their findings according to the stages of development of interventions. The recent publication of the IDEAL framework, which classifies studies according to their stage of development, provides a useful framework to organize the evidence [8,9]. Exploratory studies assess interventional efficacy, collect short-term outcomes, and prepare for designing evaluation studies. Exploratory studies do not provide evidence of effectiveness. In contrast, evaluation studies provide confidence in the intervention's effectiveness or comparative effectiveness to a standard of care [8,9]. Therefore, exploratory studies do not provide evidence of effectiveness to a standard of care [8,9]. Therefore, exploratory studies do not provide evidence of effectiveness and need to be considered separately when synthesizing evidence in a systematic review.

Moreover, the findings of exploratory studies need to be validated in evaluation studies.

The purpose of our systematic review was to update the findings of the Neck Pain Task Force [5] on the effectiveness of manual therapies, passive physical modalities, and acupuncture for the management of WAD and NAD.

Materials and methods

Registration

We registered our protocol with the International Prospective Register of Systematic Reviews (PROSPERO) in 2013 (CRD4201300XXXX, CRD4201300XXXX, CRD4201300XXXX, CRD4201300XXXX).

Eligibility criteria

Population

Our review targeted studies of adults and children with WAD and NAD grades I–III, as previously classified by the Quebec Task Force and the Neck Pain Task Force, respectively (Table 2) [10,11]. We excluded studies of neck pain due to major structural pathology (eg, fractures, dislocations, spinal cord injury, infection, neoplasms, and systemic disease).

Interventions

We restricted our review to studies evaluating the specific effectiveness of manual therapies, passive physical modalities, or acupuncture (Tables 3 and 4). We defined manual therapy (ie, manipulation, mobilization, traction, and soft tissue therapy) as the application of hands-on or mechanically assisted treatments. We defined a passive physical modality as a physical treatment (physicochemical or structural) involving a device that does not require active participation by the patient. Physicochemical modalities have a common intention to treat using a thermal or electromagnetic effect. Structural modalities include non-functional assistive devices

Classificat	Lassification of grades for whiplash-associated disorders [10] and neck pain and associated disorders [11]					
Grade	Definition					
Quebec Ta	sk Force Classification of Grades of Whiplash-Associated Disorders [12]					
Ι	Subjects with neck pain and associated symptoms in the absence of objective physical signs					
II	Subjects with neck pain and associated symptoms in the presence of objective physical signs and without evidence of neurologic involvement					
III	Subjects with neck pain and associated symptoms with evidence of neurologic involvement, including decreased or absent reflexes, decreased or limited sensation, or muscular weakness					
IV*	Subjects with neck pain and associated symptoms with evidence of fracture or dislocation					
The Neck	Pain Task Force Classification of Grades of Neck Pain and Associated Disorders [5]					
Ι	No signs or symptoms suggestive of major structural pathology and no or minor interference with activities of daily living					
II	No signs or symptoms of major structural pathology, but major interference with activities of daily living					
III	No signs or symptoms of major structural pathology, but presence of neurologic signs such as decreased deep tendon reflexes, weakness, or sensory deficits					
IV*	Signs or symptoms of major structural pathology					

Table 2 Classification of grades for whiplash-associated disorders [10] and neck pain and associated disorders [11]

* Grade IV was excluded from this systematic review.

(to encourage a state of rest in anatomical positions) and functional assistive devices (to align, support, or indirectly facilitate function). We defined acupuncture as body needling, moxibustion, electroacupuncture, laser acupuncture, microsystem acupuncture (eg, ear acupuncture), or acupressure (application of pressure at acupuncture points) [19].

Comparisons

We included studies that compared manual therapies, passive physical modalities, or acupuncture with other interventions, waiting list (wait and see), placebo or sham intervention, or no intervention.

Outcomes

Studies had to include one of the following outcomes to be eligible: self-rated or functional recovery, clinical outcomes (eg, pain, disability), psychological symptoms, administrative outcomes, or adverse events.

Study characteristics

Eligible studies met the following criteria: (1) English language; (2) randomized controlled trials (RCTs), cohort studies, case-control studies; and (3) an inception cohort of a minimum of 30 participants per treatment arm for RCTs or 100 subjects per exposed group for cohort studies or case-control

Table 3

Definition and categories of manual therapies, passive physical modalities, and acupuncture

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Intervention category	Definition
Manual therapies	
Manipulation	Manipulation includes techniques incorporating a high-velocity, low-amplitude impulse or thrust applied at or near the end of a joint's passive range of motion [13].
Mobilization	Mobilization includes techniques incorporating a low-velocity and a small- or large-amplitude oscillatory movement within a joint's passive range of motion [13,14].
Traction	Traction is defined as a manual or mechanically assisted application of an intermittent or continuous distractive force [15,16].
Soft tissue therapy	Soft tissue therapy is defined as a mechanical form of therapy where soft tissue structures are passively pressed and kneaded, using physical contact with the hand or mechanical device [17]. Soft tissue techniques using acupuncture points and exercise (such as active stretches) were not considered soft tissue therapy. Exercise is defined as any series of active movements aiming to train or develop the body by routine practice or physical training to promote good physical health [18]. We used this definition of exercise to exclude interventions that were not considered soft tissue therapy.
Passive physical modali	ties
Physicochemical	Physicochemical modalities have a common intention to treat using either a thermal or electromagnetic effect, including cold, heat, or light application affecting the body at the skin level, or light, ultrasonic, or electromagnetic radiation affecting structures beneath the skin. Examples of passive applications to the skin surface include but are not limited to heat applications (hot packs/compresses/pads, hydrotherapy, fluidotherapy) and cryotherapy (cold packs, ice massage, vapocoolant spray). Examples of passive applications affecting structures beneath the skin surface include but are not limited to low-level laser therapy, electrotherapy (transcutaneous electrical stimulation), electrogalvanic stimulation, electrical muscle stimulation, microcurrent, pulsed electromagnetic therapy, ultrasound, microwave, and ultrasonic shockwave therapy.
Structural	Structural modalities include non-functional assistive devices that may either encourage a state of rest in anatomical positions (eg, pillows, seat cushions) or actively inhibit or prevent movement (eg, collars, corsets, casts, slings, and rest splints). Functional assistive devices (eg, shoe orthotics, tenodesis splints, taping, and assistive braces) may align, support, or otherwise indirectly facilitate function in the affected region.
Acupuncture	
Acupuncture (all forms of acupuncture)	In accordance with the World Health Organization [19], we defined acupuncture 8 interventions as body needling (traditional, medical, modern, dry needling, trigger point needling, etc.), moxibustion (burning of herbs), electroacupuncture, laser acupuncture, microsystem acupuncture (such as ear acupuncture), and acupressure (application of pressure at acupuncture points).

Table 4		
Taxonomy of soft tissue therapies	[20]	

Principal goals of treatment	Relaxation massage	Clinical massage	Movement re-education	Energy work
Intention	Relax muscles, move body fluids, promote wellness	Accomplish specific goals such as releasing muscle spasms	Induce sense of freedom, ease, and lightness in body	Free energy blockages
Additional goals of treatment*	Nourish cells, remove wastes from cells, diminish pain, relax body	Focus on muscle or fascia, relieve pain and restricted motion, use focused therapeutic goals	Use movement to enhance posture, body awareness, movement, or function	Assist the flow of energy in the body
Commonly used styles (examples [†])	Swedish massageSpa massageSports massage	 Myofascial trigger point therapy Myofascial release Strain-counterstrain 	 Proprioceptive neuromuscular facilitation Strain-counterstrain Trager 	 Acupressure[§] Reiki Polarity Therapeutic touch Tuina
Commonly used techniques (examples [‡])	 Gliding Kneading Friction Holding Percussion Vibration 	 Direct pressure Skin rolling Resistive stretching Passive stretching Cross-fiber friction 	 Contract-relax Passive stretching Resistive stretching Rocking 	 Direction of energy Smoothing Direct pressure Holding Rocking Traction

* Additional goals of treatment were retrieved from the body of the paper by Sherman et al. [20].

[†] Whereas some styles of massage are commonly used in addressing one of the four principal treatment goals, some may be used to address several distinct treatment goals.

^{*} By varying the intent (or purpose) for a technique, many of them can be used in massages with different principal treatment goals.

[§] Acupressure was considered an acupuncture technique in our review (not a soft tissue therapy).

studies. A sample size of 30 is conventionally considered the minimum needed for non-normal distributions to approximate the normal distribution [12]. The assumption that data are normally distributed is required to ascertain a difference in sample means between treatment arms. We excluded the following: (1) guidelines, narrative reviews, letters, editorials, commentaries, unpublished manuscripts, dissertations, government reports, books and book chapters, conference proceedings, meeting abstracts, lectures and addresses, consensus development statements, guideline statements; (2) crosssectional studies, case reports, case series, qualitative studies, non-systematic and systematic reviews, biomechanical studies, laboratory studies, studies not reporting on methodology; (3) cadaveric or animal studies; or (4) studies already included in the Neck Pain Task Force report [5].

Information sources

We searched MEDLINE, Embase, CINAHL, PsycINFO, and Cochrane Central Register of Controlled Trials from January 1, 2000 to (1) March 21, 2013 for manipulation, mobilization, and traction; (2) February 27, 2014 for soft tissue therapy; (3) April 9, 2013 for passive physical modalities; and (4) January 31, 2013 for acupuncture. We developed four distinct search strategies with a health sciences librarian (Appendices A–D), which were reviewed by a second librarian using the Peer Review of Electronic Search Strategies (PRESS) Checklist [21].

The search strategy was first developed in MEDLINE and subsequently adapted to other bibliographic databases. The search terms included subject headings (eg, MeSH for MEDLINE) specific to each database and free text words relevant to WAD or NAD (grades I–III), manual therapies, passive physical modalities, and acupuncture. We used the EndNote X6 reference management software to create a database containing the search results [22].

Study selection

We used a two-phase screening process to select eligible studies. In Phase 1 screening, random pairs of independent reviewers screened citation titles and abstracts to determine the eligibility of studies. Phase 1 screening resulted in studies being classified as relevant, possibly relevant, or irrelevant. The same paired reviewers independently reviewed the manuscripts of possibly relevant studies in Phase 2 screening to make a final determination of eligibility. Reviewers met to resolve disagreements and reach consensus on the eligibility of studies. We involved a third reviewer if consensus could not be reached.

Assessment of risk of bias

Eligible studies were critically appraised by random pairs of independent, trained reviewers using the Scottish Intercollegiate Guidelines Network (SIGN) criteria for RCTs, cohort studies, and case-control studies [23]. All reviewers were trained in the evaluation studies using the SIGN criteria. Consensus between paired reviewers was reached through discussion, with an independent third reviewer if necessary. Authors were contacted if additional information was needed. After critical appraisal, studies with a low risk of bias were included in our evidence synthesis. The SIGN criteria were used to qualitatively evaluate the presence and impact of selection bias, information bias, and confounding on the results of a study. We did not use a quantitative score or a cutoff point to determine the internal validity of studies [24]. Rather, the SIGN criteria were used to assist reviewers in making an informed overall judgment on the internal validity of studies.

Specifically, we critically appraised the following methodological aspects of a study: (1) clarification of the research question; (2) randomization method; (3) concealment of treatment allocation, (4) blinding of treatment and outcomes, (5) similarity of baseline characteristics between or among treatment arms, (6) co-intervention contamination, (7) validity and reliability of outcome measures, (8) follow-up rates, (9) analysis according to intention-to-treat principles, and (10) comparability of results across study sites (where applicable). After critical appraisal, studies judged to have adequate internal validity were deemed scientifically admissible (ie, without high risk of bias) and were included in our data (results, evidence) synthesis.

Data extraction and synthesis of results

The lead author extracted data from studies with a low risk of bias to build evidence tables, and the data were independently checked by a second reviewer. Meta-analysis was not performed because of the heterogeneity of scientifically admissible studies with respect to patient populations, interventions, comparators, and outcomes. We performed a qualitative synthesis of findings from the studies with a low risk of bias to develop evidence statements using best evidence synthesis principles [25].

We stratified our results by the type of disorder (ie, WAD or NAD grades I–III) and duration (ie, recent [<3 months], persistent [\geq 3 months], and variable duration [study does not distinguish between recent and persistent]). To facilitate translation of evidence into clinically relevant findings, we stratified studies according to the IDEAL framework (exploratory vs. evaluation studies) [8,9]. Exploratory studies investigate the short-term efficacy (1–2 days) of interventions provided in one to two sessions.

Statistical analyses

We computed the inter-rater reliability for the screening of articles using the kappa coefficient (κ) and 95% confidence intervals (CI) [26]. We calculated the percentage agreement for classifying studies into low or high risk of bias following independent critical appraisal. To quantify the effectiveness of interventions, we used data from studies with a low risk of bias by computing the relative risk or difference in mean change and its 95% CI where this information was available. The computation of the 95% CI for the difference in mean change was based on the assumption that the pre- and post-intervention outcomes were highly correlated (r=0.8) [27,28]. We used standardized cutoff values to determine if clinically important changes were reached in each trial for common outcome measures. These include a between-group difference of 2 of 10 on the Numeric Rating Scale (NRS) [29], 10 of 100 mm on the Visual Analogue Scale (VAS) [30], and 5 of 50 on the Neck Disability Index (NDI) [30–32].

Reporting

This systematic review was organized and reported based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [33].

Results

Study selection

We screened 8,551 citations (Figure). Thirty-eight articles were critically appraised, of which 22 had a low risk of bias [34–55].

The following were the inter-rater agreement for screening of articles: (1) k=0.94 (95% CI: 0.90, 0.98) for manipulation, mobilization, and traction; (2) k=0.95 (95% CI: 0.91, 0.99) for soft tissue therapy; (3) k=0.91 (95% CI: 0.86, 0.97) for passive physical modalities; and (4) k=0.93 (95% CI: 0.84, 1.00) for acupuncture. The percentage agreement for article admissibility during independent critical appraisal was 84.2% (32 of 38).

Study characteristics

All 22 studies with a low risk of bias were RCTs (Table 5) [34–55]. Of these, we categorized 7 studies as exploratory studies [34,43,44,56–59] and 15 as evaluation studies [35–42,49–55]. Most studies (21 of 22) evaluated adults with NAD and one targeted adults with WAD [52].

Risk of bias within studies

All studies with a low risk of bias used clear research questions, appropriate randomization, valid and reliable outcome measures, and intention-to-treat analysis where applicable (Table 5). Most studies adequately fulfilled the following criteria: proper allocation concealment (20 of 22), proper blinding procedures where possible (20 of 22), and similarity at baseline across groups (17 of 22) [34–55]. The follow-up rate was above 75% in all but one study [38] (Table 5).

The main methodological limitations of studies with a high risk of bias included the following: poor or unknown randomization methods, poor or unknown allocation concealment, clinically important differences in baseline characteristics with no statistical adjustment in the analysis, likely attrition bias, and no report of intention-to-treat analysis [60–72]. We contacted the authors of five RCTs for additional information but none responded.



Figure. (A) Selection and critical appraisal of studies on the effectiveness of manipulation, mobilization, or traction for the management of neck pain. (B) Selection and critical appraisal of studies on the effectiveness of soft tissue therapy for the management of neck pain. (C) Selection and critical appraisal of studies on the effectiveness of passive physical modalities for the management of neck pain. (D) Selection and critical appraisal of studies on the effectiveness of acupuncture for the management of neck pain.

Summary of the evidence published after the Neck Pain Task Force report

Exploratory studies (Table 6) WAD

We found no exploratory studies with a low risk of bias for the management of WAD.

Grades I-II NAD of variable duration

A single strain-counterstrain session is no more effective than sham strain-counterstrain in patients with neck pain of 1 month to 5 years' duration [34]. Participants randomized to strain-counterstrain received passive neck positioning aimed to induce minimal-to-moderate muscle tension for 90 seconds. Sham strain-counterstrain involved digital pressure adjacent to the spinous process of C4 with 30° of passive neck rotation for 90 seconds. There were no between-group differences in neck pain intensity (Neck Pain Disability Scale), intensity, cervical motion, or self-perceived recovery [34].

Recent-onset grades I–II NAD

Thoracic manipulation is efficacious for the management of recent NAD grades I–II [44,45]. Masaracchio et al. reported that patients who received two sessions of thoracic manipulation reported clinically important improvements in neck pain (NRS), disability (NDI), and self-rated recovery compared with those randomized to two sessions of cervical mobilization and home exercise [44]. Similarly, Cleland et al. found that individuals who received two thoracic

Risk of bias for accepted randomized controlled trials on neck pain based on the Scottish Intercollegiate Guidelines Network (SIGN) criteria [23]

Author (year)	Research	Randomization	Concealment	Blinding	Similarity at baseline	Similarity between arms	Outcome	Percent dropout*	Intention to treat	Comparable results between sites
Cameron et al. (2011) [52]	Y	Y	Y	Y	N	CS	Y	6 mo:	Y	NA
	-	-	-			00	-	Electroacupuncture—0% Simulated acupuncture—8%	-	
Cleland et al. (2007) [56]	Y	Y	Υ	CS	Ν	CS	Y	2 to 4 d post-intervention: none	Y	CS
Dundar et al. (2007) [39]	Y	Y	CS	Y	Y	Y	Y	4 wk: 0% for both groups	NA	NA
Escortell-Mayor et al. (2011) [40]	Y	Y	Y	Y	Ν	CS	Y	Intervention completion: TENS—2.3% MMT—4.3% 6 mo: TENS—18.6% MMT—23.4%	Y	CS
Evans et al. (2012) [49]	Y	Y	Y	Y	Y	Y	Y	12 wk: ET+SMT—6.6%; ET—7.9%; HEA—5.6% 26 wk: ET+SMT—13.2%; ET—12.4%; HEA—15.6% 52 wk: ET+SMT—15.4%; ET—16.9%; HEA—14.4%	Y	NA
Fu et al. (2009) [53]	Y	Y	Y	Y	Y	Y	Y	Treatment group: 2/59=3.39% Control group: 3/58=5.17%	\mathbf{N}^{\dagger}	NA
Kanlayanaphotporn et al. (2009) [57]	Y	Y	Y	Y	Y	CS	Y	Immediately post-intervention: none	NA	NA
Kanlayanaphotporn et al. (2010) [58]	Y	Y	Y	Y	Y	Y	Y	Immediately post-intervention: none	NA	NA
Klein et al. (2013) [39]	Y	Y	Y	Y	Y	CS	Y	Post-intervention: SCS—0% Sham SCS—0%	Y	CS
Konstantinovic et al. (2010) [41]	Y	Y	Y	Y	Y	Y	Y	3 wk: LLLT—6.7% Placebo—0%	Y	NA
Kuijper et al. (2009) [42]	Y	Y	Y	CS	Y	Y	Y	6 wk: Collar—1.4%; PT—2.9%; control—1.5% 6 mo: Collar—8.7%; PT—2.9%; control—7.6%	Y	CS
Lauche et al. (2013) [49]	Y	Y	Y	Y	Y	Y	Y	Post-intervention: CM—13.3% PMR—9.7%	Y	NA
Leaver et al. (2010) [50]	Y	Y	Y	Y	Y	Y	Y	12 wk: Manipulation—2.2% Mobilization—3.3%	Y	CS
Liang et al. (2011) [54]	Y	Y	Y	Y	CS	Y	Y	At 3 mo: Acupuncture group—5/93=5.4% Placebo group—7/97=7.2%	\mathbf{N}^{\dagger}	NA

Author (year)	Research question	Randomization	Concealment	Blinding	Similarity at baseline	Similarity between arms	Outcome measures	Percent dropout*	Intention to treat	Comparable results between sites
Lin et al. (2013) [50]	Y	Y	CS	Y	Y	CS	Y	Post-intervention: LM—6.1% TCM—13.3%	Y	CS
Masaracchio et al. (2013) [44]	Y	Y	Y	Ν	Y	Y	Y	Immediately post-intervention: Experimental—2.9% Comparison—3.1%	Y	NA
Nagrale et al. (2010) [43]	Y	Y	Y	Y	Y	Y	Y	2 and 4 wk: INIT—0% MET—0%	Y	NA
Saavedra-Hernandez et al. (2012) [43]	Y	Y	Y	Y	Y	CS	Y	1 wk: Manipulation—10% Kinesio Taping—0%	Y	NA
Sherman et al. (2009) [48]	Y	Υ	Υ	Υ	Υ	CS	Y	4 wk: M+SCA—3% SCB—9% 10 wk: M+SCA—3% SCB—12% 26 wk: M+SCA—6% SCB—12%	Y	CS
Sillevis et al. (2010) [59]	Y	Y	Y	Y	Y	Y	Y	Immediately post-intervention: Manipulation—0% Placebo—2.0%	NA	NA
White et al. (2004) [55]	Υ	Υ	Υ	Υ	Υ	CS	Υ	4 wk: Acupuncture—7/70=10% Placebo—4/65=6% 8 wk: Acupuncture—11/70=15.7% Placebo—7/65=10.8% 6 mo: Acupuncture—13/70=18.6% Placebo—11/65=16.9% 12 mo: Acupuncture—16/70=23.1% Placebo—12/65=18.5%	Υ	Υ
Young et al. (2009) [51]	Y	Y	Y	Y	N	CS	Y	4 wk: Traction—13.3% Sham—16.7%	Y	CS

* Includes participant withdrawal and loss to follow-up; Y, yes; N, no; CS, can't say; NA, not applicable; CM, cupping massage; ET, exercise therapy; HEA, home exercise and advice; INIT, integrated neuromuscular inhibition technique; LLLT: low-level laser therapy; LM, Long's manipulation; M, massage; MET, muscle energy technique; MMT, multimodal therapy; PMR, progressive muscle relaxation; SCA, self-care advice; SCB, self-care book; SCS, strain-counterstrain; SMT, spinal manipulative therapy; TCM, traditional Chinese massage; TENS, transcutaneous electrical nerve stimulation.

[†] Although these studies did not perform an intention-to-treat analysis, no crossover between groups occurred in these studies [53,54].

Evidence table for accepted randomized controlled trials on manual therapies, passive physical modalities, and acupuncture for neck pain and associated disorders and whiplash-associated disorders

Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [‡]
Exploratory studies Cleland et al. (2007) [56]	Patients (18–60 years old) from primary care physicians to 1 of 5 outpatient orthopedic physical therapy clinics in the United States (NH, MA, CO, MN, CA) between June 2005 and July 2006 Case definition: neck pain (NDI score>10%) with or without unilateral upper extremity symptoms (N=60); x=56 d	Thrust mobilization/ manipulation by physical therapists: thrust to upper thoracic (T1–T4) and mid-thoracic spine (T5–T8) spine, general cervical mobility exercise, usual activities, current medication (N=30)	Non-thrust mobilization/ manipulation provided by trained physical therapists: 30-s grade III or IV central posterior- anterior non-thrust (T1–T6), general cervical mobility exercise, usual activities, current medication (N=30)	2–4 d after one intervention	Primary outcome: Disability (NDI: 0–100%) Secondary outcomes: Pain (NPRS: 0–10), self-perceived Global rating of change (GROC) –7 to 7 Adverse events	 Statistically significant mean difference (thrust mobilization/manipulation—non-thrust mobilization/manipulation): Disability: 10.03% (95% CI: 5.3,14.7) Pain: 2.03 (95% CI: 1.4, 2.7) GROC: 1.5 (95% CI: 0.48, 2.5) (50% in manipulation group reported moderate change in status vs. 10% in mobilization group) No serious side effects About 30% patients in both groups experienced mild-moderate side effects lasting <24 h. OR of experiencing side effect for manipulation=1.17(95% CI: 0.39, 3.47)
Kanlayanaphotporn et al. (2009) [57]	Patients (20–70 years old) Case definition: unilateral mechanical neck pain ≥1 wk Neck pain at rest >20 on 100 mm VAS (N=60); x=804 d	Preferred mobilization by physical therapist (1 session): unilateral PA pressure, ipsilateral to pain (N=30)	Random mobilization by physical therapist (1 session): mobilizations randomly directed pressure (ie, central PA, ipsilateral unilateral PA, or contralateral unilateral PA) to the cervical spine (N=30)	5 min after treatment	Primary outcome: Pain (VAS score: 0–100), active CROM, global perceived effect: 1–7 Adverse events	No significant difference in pain, active CROM, with the exception of flexion, and global perceived effect between groups Mean difference (preferred—random mobilization) Active CROM in flexion: 2.6° (95% CI: 0.38, 4.83) No reported adverse events
Kanlayanaphotporn et al. (2010) [58]	Patients (20–70 years old) Case definition: non- specific pain, exacerbated by neck movements or by sustained neck postures Neck pain at rest >20 on 100 mm VAS (N=60); x=1,575 d	Central PA mobilization by physical therapists (1 session): PA pressure over the spinous process of the cervical vertebra (N=30)	Random mobilization by trained physical therapist (1 session): mobilizations randomly directed pressure (ie, central PA, right unilateral PA, or left unilateral PA (N=30)	5 min after treatment	Primary outcome: Pain (VAS 0–100); active CROM (assessed with CROM device); global perceived effect Adverse events	 No significant differences between groups in neck pain at rest or CROM, except for pain intensity on most painful movement: Mean difference (central PA mobilization—random mobilization): pain intensity on the most painful movement: 9.2 (95% CI: 0.3, 18.0) No difference between groups in patients rating of global perceived effect No adverse events reported

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Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [‡]
Klein et al. (2013) [39]	Adults (18–65 years old) with acute non-specific neck pain referred from private general practice in Bavaria, Germany between February and August 2011 (N=61) Case definition: acute episode of non-specific neck pain and cervical joint restrictions	Strain-counterstrain by GP (1 session): neck positioned by therapist away from restricted cervical segment for 90 s then slowly repositioned to neutral (N=30)	Sham strain- counterstrain by GP (1 session): neck passively rotated 30° to the left and held for 90 s as therapist placed finger slightly right of the C4 spinous process; neck then slowly repositioned to neutral (N=31)	Immediately after intervention	Primary outcome: Cervical motion (goniometer) Secondary outcomes: Neck pain intensity (from NPDS), self- perceived global assessment (much worse, slightly worse, unchanged, slightly better, much better) Adverse events	 No statistically significant difference between groups for neck pain intensity or cervical motion Self-perceived recovery (strain-counterstrain vs. sham): Slightly worse: 3% versus 3% Unchanged: 37% versus 55% Slightly better: 53% versus 36% Much better: 7% versus 7% Mild transient adverse events reported (ie, pain or dizziness): Strain-counterstrain: 13.3% Sham: 3.2%
Masaracchio et al. (2013) [44]	Patients (18–60 years old) who presented to physical therapy or volunteered from 2009 to 2011 Case definition: neck pain (<3 mo) without symptoms distal to the shoulder, NDI≥20% (N=66)	Thoracic thrust manipulation+ cervical non- thrust manipulations and home exercises by physical therapist (2 sessions): 2 thrust manipulations to the upper and 2 to mid-thoracic spine Non-thrust cervical manipulation and home exercises same as comparison group (N=34)	Cervical non-thrust manipulation and home exercises by physical therapist (2 sessions): cervical non-thrust oscillating manipulation and instruction on active neck ROM exercises at home (N=32)	2–3 d after intervention	Neck pain (NPRS: 0–10); disability (NDI: 0–50); global rating of change (GROC: –7 to 7) Adverse events	Statistically significant mean differences between groups (experimental minus comparison)* Neck pain: 1.5 (95% CI: 1.06, 1.94) Disability: 8.8 (95% CI: 6.21, 11.39) GROC: 2.0 (95% CI: 1, 3) No adverse events reported other than soreness that resolved 24–48 h after treatment

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Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [‡]
Saavedra-Hernández et al. (2012) [43]	Patients (18–55 years old) with idiopathic mechanical neck pain referred to a physical therapy clinic in Almeria, Spain (N=80) Case definition: mechanical neck pain defined as generalized neck or shoulder pain provoked by sustained neck postures, neck movement, or palpation of cervical musculature	Kinesio Taping: tape applied over the cervical extensors from T1–T2 to C1–C2 spinal segments after initial examination for 7 d (N=40)	Cervical manipulation (SMT): one applied to the mid-C/S and one to the C/T junction after initial examination (N=40)	7 d	Primary outcome: Neck pain intensity (NPRS) Secondary Outcomes: Disability (NDI); CROM (goniometer) Adverse events	No difference between groups for pain, disability, cervical flexion, extension, and right or left lateral flexion Difference in mean change (degree) for range of motion (tape–SMT)*: Right rotation: 6.8 (95% CI: 3.39, 10.21) Left rotation: 6.9 (95% CI: 3.35, 10.46) No serious adverse events: 7.5% of SMT group had minor increase in neck pain or fatigue 5% of taping group had cutaneous irritation
Sillevis et al. (2010) [59]	Patients (18–65 years old) recruited from five outpatient physical therapy clinics in the United States in 2008 Case definition: non- specific pain (≥3 mo) in cervical and cervicothoracic region down to T4, provoked with neck movements (N=108)	High velocity mid- range thoracic manipulation by physical therapist (1 session): applied manipulative force to a closed hand contact at the upper thoracic spine (T3-T4) (N=50)	Placebo thoracic manipulation by physical therapist (1 session): applied manipulative force to an open hand contact at the upper thoracic spine (T3– T4) (N=51)	Immediately post- intervention	Primary outcome: Pain (VAS) Secondary outcome: pupillometric measure (Friedman test)	No statistically significant differences between groups for pain No statistically significant change in pupil diameter in manipulation group; however, statistically significant change in placebo group over time

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Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [‡]
Evaluation studies Cameron et al. (2011) [52]	Participants (18–65 years old) recruited through newspaper in Australia (N=124) Case definition: WAD grades I–II (>1 mo duration)	Real electroacupuncture (RE) by acupuncturist (2 30-min sessions per week for 6 wk): bilaterally selected treatment points to GB 39, GB 20, LI 14 and S I6 Electrical output: Frequency=2– 5 Hz, intensity=1.5 volts, needles at two acupuncture points in the cervical area, wrists and ankles	Simulated electroacupuncture (SE) by same acupuncturist (2 30-min sessions per week for 6 wk): similar procedures as RE but treatment points 20 to 30 mm away from selected points Electrical output inactivated (N=60)	3 and 6 mo	Primary outcomes: pain intensity (VAS), disability (NDI), HRQoL (SF-36) Secondary outcomes: restriction in activities of daily living (VAS), pain rating index (total of the Short-Form McGill Pain Questionnaire) Adverse events	At 3 mo Mean difference (RE—SE) Pain: 0.4 (95% CI: 0.3, 1.0) Restriction in activities of daily living: 0.5 (95% CI: 0.1, 1.0) No statistically significant difference in disability, HRQoL, and pain rating index <u>At 6 mo</u> Mean difference (RE—SE) Pain : 0.6 (95% CI: 0.1, 1.2) Restriction in activities of daily living: 0.6 (95% CI: 0.1, 1.1) No statistically significant difference in disability, HRQoL, and pain rating index Adverse reactions: No serious adverse events RE: 6.3%; SE: 3.3%
Dundar et al. (2007) [39]	Patients (20–60 years old) with chronic cervical MPS (N=64) Case definition: Cervical myofascial pain based on the major and minor criteria of Simons et al.	Low-level (Ga-As- Al) laser therapy (LLLT) by physiotherapist (15 sessions/ 3 wk) pulse frequency=1000 Hz dose=7 J/point, wavelength=830- nm, power=58 mW/cm ² , time=2 min each point; daily cervical isometric and stretching exercises supervised by a physiotherapist (N=32)	Placebo: low-level gallium arsenide aluminum (Ga-As- Al) laser therapy applied by same physiotherapist in , the same manner as LLLT group; daily cervical isometric and stretching exercises supervised by a physiotherapist (N=32)	4 wk	Pain at rest, movement, and at night (VAS); active CROM (inclinometer and goniometer); disability (NDI)	No clinical or statistical difference between groups for any outcomes at 4 wk

Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [‡]
Escortell-Mayor et al. (2011) [40]	Patients (18–60 years old) with subacute or chronic mechanical neck disorders treated in 12 primary health- care physiotherapy units in Madrid, Spain from May 2005 to May 2007 (N=90) Case definition: subacute or chronic mechanical neck disorders based on Quebec Task Force classification—grades I–II	Transcutaneous electrical nerve stimulation (TENS) by physical therapists (ten 30-min sessions on alternate days) at 80 Hz, \leq 150 µs pulse duration; home program of postural skills and exercises (N=43)	Multimodal therapy by physical therapists (ten 30- min sessions on alternate days): neuromuscular technique, post- isometric stretching, spray and stretch, and Jones technique; home program of postural skills and exercises (N=47)	Post-intervention, 6 mo	Primary outcome: Pain intensity (VAS) Secondary outcomes: Disability (NDI), health-related quality of life (SF- 12) Adverse events	No difference between groups for pain, disability, or health- related quality of life in the short or medium term No significant adverse events
Evans et al. (2012) [49]	Residents from Minnesota (18–65 years old) Case definition: NAD grades I/II (≥12 wk) and neck pain intensity ≥3/10 (N=270)	SMT by chiropractor+ exercise therapy (ET) supervised by exercise therapist: 20 sessions over 12 wk ET: high-dose strengthening exercise program SMT: cervical and thoracic spine (max: 5-min light soft tissue massage if necessary) (N=91)	Home exercise with advice (HEA) by physical therapists with in-person (two 1-h sessions): individualized program of neck and shoulder self- mobilization; education and advice regarding posture and daily activities (N=90) ET: same as intervention group; 20 sessions in 12 wk (N=89)	4, 12, 26, and 52 wk	Primary outcome: Pain: (NRS) Secondary outcomes: disability (NDI); med use; global perceived effect; quality of life (SF- 36); satisfaction; additional care visits; change expectations in neck pain; ROM and strength Adverse event	No statistically significant differences between SMT+ET and ET in pain, disability, quality of life scores, global perceived effect, medication use, and satisfaction at each assessment period at 12 and 52 wk No statistically significant differences in CROM and strength except for static flexion endurance at 12 wk: 62.7 (95% CI: 32.6, 158.1) Additional health care reported at 52 wk: ET+SMT: 25.3%; ET: 25.8% Non-serious adverse events (mild and transient): ET+SMT: 98.9%; ET: 96.6%; HEA: 33.3% Moderate adverse event in 1 patient in ET group

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disability

Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [*]
Fu et al. (2009) [53]	Patients (18–60 years old) diagnosed in a Guangzhou hospital, China (N=117) Case definition: cervical spondylosis according to "Standard for diagnosis and efficacy evaluation of traditional Chinese medicine syndromes and diseases" ≥6 mo duration	Acupuncture (nine 20-min sessions/ 18 d): selected acupuncture points DU14, Ex-HN15, and SI15, and needles manipulated to Deqi, infrared radiation provided (N=59)	Sham acupuncture (nine 20-min sessions/18 d): sham points 1 cm lateral to Ex-HN15 and SI15, needles inserted superficially without manipulation; infrared irradiation provided (N=58)	18 d (post- intervention), 1 and 3 mo	Outcomes: disability (NPQ), pain intensity (VAS)	Post-interventionMean difference (acupuncture—sham acupuncture)*Neck disability: 5.46 (95% CI: 2.54, 8.38)Pain: 0.51 (0.09, 0.93) <u>1 mo</u> Mean difference (acupuncture—sham acupuncture)*Neck disability: 6.51 (95% CI: 3.52, 9.50)Pain: 0.48 (95% CI: 0.08, 0.88) <u>3 mo</u> Mean difference (acupuncture—sham acupuncture)*Neck disability: 5.64 (95% CI: 2.51, 8.77)Pain: -0.05 (95% CI: -0.45, 0.35)Adverse events not reported
Konstantinovic et al. (2010) [41]	Patients with acute neck pain and unilateral radiculopathy (<4 wk and ≤3 previous episodes) treated at the Belgrade University Rehabilitation Clinic in Serbia from January 2005 to September 2007 (N=60) Case definition: unilateral radiculopathy defined as neck or unilateral arm pain with neurologic signs, moderate/severe	Low-level laser therapy (LLLT) by therapist (5 times/wk over 3 wk): 1 cm ² diode surface; wavelength=905 m frequency=5000 H power density=12 mW/ cm ² ; intensity=2 J/cm ² ; duration=120 s/ trigger point over 6 points (N=30)	Placebo: inactive LLLT applied by the same therapist in the same manner as LLLT group (N=30) m; z;	3 wk	Primary outcome: Neck and arm pain intensity (VAS) Secondary outcomes: Disability (NDI); health-related quality of life (SF- 12); neck mobility (mm) Adverse events	 Difference in mean change at 3 wk (LLLT—Placebo)*: Neck pain (VAS): 4.49 (95% CI: 0.70, 8.28) Arm pain (VAS): 5.09 (95% CI: 3.07, 7.11) Disability (NDI): 4.71 (95% CI: 2.80, 6.62) PCS (SF-12): -0.90 (95% CI: -1.37, -0.43) Adverse events: LLLT group: transitional worsening pain: 20%; persistent nausea: 3.33%; increased blood pressure: 3.3% Placebo group: no adverse events

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Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [‡]
Kuijper et al. (2009) [42]	Patients (18–75 years old) with cervical radiculopathy (<1 mo)from 3 Dutch hospitals (N=205) Case definition: Acute cervical radiculopathy with arm pain (>40/100 VAS score) reproduced by neck movements (≥1 time), or sensory changes, diminished deep tendon reflexes, or muscle weakness	Cervical collar: rest and a semi-hard cervical collar during the day for 3 wk, then weaned off during weeks 3–6; pain killers allowed (N=69)	Physiotherapy (PT): 2×/wk for 6 wk; (standardized graded neck strengthening exercises; education to do home exercises) (N=70) Wait and see: advice to continue daily activities (N=66) All patients were allowed to use pain killers	3 wk, 6 wk, and 6 mo	Primary outcomes: neck pain intensity (VAS), arm pain intensity (VAS), disability (NDI) Secondary outcomes: treatment satisfaction, opioid use, work status	Arm pain (VAS) Differences in mean changes (collar—control):* 3 wk: 6.2 (95% CI: 0.63, 11.77) 6 wk: 12.5 (95% CI: 5.97, 19.04) Neck pain (VAS) Differences in mean changes (collar—control)* 3 wk: 18.8 (95% CI: 12.40, 25.20) 6 wk: 21.9 (95% CI: 12.40, 25.20) 0 wk: 21.9 (95% CI: 15.45, 28.35) Disability (NDI) Differences in mean changes (collar—control)* 6 wk: 5.2 (95% CI: 1.13, 9.27) No significant difference in disability (collar-control) at 3 wk* No significant differences in disability and arm or neck pain (collar-PT) at 3 or 6 wk* No significant difference between groups for median arm pain, neck pain, or disability at 6 mo No significant differences between groups for treatment satisfaction, NSAID use, opioid use, or sick leave at 3

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and 6 wk

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Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [‡]
Lauche et al. (2013) [49]	Patients (18–75 years old) with persistent neck pain (≥3 mo) were recruited via a local newspaper advertisement in Essen, Germany between December 2011 and May 2012 (N=61) Case definition: persistent non-specific neck pain occurring a minimum of 5 d/wk with an intensity of ≥45 mm on VAS	Cupping massage (CM) instructed by experienced teacher (taught during one workshop) and done by partner at home twice a week for 12 wk (10–15 min each): cupping massage technique using cupping glass and massage oil; could attend refresher session; given written information (N=30)	Progressive muscle relaxation (PMR) instructed by a psychologist (PMR taught during a 1-h session); 2 independent home sessions/wk for 12 wk): aimed to achieve deep relaxation, relieve muscle tension, and improve general well-being; given written information and CD on relaxation training (N=31)	Post-intervention (12 wk)	Primary outcomes Pain (VAS, 100 mm), affective perception of pain (pain description list [SBL]), neck- related disability (NDI), psychological distress (HADS; anxiety: 0–21; depression: 0–21); health-related quality of life (SF- 36), stress perception (PSQ- 20), locus of control beliefs (health-related control beliefs), psychological well- being (FEW16), pressure pain threshold (digital algometer, increments of 40 kPa/s	 Difference in mean change at post-intervention (CM—PMR)[†]: Disability (NDI—out of 50): -2.18 (-4.56, -0.21) Psychological outcomes: Stress resistance (FEW16): 1.76 (95% CI: 0.01, 3.50) Vitality (FEW16): 1.76 (95% CI: 0.01, 3.50) Inner peace (FEW16): 1.60 (95% CI: -0.26, 2.94) Pressure pain threshold at site of maximum pain (algometer): 63.55 (95% CI: 6.33, 121.56) No statistically significant difference in mean change between groups post-intervention for the outcomes pain, pain at motion, pain perception, days of interference in the past 3 mo, interference in daily life, anxiety, depression, and quality of life Adverse events: No adverse events reported in PMR group Three patients reported adverse events in CM group: muscular tension and pain (3.3% or 1/30); pain in shoulder area (3.3% or 1/30); prolapsed intervertebral disc (3.3% or 1/30—considered serious but not a consequence of cupping massage)

Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [‡]
Leaver et al. (2010) [50]	Patients (18–70 years old) recruited from 12 private physiotherapy, chiropractic, and osteopathy clinics in Sydney, Australia from 2006–2008 Case definition: recent onset of neck pain (≥2 NRS) for <3 mo and preceded by 1 mo without neck pain (N=182)	Neck manipulation by physiotherapist, chiropractor, or osteopath: manual high- velocity, low- amplitude thrust techniques directed at the cervical joints; 4 treatments over 2 wk unless recovery occurred or serious adverse event; advice, reassurance, or continued exercise program as indicated (N=91)	Neck mobilization by physiotherapist, chiropractor, or osteopath: manual low-velocity oscillating passive movement directed at the cervical joints; 4 treatments over 2 wk unless recovery occurred or serious adverse event; advice, reassurance, or continued exercise program as indicated (N=91)	2, 4, and 12 wk	Primary outcome: Time to recovery (7 consecutive days with NRS <1/10) Secondary outcomes: Time to recovery of normal activity (7 consecutive days with no activity interference), pain (NRS), disability (NDI), function (Specific Functional Scale), global perceived effect, quality of life (SF-12) Adverse events	No statistically significant difference in Kaplan-Meier recovery curves between groups for recovery from neck pain and recovery of normal activity No statistically significant differences between groups for pain, disability, function, global perceived effect, or health-related quality of life at any follow-up point No serious neurovascular events No statistically significant differences in incidence of minor adverse effects between groups Minor adverse events of increased neck pain (29.4% of subjects) and headache (22.0% of subjects)

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Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [*]
Liang et al. (2011) [54]	Participants (18–60 years old) recruited from leaflet dissemination in Guangzhou, China (N=190) Case definition: neck pain or stiffness in neck and shoulder (>once per month for ≥6 mo) and neck pain between 3 and 7 of 10	Traditional acupuncture (TA) by acupuncturists (nine 20-min sessions/3 wk): acupuncture points DU14, S115, and Ex- HN15 bilaterally, needles manipulated, infrared irradiation on the cervical region (N=93)	Sham acupuncture (SA) by acupuncturists (nine 20-min sessions/3 wk): sham points 1 cm lateral to selected acupuncture points, no needle manipulation; infrared irradiation on the cervical region (N=97)	Immediately, 1 mo and 3 mo post- intervention	Primary outcomes: disability (NPQ), pain intensity (VAS) Secondary outcome: HRQoL (SF-36) Adverse events	Immediately after 3-wk intervention Mean difference (TA–SA)* NPQ: 3.03 (95% CI: 0.89, 5.17) VAS: 0.34 (95% CI: 0.02, 0.66) Vitality: 2.35 (95% CI: 0.03, 4.67) Social functioning: 2.55 (95% CI: -0.63 , 5.72) Mental health: 2.55 (95% CI: -0.02 , 5.12) No statistically significant difference in other domains in SF-36 1 mo after 3-wk intervention Mean difference (TA–SA)* NPQ: 3.85 (95% CI: 1.72, 5.98) VAS: 0.41 (95% CI: 0.11, 0.71) Vitality: 3.69 (95% CI: 1.38, 6) Social functioning: 6.79 (95% CI: 3.63, 9.95) Mental health: 0.55 (95% CI: -2.04 , 3.14) No statistically significant difference in other domains in SF-36 3 mo after 3-wk intervention Mean difference (TA–SA)* NPQ: 4.14 (95% CI: 1.89, 6.39), VAS: 0.12 (95% CI: -0.18, 0.42) Vitality: 3.36 (95% CI: 1.03, 5.69) Social functioning: 2.58 (95% CI: -0.56, 5.72) Mental health: 1.5 (95% CI: -1.11, 4.1) No statistically significant difference in other domains in SF-36 Adverse reactions: No serious adverse events Fainting: TA–3.2%; PA–4.1% Numbness and aching: TA–4.3%; PA–2%

[43]

with non-specific neck

pain (<3 mo) referred

providers or recruited

through advertising in

newspapers and health

between June 2007 and

April 2008 (N=60)

specific neck pain

(<3 mo) and active

trapezius muscle

trigger points in upper

by health-care

magazines in

Dhamtari, India

Case definition: non-

(Continued)						
Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [‡]
Lin et al. (2013) [50]	Adults (18–65 years old) with mechanical neck pain (>3 mo) recruited from an outpatient clinic in Hong Kong between February 2011 and March 2012 (N=63) Case definition: mechanical neck pain without neurologic or vascular deficit, restriction of movement of a motion segment, possible discomfort with joint challenge/pressure, abnormal changes of cervical curve and alignment on radiographs	Long's manipulation (LM) and traditional Chinese massage (TCM) by manual therapist (1 session every 3 d for 8 sessions total, 20 min each): a high- velocity, low- amplitude manipulation to the cervical spine; traditional Chinese massage was the same as comparison group (N=33)	Traditional Chinese massage (TCM) by manual therapist (1 session every 3 d for 8 sessions total, 20 min each): relaxation massage to release tension or spasm, followed by provocative massage techniques (pinching, plucking), then gentle massage techniques (stroking, rubbing) to the neck (N=30)	Immediately after intervention, 3 mo	Neck pain (Northwick Park Neck Pain Questionnaire: 0–100), pain intensity (NPRS: 0–10), craniovertebral angle (electronic head posture instrument), CROM, perceived satisfaction (11- point scale) Adverse events	Difference in mean change (LM–TCM) immediately after intervention [†] : NPQ (out of 100): 8.65 (95% CI: 4.13, 13.17) NPRS (out of 10): 2.14 (95% CI: 1.55, 2.73) Satisfaction (out of 10): 1.16 (95% CI: 0.63, 1.69) No statistically significant differences in craniovertebral angle or cervical ranges of motion between groups immediately after intervention No serious adverse events reported except increased neck pain reported by 1 patient receiving TCM (3%)
Nagrale et al. (2010)	Adults (18-55 years old)	Integrated	Muscle energy	2 wk, 4 wk post-	Outcomes:	Difference in mean change (INIT-MET) at 2 wk [†] :

technique (MET)

upper trapezius (3

sessions/wk for 4

positioning of neck

away from affected

by therapist to

wk): passive

muscle, then

submaximal

contraction of

trapezius for 7-10 s

practitioner's hand;

stretched passively for 30 s, 3–5

repetitions (N=30)

isometric

against

muscle then

intervention

Neck pain intensity

(VAS 10 cm),

lateral flexion

of 50)

degrees of cervical

(goniometer), neck

disability (NDI out

neuromuscular

technique (INIT)

by therapist to

upper trapezius

(3 sessions/wk

compression over

trigger points

 $(\leq 90 \text{ s})$, strain-

counterstrain

pressure over

trigger points for

20-30 s with 3-5

repetitions, and MET same as

comparison group (N=30)

with digital

for 4 wk):

ischemic

inhibition

Difference in mean change (INIT–MET) at 2 wk^{\dagger}: Neck pain intensity (out of 10): 0.73 (95% CI: 0.52, 0.93) Cervical lateral flexion: 3.13 (95% CI: 2.65, 3.61) Neck disability (out of 50): 4.72 (95% CI: 2.76, 6.68) Mean difference (INIT–MET) at 4 wk^{\dagger}: Neck pain intensity (out of 10): 0.98 (95% CI: 0.78, 1.18) Cervical lateral flexion: 5.18 (95% CI: 4.69, 5.67) Neck disability (out of 50): 4.75 (95% CI: 2.82, 6.68)

Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [‡]
Sherman et al. (2009) [48]	Patients (20–64 years old) with persistent neck pain and who received primary care for neck pain at least 3 mo prior, enrolled in Group Health in Washington State and Idaho, United States (N=64) Case definition: persistent neck pain (>12 wk and ≥3/10 on bothersome scale)	Massage and self- care advice by licensed massage practitioners (maximum 10 sessions over 10 wk): massage included a variety of Swedish and clinical massage techniques; self- care advice included advice to exercise and drink more water (N=32)	Self-care book sent by mail: "What to do for a pain in the neck" with information on neck pain causes, neck-related headache, whiplash, exercises, posture, conventional and complementary treatment, first aid for intermittent flare-ups (N=32)	4, 10, and 26 wk after randomization	Primary outcomes: Neck disability (NDI out of 50), symptom bothersomeness (NRS 0–10) Secondary outcomes: Neck functional disability (Copenhagen Neck Functional Disability Scale: 0–30), health- related quality of life (SF-36), medication use in the last week, self- perceived global improvement (7- point Likert scale from completely gone to much worse) Adverse events	At 4 wk Difference in mean change (massage–self-care book) [†] : Neck disability (out of 50): 2.1 (95% CI: 0.03, 4.0) Symptom bothersomeness (out of 10): 1.6 (95% CI: 0.7, 2.5) Neck functional disability (out of 30): 1.6 (95% CI: -0.24, 3.4) <u>At 10 wk</u> Difference in mean change (massage–self-care book) [†] : Neck disability (out of 50): 2.3 (95% CI: -0.15, 4.7) Symptom bothersomeness (out of 10): 1.2 (95% CI: -0.1, 2.5) Neck functional disability (out of 30): 0.7 (95% CI: -0.15, 2.8) <u>At 26 wk</u> Difference in mean change (massage–self-care book) [†] : Neck disability (out of 50): 1.9 (95% CI: -0.63, 4.4) Symptom bothersomeness (out of 10): 0.14 (95% CI: -1.2, 1.5) No statistically significant difference between groups for quality of life Medication use (baseline to 26 wk): Massage: no change Self-care book: increased by 14% RR for improvement of ≥5 points on NDI with massage: 4 wk: 5.1 (95% CI: 0.97, 3.5) 26 wk: 1.8 (95% CI: 0.97, 3.5) RR for improvement of >30% on symptom bothersomeness with massage: 4 wk: 4.7 (95% CI: 1.0, 4.2) 26 wk: 1.1 (95% CI: 0.7, 2.0) RR for 'better' or 'much better' on global improvement with massage: 4 wk: 8.5 (95% CI: 2.0, 35.4) 10 wk: 2.2 (95% CI: 1.1, 4.5) 26 wk: 1.8 (95% CI: 0.7, 3.5) RR for ibetter' or sported non-disruptive mild adverse experiences likely attributable to massage (<i>Continued</i>)

(Continued)

Author(s) (year)	Setting and subjects, number (N) enrolled	Interventions, number (N) of subjects	Comparisons, number (N) of subjects	Follow-up	Outcomes	Key findings [‡]
White et al. (2004) [55]	Patients (18–80 years old) referred by rheumatologists, family physicians, or physiotherapy waiting lists in the United Kingdom (N=135) Case definition: chronic neck pain (>2 mo and >30/100 in VAS)	Western acupuncture (two 20-min sessions/ wk/4 wk): acupuncture points selected according to pain distribution and palpitation of <i>ah-shi</i> or tender points, needle manipulation, acetaminophen allowed for pain relief (N=70)	Placebo electroacupuncture by same practitioner (two 20-min sessions/wk over 4 wk): inactivated electroacupuncture stimulator, points selected in the same manner as acupuncture group, acetaminophen allowed for pain relief (N=65)	1 wk, 8 wk, 6 mo, and 12 mo post- intervention	Primary outcome: Average pain at 1-wk post-treatment (daily pain diary; VAS) Secondary outcomes: Pain (VAS) at various time points, disability (NDI), HRQoL (SF-36), acetaminophen use (diary) Adverse events	Mean difference in pain (acupuncture-placebo)*: 1 wk post-intervention: 5.79 (95% CI: 1.32, 10.26) 8 wk post-intervention: 1.39 (95% CI: -2.77, 5.55) No significant differences between groups in average weekly pain at 6 mo or 12 mo post-intervention No significant differences between groups in disability, HRQoL, or acetaminophen use at 1 wk, 8 wk, 3 mo, or 6 mo post-intervention Adverse reactions: No serious adverse events Acupuncture—11.4% ; placebo—12.3%
Young et al. (2009) [51]	Patients (18–70 years old) recruited from orthopedic physical therapy clinic in the United States Case definition: cervical radiculopathy of unspecified duration diagnosed through positive tests of clinical prediction rule (N=81)	Posture education, manual therapy, exercise, home exercise, and intermittent cervical traction (average of 7 visits), provided by trained physical therapists (N=45)	Posture education, manual therapy, exercise, home exercise, and sham intermittent cervical traction, provided by trained physical therapists (N=36)	2, 4 wk	Primary outcomes: Neck disability (NDI), activity limitations (Patient-Specific Functional Scale), pain (NPRS) Secondary outcomes: GROC, type and location of symptoms (pain diagram), fear and avoidance beliefs (Fear-Avoidance Beliefs Questionnaire), patient satisfaction, grip strength	No significant differences between groups for primary and secondary outcome measures with or without addition of cervical traction

CI, confidence interval; CM, cupping massage; GP, general practitioner; INIT, integrated neuromuscular inhibition technique; LM, Long's manipulation; MET, muscle energy technique; NDI, Neck Disability Index; NPDS, Neck Pain Disability Scale; PMR, progressive muscle relaxation; RR, relative risk; SCA, self-care advice; SF-36, Short-Form-36; TCM, traditional Chinese massage; VAS, visual analogue scale; SMT, spinal manipulative therapy; ROM, range of motion; NRS, Numeric Rating Scale; ET, exercise therapy; WAD, whiplash-associated disorders; CROM, cervical range of motion.

[†] Recalculated data from study.

* Statistically or clinically significant results were reported.

manipulations had clinically important reductions in neck pain (NRS) and disability (NDI) compared with those treated with thoracic mobilization [45].

Persistent grades I-II NAD

The type of neck mobilization has little impact on the outcomes of patients with persistent NAD grades I–II [46,47]. In patients with persistent unilateral neck pain, there were no differences in pain (VAS) or range of motion (ROM) immediately after one session of targeted cervical mobilization targeted to the symptomatic side compared with one session of non-targeted cervical mobilization [46]. Similarly, patients receiving central posterior-anterior cervical mobilization had statistically significant but not clinically important reductions in pain (VAS) compared with those receiving randomly directed mobilization [47]. Moreover, there were no post-intervention differences in cervical ROM or global perceived recovery [47].

The efficacy of spinal manipulation for the management of persistent NAD grades I–II is unclear. There were no clinically or statistically significant differences in pain intensity (NRS), disability (NDI), and ROM outcomes between administration of one mid-cervical and one cervicothoracic manipulation, and a 7-day application of Kinesio Tape over the cervical extensors [43]. Finally, one session of upper thoracic manipulation and placebo thoracic manipulation (applied manipulative force to an open hand contact at the upper thoracic spine) provides similar outcomes for pain (VAS) in patients with persistent NAD grades I–II [48].

Evaluation studies (Table 6)

Grades I-II WAD of variable duration

A 6-week course of needle electroacupuncture or simulated electroacupuncture provides similar disability (NDI) and health-related quality of life (Short-Form-36 [SF-36]) outcomes for WAD grades I–II [52]. Needle electroacupuncture led to statistically but not clinically significant changes in pain intensity (VAS) at 3- and 6-month follow-up [52]. Electroacupuncture involved needle electroacupuncture at specific points, whereas simulated electroacupuncture involved deactivated electroacupuncture on needled points 20 to 30 mm away from these specific points.

Recent-onset grades I–II NAD

In comparing a course of neck manipulation and neck mobilization (four treatments over 2 weeks) for recent NAD grades I–II, there were no differences in pain (NRS), disability (NDI), and health-related quality of life (SF-12) immediately and up to 12 weeks post-intervention for recent NAD grades I–II [50].

A soft tissue therapy intervention combining ischemic compression, strain-counterstrain, and muscle energy technique is associated with statistically but not clinically significant differences in pain (VAS), disability (NDI), and lateral flexion compared with muscle energy technique alone [35]. One group received integrated neuromuscular inhibition technique (ie, ischemic compression, strain-counterstrain, and muscle energy technique) to the upper trapezius, whereas the other group received muscle energy technique alone to the upper trapezius.

Persistent grades I–II NAD

The effectiveness of spinal manipulation may be dependent on the treatment modalities that are provided with manipulation. Adding cervical and thoracic manipulation to a high-dose supervised exercise program provides no additional improvement in pain, disability (NDI), global perceived effect, ROM, strength, or satisfaction up to 52 weeks post-intervention in patients with persistent NAD grades I–II [49]. Cervical manipulation with traditional Chinese massage is superior to traditional Chinese massage (relaxation, provocative, and gentle massage techniques) alone in reducing neck pain intensity (NRS) but not neck pain-related disability immediately post-intervention in patients with persistent NAD grades I–II [38].

Compared with a self-care book, Swedish or clinical massage with self-care advice is superior for reducing neck disability (NDI) and symptom bothersomeness (NRS) in the short term, and for reducing symptom bothersomeness in the long term for patients with persistent neck pain [36]. The massage group received various Swedish and clinical massage techniques at the discretion of the practitioner with verbal self-care advice, whereas the control group received information on neck pain causes, associated symptoms, exercises, posture, and treatment options.

Cupping massage and progressive muscle relaxation lead to similar changes in pain (VAS), pain perception, disability (NDI), psychological outcomes, and quality of life (SF-36) in patients with persistent NAD [37]. Participants randomized to cupping massage attended a 1-hour workshop on the home-based cupping massage technique (using a cupping glass and massage oil). Progressive muscle relaxation involved 1 hour of instruction by a psychologist on homebased techniques to achieve deep muscle relaxation, relieve muscle tension, and improve general well-being. Both groups continued independent home care twice per week for 12 weeks.

Low-level laser therapy is not effective in reducing pain (VAS) or disability (NDI) compared with an inactivated laser device for the management of persistent cervical myofascial pain syndrome [39]. Participants were randomized to receive LLLT to three trigger points bilaterally using either an active device (wavelength of 830 nm, frequency 1,000 Hz, power output 58 mW/cm², dose 7J per point) or a device that was not activated.

Transcutaneous electrical nerve stimulation and a multimodal soft tissue therapy program (neuromuscular technique, post-isometric stretching, spray and stretch, and strain-counterstrain) lead to similar changes in pain (VAS), disability (NDI), and health-related quality of life (SF-12) at 1- or 6-month follow-up for persistent NAD grades I–II [40]. Participants were randomized to (1) TENS (80 Hz, \leq 150 µs pulse duration) or (2) multimodal therapy that included a neuro-muscular technique, post-isometric stretching, spray and stretch, Jones technique (ie, strain-counterstrain). Both groups

Adverse events reported in the accepted randomized controlled trials on manual therapies, passive physical modalities, and acupuncture for neck pain

Intervention	Adverse events
Manipulation, mobilization, or traction	The rate of adverse events reported in six of the nine studies varied from 0% [46,47] to about 30% [43–45,50]. Most adverse events were mild to moderate and transient. One study [49] reported mild and transient adverse events in 98.9% of patients who received high-dose strengthening exercise therapy and spinal manipulation, and 96.6% who received the same exercise therapy alone. Two serious adverse events in patients allocated to cervical mobilization were reported in one study, but were considered unrelated to treatment by the attending medical specialists as reported by the authors (one participant had a cardiac event, and one developed severe arm pain and weakness 3 d after the mobilization session) [50]. No serious neurovascular adverse events were reported.
Soft tissue therapy	Four of the five RCTs with low risk of bias reported on adverse events and none reported serious adverse events [34,36]. Most adverse events were mild, transient, and affected a small percentage of patients [34,36,38]. In one RCT, 10% (3/ 30) of subjects reported minor adverse events with cupping massage [ie, muscular tension that resolved hours later (1/ 30), increased pain in shoulder area (1/30; however, this patient had history of shoulder problems), and prolapsed intervertebral disc (1/30; considered serious but not a direct consequence of cupping massage)] [37].
Passive physical modalities	Three of the five RCTs reported on adverse events [40,41,43]. In one study, 7.5% of participants receiving manipulative therapy reported mild adverse events (minor increase in neck pain and fatigue), whereas 5% in the Kinesio Tape group reported cutaneous irritation [43]. Twenty percent of those in the LLLT group reported a transient worsening of pain that occurred after the first three treatments. Additionally, one individual reported increased blood pressure, whereas another had persistent nausea [41]. Two studies reported no significant adverse events occurred [40].
Acupuncture	Three of the four studies reported on adverse events [52,54,93]. No serious adverse events were related to acupuncture. The incidence of non-serious events in the acupuncture groups varied among studies, ranging from 3.2% to 11.4% [54,55]. Common minor side effects were slight pain, sweating, fainting, bruising, dizziness, swelling, and local bleeding. Similar side effects were reported for the placebo/sham groups. In the RCT by White et al., 11.4% of the acupuncture group reported minor adverse events; however, 12.3% of the placebo group also reported minor adverse events [55].

RCT, randomized controlled trial; LLLT, low-level laser therapy.

Table 7

received a home program consisting of postural skills and exercises.

The evidence does not support the use of needle acupuncture for the management of persistent NAD grades I-II. Two studies found that traditional Chinese medicine acupuncture and sham-penetrating acupuncture (same procedure as the needle acupuncture group, but needles were superficially inserted 1 cm lateral to traditional acupuncture points) lead to similar outcomes [53,54]. There were statistically significant but not clinically important differences in pain (VAS) and disability (Northwick Park Neck Pain Questionnaire), favoring traditional Chinese medicine acupuncture [53,54]. Moreover, Western acupuncture provides statistically but not clinically significant improvements in pain (VAS), disability (NDI), and healthrelated quality of life (SF-36) compared with non-penetrating placebo electroacupuncture for persistent NAD grades I-II [55]. Western acupuncture involved needling of locally tender and traditional points, whereas the placebo group received inactivated electrodes to acupuncture points.

Grade III NAD of variable duration

Adding intermittent cervical traction to a multimodal program of care (postural education, manipulation or mobilization, exercise, and home exercise) provides no additional benefits in pain (NRS) or disability (NDI) compared with sham cervical traction with the same multimodal care up to 4 weeks of followup for the management of NAD grade III [51]. Patients were treated an average of seven visits over an average of 4.2 weeks.

Recent-onset grade III NAD

Participating in a graded strengthening exercise program or wearing a semi-rigid cervical collar for 6 weeks provides similar improvements in arm pain (VAS), neck pain (VAS), or disability (NDI) to patients with recent NAD grade III [42]. Both treatments were superior to advice. Participants were randomized to (1) 3 weeks of wearing a semi-hard cervical collar and were prescribed to rest followed by 3 weeks of weaning from the collar; (2) continue daily activities; or (3) 6 weeks of supervised graded strengthening exercises for the neck and shoulder.

Low-level laser therapy leads to statistically but not clinically significant improvements in arm pain, neck pain (VAS), disability (NDI), and physical health-related quality of life (SF-12) compared with the placebo LLLT (deactivated laser treatment) for the management of recent NAD grade III [41].

Adverse events

Sixteen of the 22 studies with a low risk of bias addressed the occurrence of adverse events [34,36-38,40,41,43-47,49,50,54,73,74]. Most adverse events were mild to moderate and transient (Tables 6 and 7). No serious neurovascular adverse events were reported. Most studies had a rate of minor adverse events ranging from 0% to about 30% [40,42-44,46-54,56]. One study [49] reported mild and transient adverse events in 98.9% of patients who received highdose strengthening exercise therapy and spinal manipulation, and 96.6% who received the same exercise therapy alone. Two serious adverse events in patients allocated to cervical mobilization were reported in one study, but were reported as unrelated to treatment by the attending medical specialists (one participant had a cardiac event, and one participant developed severe arm pain and weakness 3 days after the mobilization session) [50].

Discussion

Since 2008, the literature on the effectiveness of manual therapies, passive physical modalities, and acupuncture for neck pain has been advancing. Our review adds to the existing knowledge base by clarifying the effectiveness of acupuncture, manipulation, mobilization, soft tissue therapies, LLLT, and taping for NAD grades I–II. There are recent studies with a low risk of bias investigating the effectiveness of a cervical collar, LLLT, and traction for the management of NAD grade III. Key findings from our synthesis of the evidence are outlined in Table 8.

New findings since the publication of the Neck Pain Task Force report

Exploratory studies

Based on exploratory evidence, we found that thoracic manipulation provides benefit to individuals with recent NAD grades I–II, but is no better than placebo for treating persistent NAD grades I–II. We found that the type of neck mobilization may not impact the outcomes of patients. We also found that one session of cervical and cervicothoracic manipulation is as effective as 1 week of Kinesio Tape over the neck in the short term for persistent NAD grades I–II. For soft tissue therapy, we found that strain-counterstrain is not efficacious for NAD.

Evaluation studies

We found that strain-counterstrain and ischemic compression provide no added benefit to muscle energy technique for recent NAD grades I-II. For persistent NAD grades I-II, we found that manipulation provides added benefit to traditional Chinese massage, but not to high-dose supervised exercises. We also found that home-based cupping massage leads to similar outcomes to home-based progressive muscle relaxation for persistent NAD grades I-II. However, it is important to note that the progressive muscle relaxation used in this study does not reflect how the intervention would be delivered in clinical practice. Specifically, the trial by Lauche et al. investigated progressive muscle relaxation performed by patients at home after they were instructed by a psychologist during a 1-hour session [37]. Finally, we found that LLLT was not effective for recent-onset NAD grade III and traction does not provide added benefit to a multimodal program for NAD grade III.

Results that are consistent with findings of the Neck Pain Task Force

Evaluation studies

We found that cervical manipulation and cervical mobilization lead to similar outcomes in individuals with recent NAD grades I–II. We also found that there were no serious

Table 8

The effectiveness of manual therapies, passive physical modalities, and acupuncture for the management of neck pain based on preponderance of evidence from the Neck Pain Task Force [5,6] and our update

Grade of neck pain	Duration of neck pain [†]	Likely helpful (worth considering)	Possibly helpful (might consider)	Likely not helpful (not worth considering)	Not enough or inconsistent evidence to make determination
WAD grades I–II	Recent	Mobilization	Pulsed electromagnetic therapy	Collars, passive modalities (heat, cold, diathermy, hydrotherapy), electroacupuncture*	Manipulation, traction, acupuncture*
	Persistent	_	_	Passive modalities (TENS, ultrasound), <i>electroacupuncture</i> *	Manipulation, traction, acupuncture*
NAD grades I–II	Recent	Manipulation*, mobilization*, low-level laser therapy	_	Collars, passive modalities (heat therapy, TENS, electrical muscle stimulation), strain-counterstrain*	Magnetic stimulation, traction, massage, acupuncture*
	Persistent	Manipulation*, mobilization*, low level laser therapy*, clinical massage*	_	Collars, passive modalities (heat therapy, TENS, electrical muscle stimulation), <i>relaxation massage*</i> , <i>strain-counterstrain*</i>	Magnetic stimulation, massage, traction, acupuncture*
NAD grade III	Recent	_	Short-term use of cervical collar* [‡]	Traction*, low-level laser therapy*	All other interventions
	Persistent	_	_		All interventions

NAD, neck pain and associated disorders; TENS, transcutaneous electrical nerve stimulation; WAD, whiplash-associated disorders.

* Italicized interventions refer to interventions for which we found new evidence in our update of the Neck Pain Task Force.

[†] Recent means <3 months; persistent means \geq 3 months.

* Caution should be taken when considering the use of cervical collars because of the potential for iatrogenic disability [6,10,75].

adverse events reported in randomized clinical trials on manipulation. We did not find any studies that compared different techniques of cervical manipulation; therefore, it is unclear if specific cervical manipulation techniques are more effective than others.

Results that are not consistent with findings of the Neck Pain Task Force

Evaluation studies

We found that relaxation or clinical massage added benefit to self-care advice when compared with self-care advice alone for persistent NAD grades I–II. In 2008, the Neck Pain Task Force reported that relaxation massage was not effective (equal to sham acupuncture) for chronic neck pain. Although these results may appear contradictory, it is possible that the clinical (not relaxation) massage provides benefit to patients with persistent neck pain.

We found new evidence suggesting that LLLT is not effective for persistent NAD grades I–II. However, when combining the new evidence with Neck Pain Task Force findings from five studies [76–80], the preponderance of evidence suggests that clinic-based LLLT is effective for persistent NAD.

We found that for NAD grade III, graded strengthening exercises and cervical collar with rest were equally effective. However, caution should be taken when considering the use of cervical collars because of the potential for iatrogenic disability [6,12,75].

For acupuncture, we found that electroacupuncture is not effective for WAD grades I–II, whereas Western acupuncture and needle acupuncture are not effective for persistent NAD grades I–II.

These new findings contradict the evidence available to the Neck Pain Task Force [75], which found that needle acupuncture, when added to routine general medical care, may provide short-term benefits to patients with persistent neck pain [74]. However, the Neck Pain Task Force warned that this result may be attributed to favorable patients' expectations because all participants in this study were patients of physicians who practice acupuncture [75]. Overall, the updated evidence suggests that acupuncture may not be effective for the management of recent or persistent neck pain. It is important to note that acupuncture was compared with needling interventions where skin was penetrated, which may have a physiological effect; studies with non-penetrating sham or placebo interventions are needed.

Findings of the Neck Pain Task Force that we cannot support or clarify

We did not find new evidence on the effectiveness of ultrasound, diathermy, heat therapy, electrical muscle stimulation, or magnetic necklaces. The Neck Pain Task Force found that TENS provides no clinically important benefit compared with placebo [75,81]. Our review found new evidence that TENS provides similar outcomes to a multimodal program of care focused on soft tissue therapy. However, as the effectiveness of this multimodal program of care is unknown, this new evidence cannot be used to support or refute the findings of the Neck Pain Task Force. Overall, there is a lack of evidence supporting the effectiveness of TENS in this population.

Unlike previous systematic reviews, we stratified admissible studies into exploratory (efficacy) and evaluation (comparative effectiveness) according to the IDEAL framework to facilitate the clinical interpretability of results [8,9]. Exploratory studies are used to develop well-informed hypotheses about the effectiveness of promising interventions that need to be tested in evaluation studies. Our review differentiates studies by the nature of their design for the purpose of contextualizing the dose and duration of outcomes to reflect clinical practice. It is important for clinicians, policy makers, and patients to place more emphasis on the results of the evaluation studies because they provide confidence in the intervention's effectiveness or comparative effectiveness to a standard of care. There should be caution in including results from exploratory studies into clinical guidelines or practice pending more robust evaluation studies.

Strengths and limitations

There are strengths to our review. We conducted a rigorous search of the literature and the search strategy was peerreviewed. We used clear case definitions, inclusion criteria, and exclusion criteria for the selection of studies, and we only considered studies with adequate sample sizes. We used the SIGN criteria to standardize the critical appraisal process [26]. Last, our conclusions were based on the best evidence synthesis method to minimize the risk of bias associated with using low-quality studies [27]. A best evidence synthesis is considered an appropriate alternative to a meta-analysis when heterogeneity exists across patient populations, interventions, comparisons, and outcomes [27].

Our review also has limitations. We only searched the English literature, which may have excluded some relevant studies, but this is an unlikely source of bias [82–86]. Qualitative studies that explored the lived experience of patients were not included. Thus, this review cannot comment on how patients valued and experienced their exposure to manual therapies, passive physical modalities, or acupuncture.

Conclusions

Since 2008, there has been new scientific evidence on the effectiveness of manual therapies, passive physical modalities, and acupuncture informing their use for the management of neck pain. Our update of the Neck Pain Task Force suggests that mobilization, manipulation, and clinical massage are effective interventions for the management of neck pain. It also suggests that electroacupuncture, strain-counterstrain, relaxation massage, and other passive physical modalities (heat, cold, diathermy, hydrotherapy, and ultrasound) are not effective and should not be used to manage neck pain.

Acknowledgments

This study was funded by the Ontario Ministry of Finance and the Financial Services Commission of Ontario (RFP No.: OSS 00267175). This research was undertaken, in part, thanks to funding from the Canada Research Chairs program to Dr. Pierre Côté, Canada Research Chair in Disability Prevention and Rehabilitation at the University of Ontario Institute of Technology. The funding agencies were not involved in the collection of data, data analysis, interpretation of the data, or drafting of the manuscript. The authors acknowledge the invaluable contributions to this review from Angela Verven, J. David Cassidy, Doug Gross, Gail Lindsay, John Stapleton, Michel Lacerte, Mike Paulden, Murray Krahn, Patrick Loisel, Poonam Cardoso, Richard Bohay, Roger Salhany, and Shawn Marshall. The authors also thank Trish Johns-Wilson at the University of Ontario Institute of Technology for her review of the search strategy.

Appendix A: MEDLINE search strategy for neck pain and associated disorders, whiplash-associated disorders, and manual therapy

- 1. exp Whiplash Injuries/
- 2. exp Neck Injuries/
- 3. exp Neck Pain/
- 4. Neck Muscles/in [Injuries]
- 5. exp Cervical Vertebrae/in [Injuries]
- 6. exp Radiculopathy/
- 7. exp Brachial Plexus Neuropathies/
- 8. exp Torticollis/
- 9. whiplash.ab,ti.
- 10. "neck injur*".ab,ti.
- 11. "neck pain*".ab,ti.
- 12. "cervical pain*".ab,ti.
- 13. "neck ache*".ab,ti.
- 14. "neckache*".ab,ti.
- 15. "cervicalgia*".ab,ti.
- 16. "cervicodynia*".ab,ti.
- 17. "radiculopath*".ab,ti.
- 18. "brachial plexus neuropath*".ab,ti.
- 19. torticollis.ab,ti.
- 20. ("headache*" adj4 (whiplash or WAD or neck pain)).ab,ti.
- 21. Randomized Controlled Trials as Topic/
- 22. exp Controlled Clinical Trials as Topic/
- 23. exp consensus development conferences as topic/
- 24. meta-analysis.pt.
- 25. exp case-control studies/
- 26. exp Cohort Studies/
- 27. Double-Blind Method/
- 28. single-blind method/
- 29. Placebos/
- 30. randomized controlled trial.pt.
- 31. controlled clinical trial.pt.
- 32. (meta analys* or meta-analys* or metaanalys*).ab,ti.

- 33. (cohort adj4 (study or studies or analys*)).ab,ti.
- 34. (random* adj4 (control* or clinical or allocat*)).ab,ti.
- 35. (case adj control*).ab,ti.
- 36. ((double or single) adj3 blind*).ab,ti.
- 37. "placebo*".ab,ti.
- 38. or/1–20
- 39. or/21–37
- 40. Musculoskeletal Manipulations/
- 41. Manipulation, Spinal/
- 42. Manipulation, Chiropractic/
- 43. Manipulation, Orthopedic/
- 44. Manipulation, Osteopathic/
- 45. Motion Therapy, Continuous Passive/
- 46. Muscle Stretching Exercises/
- 47. (manipulat* adj4 (spinal or lumbar or thoracic or cervical)).ab,ti.
- 48. (mobili?ation adj4 (spinal or lumbar or thoracic or cervical)).ab,ti.
- 49. (manipulat* adj4 (chiropract* or osteopath* or orthopedic* or orthopaedic*)).ab,ti.
- 50. (mobli?ation adj4 (chiropract* or osteopath* or orthopedic* or orthopaedic*)).ab,ti.
- 51. (adjustment* adj4 (chiropract* or spinal or lumbar or cervical or thoracic)).ab,ti.
- 52. (therap* adj4 (manual or manipulat* or mobili?at*)).ab,ti.
- 53. (traction and (manual or passive or mechanical or nonsurgical or nonsurgical)).ab,ti.
- 54. (flexion-distraction or flexion distraction).ab,ti.
- 55. (HVLA or high velocity low amplitude).ab,ti.
- 56. (manipulat* and (instrument assisted or instrument-assisted)).ab,ti.
- 57. (manipulat* and (physiotherap* or physical therap*)).ab,ti.
- 58. (mobili?ation and (physiotherap* or physical therap*)).ab,ti.
- 59. (musculoskeletal and (physiotherap* or physical therap*)).ab,ti.
- 60. or/40-59
- 61. 38 and 39 and 60
- 62. limit 61 to (english language and yr="2000 -Current")

Appendix B: MEDLINE search strategy for neck pain and associated disorders, whiplash-associated disorders, and soft tissue therapy

- 1. Acupressure/
- 2. Complementary Therapies/
- 3. Manipulation, Chiropractic/
- 4. Manipulation, Orthopedic/
- 5. Manipulation, Osteopathic/
- 6. Massage/
- 7. Muscle Stretching Exercises/
- 8. Musculoskeletal Manipulations/
- 9. Physical Therapy Modalities/
- 10. Reflexotherapy/

- 11. Therapeutic Touch/
- 12. exp Medicine, Chinese Traditional/
- 13. Vibration/tu [Therapeutic Use]
- 14. active release.ab,ti.
- 15. acupressure.ab,ti.
- 16. "Alexander technique*".ab,ti.
- 17. "Anma massage*".ab,ti.
- 18. Aston patterning.ab,ti.
- 19. "Ayurvedic massage*".ab,ti.
- 20. bodywork.ab,ti.
- 21. Chih Ya.ab,ti.
- 22. cranial release.ab,ti.
- 23. (cranio-sacral and (massage or therap*)).ab,ti.
- 24. (craniosacral and (massage or therap*)).ab,ti.
- 25. Cyriax friction.ab,ti.
- 26. "deep tissue therap*".ab,ti.
- 27. Feldenkrais method.ab,ti.
- 28. "friction massage*".ab,ti.
- 29. Graston.ab,ti.
- 30. Gua Sha.ab,ti.
- 31. Guasha.ab,ti.
- 32. Hakomi method.ab,ti.
- 33. "Hot stone massage*".ab,ti.
- 34. (instrument assisted and (massage* or soft tissue or soft-tissue)).ab,ti.
- 35. (instrument-assisted and (massage* or soft tissue or soft-tissue)).ab,ti.
- 36. Jin Shin.ab,ti.
- 37. "manual therap*".ab,ti.
- 38. "massage*".ab,ti.
- 39. "muscle energy technique*".ab,ti.
- 40. myofascial release.ab,ti.
- 41. "neuromuscular therap*".ab,ti.
- 42. Nimmo.ab,ti.
- 43. "Pfrimmer therap*".ab,ti.
- 44. "polarity therap*".ab,ti.
- 45. ((post isometric or post-isometric) and relaxation).ab,ti.
- 46. "pressure point* therap*".ab,ti.
- 47. proprioceptive neuromuscular facilitation.ab,ti.
- 48. reflexology.ab,ti.
- 49. "reflexotherap*".ab,ti.
- 50. Reiki.ab,ti.
- 51. Rolfing.ab,ti.
- 52. Shiat?u.ab,ti.
- 53. (soft tissue and (mobili?ation or therap*)).ab,ti.
- 54. (soft-tissue and (mobili?ation or therap*)).ab,ti.
- 55. "sports massage*".ab,ti.
- 56. "Swedish massage*".ab,ti.
- 57. TCM.ab,ti.
- 58. "Thai massage*".ab,ti.
- 59. "therapeutic touch*".ab,ti.
- 60. Thumper.ab,ti.
- 61. traditional Chinese medicine.ab,ti.
- 62. Trager psychophysical.ab,ti.
- 63. "trigger point* therap*".ab,ti.
- 64. Tui Na.ab,ti.

- 65. Tuina.ab,ti.
- 66. "vibration therap*".ab,ti.

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- 67. Vibromax.ab,ti.
- 68. VMTX.ab,ti.
- 69. Zhi Ya.ab,ti.
- 70. "Zone therap*".ab,ti.
- 71. or/1-70
- 72. exp Back/
- 73. exp Back Injuries/
- 74. Back Pain/
- 75. Low Back Pain/
- 76. Coccyx/in [Injuries]
- 77. Intervertebral Disc Degeneration/
- 78. Intervertebral Disc Displacement/
- 79. Lumbar Vertebrae/in [Injuries]
- 80. exp Lumbosacral Plexus/
- 81. Lumbosacral Region/in [Injuries]
- 82. Osteoarthritis, Spine/
- 83. Piriformis Muscle Syndrome/
- 84. Polyradiculopathy/
- 85. Radiculopathy/
- 86. Sacrococcygeal Region/
- 87. Sacroiliac Joint/
- 88. Sacrum/
- 89. Sciatica/
- 90. Spinal Diseases/
- 91. Spinal Stenosis/
- 92. (avulsed lumbar and (disc* or disk*)).ab,ti.
- 93. (back and (ache* or injur* or pain*)).ab,ti.
- 94. (backache* and (injur* or pain*)).ab,ti.
- 95. (back pain or back-pain).ab,ti.
- 96. coccydynia.ab,ti.
- 97. coccyx.ab,ti.
- 98. dorsalgia.ab,ti.
- 99. (lumbar disc* and (extruded or degenerat* or herniat* or prolapse* or sequestered or slipped)).ab,ti.
- 100. (lumbar disk* and (extruded or degenerat* or herniat* or prolapse* or sequestered or slipped)).ab,ti.
- 101. "low* back pain".ab,ti.
- 102. "low*-back-pain*".ab,ti.
- 103. (lumbar and (pain or facet or nerve root* or osteoarthritis or radicul* or spinal stenosis or spondylo* or zygapophys*)).ab,ti.
- 104. "lumbarsacr*".ab,ti.
- 105. lumboischialgia.ab,ti.
- 106. "lumbosacr*".ab,ti.
- 107. "Piriformis syndrome*".ab,ti.

110. sacrococcygeal pain*.ab,ti.

111. (sacroiliac or sacro-iliac).ab,ti.

- 108. radiculalgia.ab,ti.
- 109. sacral pain*.ab,ti.

112. "sciatic*".ab,ti.

114. spinal stenos?s.ab,ti.

116. "tailbone pain*".ab,ti.

115. spondylosis.ab,ti.

113. SI joint.ab,ti.

- 117. "vertebrogenic pain*".ab,ti.
- 118. or/72-117
- 119. Whiplash Injuries/
- 120. Neck Injuries/
- 121. Neck Pain/
- 122. Neck Muscles/in [Injuries]
- 123. exp Cervical Vertebrae/in [Injuries]
- 124. Radiculopathy/
- 125. exp Brachial Plexus Neuropathies/
- 126. Torticollis/
- 127. whiplash.ab,ti.
- 128. "neck injur*".ab,ti.
- 129. "neck pain*".ab,ti.
- 130. "cervical pain*".ab,ti.
- 131. "neck ache*".ab,ti.
- 132. "neckache*".ab,ti.
- 133. "cervicalgia*".ab,ti.
- 134. "cervicodynia*".ab,ti.
- 135. "radiculopath*".ab,ti.
- 136. "brachial plexus neuropath*".ab,ti.
- 137. torticollis.ab,ti.
- 138. "headache* and (whiplash or WAD or neck pain*)".ab,ti.
- 139. or/119–138
- 140. 118 or 139
- 141. Randomized Controlled Trials as Topic/
- 142. Controlled Clinical Trials as Topic/
- 143. Clinical Trials as Topic/
- 144. exp Case-Control Studies/
- 145. exp Cohort Studies/
- 146. Double-Blind Method/
- 147. Single-Blind Method/
- 148. Placebos/
- 149. randomized controlled trial.pt.
- 150. controlled clinical trial.pt.
- 151. comparative study.pt.
- 152. (meta analys* or meta-analys* or metaanalys*).ab,ti.
- 153. (cohort and (study or studies or analys*)).ab,ti.
- 154. (random* and (control* or clinical or allocat*)).ab,ti.
- 155. (case adj control*).ab,ti.
- 156. ((double or single) and blind*).ab,ti.
- 157. "placebo*".ab,ti.
- 158. (comparative and (study or studies)).ab,ti.
- 159. (case adj control*).ab,ti.
- 160. (meta analys* or meta-analys* or metaanalys*).ab,ti.
- 161. or/141-160
- 162. 71 and 140 and 161
- 163. limit 162 to (english language and humans and yr="2000 -Current")

Appendix C: MEDLINE search strategy for neck pain and associated disorders, whiplash-associated disorders, and passive physical modalities

- 1. exp Hydrotherapy/
- 2. Laser Therapy, Low-Level/

- 3. Cryotherapy/
- 4. Magnetic Field Therapy/
- 5. exp Electric Stimulation Therapy/
- 6. exp Orthotic Devices/
- 7. exp Diathermy/
- 8. Hot Temperature/tu [Therapeutic Use]
- 9. Casts, Surgical/
- 10. Fluid Therapy/
- 11. Magnetics/tu [Therapeutic Use]
- 12. "Bedding and Linens"/
- 13. High-Energy Shock Waves/tu [Therapeutic Use]
- 14. Bed Rest/
- 15. Rest/
- 16. Self-Help Devices/
- 17. Restraint, Physical/
- 18. or/1–17
- 19. (cold and (therap* or pack* or compress or massage or immersion or soak or treatment or therap*)).ab,ti.
- 20. (ice and (therap* or pack* or compress or massage or immersion or soak or treatment or therap*)).ab,ti.
- 21. (heat* and (therap* or pack* or compress or massage or lamp or pad or bath or soak or tub or bottle or superficial or therapeutic)).ab,ti.
- 22. (hot and (therap* or pack* or compress or massage or lamp or pad or bath or soak or tub or bottle or superficial or therapeutic)).ab,ti.
- 23. ((shockwave* or shock wave* or shock-wave*) and (ultrasonic or therap* or radiation)).ab,ti.
- 24. "assistive device*".ab,ti.
- 25. (athletic and (tape or taping)).ab,ti.
- 26. "back belt*".ab,ti.
- 27. (braces or brace or bracing).ab,ti.
- 28. (cast or casts).ab,ti.
- 29. (collar or collars).ab,ti.
- 30. (corset or corsets).ab,ti.
- 31. "cryotherap*".ab,ti.
- 32. diathermy.ab,ti.
- (electric* and (stimulation or EMS or heating pad*)).ab,ti.
- 34. electroanalgesia.ab,ti.
- 35. (electrogalvanic stimulation or EGS).ab,ti.
- 36. (electromagnet* and (radiation or therap*)).ab,ti.
- 37. "electromodalit*".ab,ti.
- 38. electrotherapy.ab,ti.
- 39. "fluidotherap*".ab,ti.
- 40. galvanic stimulation.ab,ti.
- 41. (guard* and (teeth or night or mouth or wrist or knee)).ab,ti.
- 42. (high energy shock wave* or high-energy shock wave* or HESW).ab,ti.
- 43. (H-Wave Device Stimulation or HWDS).ab,ti.
- 44. "hydrocollar*".ab,ti.
- 45. "hydrotherap*".ab,ti.
- 46. infrared.ab,ti.
- 47. (interferential current* or ICS or IFC).ab,ti.
- 48. iontophoresis.ab,ti.

- 49. "kinesiotap*".ab,ti.
- 50. (laser* and (phototherapy or irradiation or biostimulation or light or therap*)).ab,ti.
- 51. "low level laser*".ab,ti.
- 52. "lumbar support*".ab,ti.
- 53. (magnetic and (necklace* or therap* or bracelet*)).ab,ti.
- 54. Microcurrent Electrical Neuromuscular Stimulation.ab,ti.
- 55. "microwave*".ab,ti.
- 56. "moist air bath*".ab,ti.
- 57. muscle activation.ab,ti.
- 58. myofascial release.ab,ti.
- 59. (Neuromuscular Electrical Stimulation or NMES).ab,ti.
- 60. "orthotic*".ab,ti.
- 61. (paraffin and (treatment* or therap*)).ab,ti.
- 62. "passive modalit*".ab,ti.
- 63. "Percutaneous Electric* Nerve Stimulation".ab,ti.
- 64. "pillow*".ab,ti.
- 65. (pulsed and (electromagnetic or magnetic or radio frequency or energy)).ab,ti.
- 66. radiant light.ab,ti.
- 67. Russian stimulation.ab,ti.
- 68. "seat cushion*".ab,ti.
- 69. (short wave* or short-wave*).ab,ti.
- 70. (sling or slings).ab,ti.
- 71. (splint or splinting or splints).ab,ti.
- 72. "spray and stretch".ab,ti.
- 73. (tape or taping).ab,ti.
- 74. (transcutaneous electrical stimulation or TENS).ab,ti.
- 75. ultrasound.ab,ti.
- 76. vapocoolant spray.ab,ti.
- 77. "vibration therap*".ab,ti.
- 78. "warm compress*".ab,ti.
- 79. "wax treatment*".ab,ti.
- 80. whirlpool.ab,ti.
- 81. or/19–80
- 82. 18 or 81
- 83. Whiplash Injuries/
- 84. Neck Injuries/
- 85. Neck pain/
- 86. Neck Muscles/in [Injuries]
- 87. exp Cervical Vertebrae/in [Injuries]
- 88. Radiculopathy/
- 89. exp Brachial Plexus Neuropathies/
- 90. Torticollis/
- 91. whiplash.ab,ti.
- 92. "neck injur*".ab,ti.
- 93. "neck pain*".ab,ti.
- 94. "cervical pain*".ab,ti.
- 95. "neck ache*".ab,ti.
- 96. "neckache*".ab,ti.
- 97. "cervicalgia*".ab,ti.
- 98. "cervicodynia*".ab,ti.
- 99. "radiculopath*".ab,ti.

- 100. "brachial plexus neuropath*".ab,ti.
- 101. torticollis.ab,ti.
- 102. (headache* adj4 (whiplash or WAD or neck pain)).ab,ti.

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- 103. or/83-102
- 104. Randomized Controlled Trials as Topic/
- 105. Controlled Clinical Trials as Topic/
- 106. exp case-control studies/
- 107. exp cohort studies/
- 108. double-blind method/
- 109. single-blind method/
- 110. Placebos/
- 111. randomized controlled trial.pt.
- 112. controlled clinical trial.pt.
- 113. meta-analysis.pt.
- 114. (meta analys* or meta-analys* or metaanalys*).ab,ti.
- 115. (cohort adj4 (study or studies or analys*)).ab,ti.
- 116. (cohort adj4 (study or studies or analys*)).ab,ti.
- 117. (random* adj4 (control* or clinical or allocat*)).ab,ti.
- 118. (case adj control*).ab,ti.
- 119. ((double or single) adj3 blind*).ab,ti.
- 120. "placebo*".ab,ti.
- 121. or/104-120
- 122. 82 and 103 and 121
- 123. limit 122 to (english language and yr="2000 -Current")

Appendix D: MEDLINE search strategy for neck pain and associated disorders, whiplash-associated disorders, and acupuncture

- 1. exp Whiplash Injuries/
- 2. exp Neck Injuries/
- 3. exp Neck pain/
- 4. Neck Muscles/in [Injuries]
- 5. exp Cervical Vertebrae/in [Injuries]
- 6. exp Radiculopathy/
- 7. exp Brachial Plexus Neuropathies/
- 8. exp Torticollis/
- 9. whiplash.ab,ti.
- 10. "neck injur*".ab,ti.
- 11. "neck pain*".ab,ti.
- 12. "cervical pain*".ab,ti.
- 13. "neck ache*".ab,ti.
- 14. "neckache*".ab,ti.
- 15. "cervicalgia*".ab,ti.
- 16. "cervicodynia*".ab,ti.
- 17. "radiculopath*".ab,ti.
- 18. "brachial plexus neuropath*".ab,ti.
- 19. torticollis.ab,ti.
- 20. Randomized Controlled Trials as Topic/
- 21. exp Controlled Clinical Trials as Topic/
- 22. meta-analysis.pt.
- 23. exp case-control studies/

24. exp Cohort Studies/

- 25. Double-Blind Method/
- 26. single-blind method/
- 27. Placebos/
- 28. randomized controlled trial.pt.
- 29. controlled clinical trial.pt.
- 30. (meta analys* or meta-analys* or metaanalys*).ab,ti.
- 31. (cohort adj4 (study or studies or analys*)).ab,ti.
- 32. (random* adj4 (control* or clinical or allocat*)).ab,ti.
- 33. (case adj control*).ab,ti.
- 34. ((double or single) adj3 blind*).ab,ti.
- 35. "placebo*".ab,ti.
- 36. exp Acupuncture Therapy/
- 37. Acupuncture Points/
- 38. Acupuncture/
- 39. Electric Stimulation Therapy/
- 40. Electroacupuncture/
- 41. Acupressure/
- 42. exp Auriculotherapy/
- 43. "acupuncture*".ab,ti.
- 44. (needling and (dry or body or "trigger point*")).ab,ti.
- 45. acupressure.ab,ti.
- 46. auriculotherapy.ab,ti.
- 47. (Shiatsu or Shiatzu or Zhi Ya or Chih Ya).ab,ti.
- 48. moxibustion.ab,ti.
- 49. electrical stimulation.ab,ti.
- 50. (Ching Lo or Jing Luo or Jingluo).ab,ti.
- 51. artemisia vulgaris.ab,ti.
- 52. Japanese Meridian Therapy.ab,ti.
- 53. French Energetic.ab,ti.
- 54. Korean Constitutional.ab,ti.
- 55. Lemington Five Elements.ab,ti.
- 56. intramuscular stimulation.ab,ti.
- 57. or/1-19
- 58. or/20-35
- 59. or/36-56
- 60. 57 and 58 and 59
- 61. limit 60 to (english language and humans and yr="2000 -Current")

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