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Treatment of Neck Pain: Noninvasive Interventions

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

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Study Design. Best evidence synthesis.

Objective. To identify, critically appraise, and synthesize literature from 1980 through 2006 on noninvasive interventions for neck pain and its associated disorders.

Summary of Background Data. No comprehensive systematic literature reviews have been published on interventions for neck pain and its associated disorders in the past decade.

Methods. We systematically searched Medline and screened for relevance literature published from 1980 through 2006 on the use, effectiveness, and safety of noninvasive interventions for neck pain and associated disorders. Consensus decisions were made about the scientific merit of each article; those judged to have adequate internal validity were included in our best evidence synthesis.

Results. Of the 359 invasive and noninvasive intervention articles deemed relevant, 170 (47%) were accepted as scientifically admissible, and 139 of these related to noninvasive interventions (including health care utilization, costs, and safety). For whiplash-associated disorders, there is evidence that educational videos, mobilization, and exercises appear more beneficial than usual care or physical modalities. For other neck pain, the evidence suggests that manual and supervised exercise interventions, low-level laser therapy, and perhaps acupuncture are more effective than no treatment, sham, or alternative interventions; however, none of the active treatments was clearly superior to any other in either the short- or long-term. For both whiplash-associated disorders and other neck pain without radicular symptoms, interventions that focused on regaining function as soon as possible are relatively more effective than interventions that do not have such a focus.

Conclusion. Our best evidence synthesis suggests that therapies involving manual therapy and exercise are more effective than alternative strategies for patients with neck pain; this was also true of therapies which include educational interventions addressing self-efficacy. Future efforts should focus on the study of noninvasive interventions for patients with radicular symptoms and on the design and evaluation of neck pain prevention strategies.

Key words: best evidence synthesis, cervical spine, neck pain, whiplash-associated disorder.

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Since publication of the Québec Task Force on whiplash-associated disorders (WAD) best evidence synthesis in 1995,[1] several additional systematic reviews of interventions for whiplash and other types of neck pain have been published. However, no comprehensive reviews have been published on the utilization, safety, effectiveness, and cost effectiveness of noninvasive interventions, for both WAD and for nonspecific neck pain and associated disorders. Instead, the reviews typically focus on a specific type of treatment (*e.g.*, manual therapy) or a specific patient population (*e.g.*, those with WAD). Given the recent explosive growth of the neck pain literature and a lack of synthesis, this is an appropriate time to critically examine the evidence and to offer informed judgment about the current state of knowledge regarding noninvasive interventions for neck pain.

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The primary objective of this study was to identify, critically appraise, and synthesize the literature published between 1980 and 2006 on the use, effectiveness, and safety of noninvasive interventions for neck pain and its associated disorders. The review of invasive interventions, including injection therapies and surgery, is described in a separate article.[2] The secondary objectives of this review were (1) to identify gaps in and problems with the literature, and (2) to suggest areas where resources should be expended in an effort to reduce the individual and societal burden of neck pain and its associated disorders.

We begin with a brief discussion about how and where noninvasive interventions fit into our conceptual model of the course and care of neck pain. We then describe our methods and the results of the literature search and screening. Finally, we discuss the accepted studies according to their type: health-care utilization, effectiveness of interventions, safety of interventions, systematic reviews, cost and cost-benefit, and workplace interventions. The chapter ends with our thoughts on the study's limitations, our recommendations for future research, and evidence statements drawn from the best evidence synthesis.

Noninvasive Intervention and the Conceptual Model of the Course and Care of Neck Pain

Although much of the literature focuses on what "we" (health-care practitioners and scientists) do in the area of neck pain treatment, we have tried to keep our primary perspective focused on the person who is experiencing neck pain or who may be at risk for neck pain.

With the person with neck pain firmly in mind, one always seeks the most effective interventions. Such interventions, whether therapeutic, diagnostic, or preventive, favorably influence the natural history of illness. Because most of the interventions described in the literature are treatments applied by health-care practitioners, the vast majority of those discussed in this chapter are by definition health-care interventions.

However, effective interventions, such as health promotion programs and policies applied at the community or regional level, are not necessarily health-care interventions. Our conceptual model vividly illustrates that many other factors and systems (beyond the health care system) impact the person with or at risk of neck pain. This means there are many potential places and points in time for intervention to occur and for intervention effects to be realized (Figure 1, available online through Article Plus). Furthermore, intervention can be conceptualized as just one of many possible prognostic factors. Indeed, some interventions themselves may actually become risk factors for prolonging symptoms and/or side effects; thus, an intervention intended to solve a problem may actually create a need for further treatment.

The experience of being diagnosed—undergoing various examinations and tests and then receiving a "label"—may itself be therapeutic (or harmful), and thus "prognostic." In other words, the place where diagnosis ends and intervention begins is not clear-cut. Diagnosis and intervention need not take place within a health-care environment: self-diagnosis and self-care have their own therapeutic potential, and it is likely that people with neck pain understand this fact.

The line between diagnosis and intervention becomes even more blurred if we consider a prognostic criterion as a reference standard for diagnosis. Given the lack of a "gold standard" assessment for neck pain, a prognostic criterion seems reasonable and most relevant to the person with neck pain. In this case, the outcome measures used in so-called "outcomes" studies would also be used in diagnostic studies with prognostic criteria. The patient may not care what his or her diagnosis is; what's important is the outcome. For example, regardless of diagnosis, patients want answers to questions like: "Am I going to get better? How long will it take to get better? Will I be able to return to work and my usual activities?"

Interventions may have different effects in different populations (*e.g.*, workers *vs.* nonworkers, claimants *vs.* nonclaimants, litigants *vs.* nonlitigants). Intervention effects may also vary by type of outcome measure (*e.g.*, pain, disability, global improvement, return to work) and by follow-up time (*e.g.*, days, weeks, months, years). In addition, access to and preferences for certain types of care and treatment expectations may also influence outcomes. For example, patients who have had favorable results with manual therapy may prefer manual therapy for subsequent episodes of neck pain. Not receiving a favored therapy may adversely affect outcomes, and conversely, it is possible that receiving a preferred therapy may enhance patients' response to therapies. Although this could have important clinical and policy implications, it is an understudied topic.

■ Materials and Methods

The literature search and critical review strategy is outlined in detail elsewhere in the Task Force report.[3] Briefly, we systematically searched the electronic library database Medline for literature published from 1980 through 2005 on neck pain and its associated disorders; we also systematically checked reference lists of relevant articles, and updated our search by including key articles on intervention for neck pain published in 2006 and early 2007 (January through March). Details of our electronic search strategy are available online through Article Plus.

We screened each citation for relevance to the Neck Pain Task Force mandate, using *a priori* inclusion and exclusion criteria; however, we made no attempt to assess the scientific quality of the study when establishing this relevance to mandate. Studies were considered relevant if they pertained to the assessment, incidence, prevalence, risk factors, prevention, course, prognosis, treatment and rehabilitation, or economic costs of neck pain; if they contained data and findings specific to neck pain and/or disorders associated with neck pain; if they included at least 20 persons with neck pain or at risk for neck pain; or if they described a systematic review of the literature on neck pain. We included neck pain resulting from WAD and work-related injuries and strains, as well as neck pain of un-

known etiology in the general population. Clinical case series were included if they were judged to be of special relevance to the Neck Pain Task Force report—for example, if they were frequently cited in the literature, or if they were on a topic for which there was little or no information available. We excluded studies on neck pain that was associated with serious local pathology or systemic disease, such as neck pain from fractures or dislocations (except where such studies were related to differential diagnosis of neck pain); myelopathy; infections; rheumatoid arthritis and other inflammatory joint diseases; or tumors.

Rotating pairs of Neck Pain Task Force Scientific Secretariat members performed independent in-depth critical reviews of each article, identifying methodologic strengths and weaknesses, and made decisions about the article's scientific merit after discussions of each article. Criteria used in the methodologic appraisal of the studies are available online through Article Plus. Our methodologic appraisal focused on sources of potential selection bias, information bias, confounding; and consideration of whether these biases would likely result in erroneous or misleading conclusions. Studies judged to have adequate internal validity were included in our best evidence synthesis.[4] Because of large between-study heterogeneity with respect to study populations, intervention groups, outcome measures, follow-up times, and estimated effects, we did not pool studies for metaanalyses.

We extracted major features and data from all accepted studies and constructed detailed sets of evidence tables showing study design, source population, characteristics of participants, sample size, interventions, outcomes and outcome measures, duration of follow-up and follow-up points, and key results. We stratified primary studies by (1) type of study population (WAD or other neck pain and associated disorders) and (2) type of intervention (noninvasive or invasive),[2] and intervention contrasts by type of comparator (placebo or sham, "usual care," no care, or another intervention). Differences in pain and disability outcomes between intervention groups in each study were evaluated for clinical importance. Results were then qualitatively synthesized through informed scientific and clinical judgment, giving relatively more weight to randomized trials and large, well-designed population-based cohort studies, and focusing on the consistency of results across studies.[5]

■ Results

Literature Screening

Of the 31,878 citations screened, 1203 articles were relevant to the Task Force mandate; of these, 359 related to interventions for neck pain and its associated disorders and 170 (47%) were deemed scientifically admissible, 139 of which related to noninvasive interventions.

- These articles included 78 primary studies (94 separate articles) evaluating the *efficacy or effectiveness* of preventive or therapeutic regimens for neck pain or an associated disorder. These were accepted as scientifically admissible and included in our best evidence synthesis.
- With the exception of 3 cohort studies and 5 nonrandomized intervention studies,[6–14] all were randomized clinical trials, including 5 randomized crossover trials and 1 with cluster randomization.[15]
- Seventeen studies were primarily of whiplash patients; 46 studies included mostly neck-pain patients with no trauma (Grades I and II in our proposed classification system)[16]; and 11 studies included mostly disc or radiculopathy patients (Grade III in our proposed classification system),[16] 3 of which focused on noninvasive interventions. Two studies focused on cervicogenic headache.
- Six scientifically admissible studies (including one in the above tally) dealt primarily with the risks of treatment-related complications.[10,17–21]
- Ten others focused on health-care utilization rather than on efficacy or effectiveness.[22–31]
- Two studies looked at patterns of clinical care and their relations to rates of recovery from WAD.[32,33]
- Two studies estimated the effects of possible pain-reduction predictors following multimodal treatment[34] or thoracic spine manipulation.[35]
- Three articles focused on the cost effectiveness of interventions for nonwhiplash neck disorders.[36–38]
- Of the 30 systematic reviews identified and accepted as scientifically admissible, 24 involved noninvasive interventions.

Health Care Utilization for Neck Pain and Its Associated Disorders

Ten accepted studies dealt with utilization of health services.[22,23,25–31,39] For example, an analysis of 2001 and 2002 US national health surveys estimated an annual neck pain visit rate of 10.2 million to physician offices and hospital outpatient departments, and an annual hospital discharge rate of 179,000 (79% involving surgery).[30] These surveys did not include visits to chiropractic and/or complementary/alternative medicine (CAM) providers.

Interestingly, many of the utilization studies included data on complementary therapies. This is not surprising, given that more persons with neck or back pain in the United States said they had used complementary therapies (54%) in the previous year compared with those who had reported seeking conventional care (37%).[31] Neck pain is the second most common reason Americans seek chiropractic care,[28] which is the most frequently reported complementary treatment for upper back or neck pain, followed by massage and relaxation techniques.[31]

A Spanish study of persons reporting neck pain found they were more likely to use complementary medicine (29.4%) than to self-medicate (22.8%).[23] In fact, complementary medicine was used more often for pain in the neck than for pain in other locations.[23] Previous visits to providers of nonchiropractic CAM have been strongly associated with subsequent visits to physical therapists.[26] [Although not eligible for inclusion in our best evidence synthesis, one survey of US adults found those with neck conditions or headache who used both complementary or alternative medical therapies and conventional care much more likely to perceive the CAM ther-

apies as being helpful (61% *vs.* 6.4% for neck conditions; 39.1% *vs.* 19% for headaches).[40]]

Of neck and upper extremity complaints, neck pain symptoms were most commonly reported among general practice patients in the Netherlands (23.1 per 1000 person-years),[25] although the majority (56%) of persons with neck pain lasting longer than 6 months said they had not sought general practitioner care in the previous year.[24] In Sweden, the 4 to 6-year cumulative incidence of seeking care for neck/shoulder pain was an estimated 29% for women and 18% for men.[27] Among persons seeking primary care for neck or neck/shoulder pain in Finland, 50% had additional episodes of care for musculoskeletal pain in the subsequent 12 months.[29]

Summary of Intervention Studies

Whiplash-Associated Disorders. Among the 19 studies that included primarily whiplash patients, there were 4 placebo or sham comparison groups and a total of 3 possible treatment contrasts with placebo or sham groups (Figure 2, available online through Article Plus). Two studies looked at medications, whereas 1 involved pulsed electromagnetic therapy (PEMT) for whiplash symptoms. Twenty-one (21) additional contrasts dealt with the relative effectiveness of nonplacebo or sham comparators. Detailed summaries of the accepted whiplash studies are given in Evidence Table 1 (available online through Article Plus).

Briefly, sample sizes ranged from 40 to over 6000; episode durations ranged from less than 24 hours to 13 weeks; follow-up times ranged from 2 weeks to 3 years; and neck pain, disability, and range of motion were the most commonly reported outcomes. Patients presenting for care with Grade I or II neck pain (with or without interference of daily activities) of less than 6 weeks' duration predominated in these studies.

Other ("Nonspecific") Neck Pain and Associated Disorders. Among the nonwhiplash studies, 12 included surgeries or injections and are covered in a separate article of the Neck Pain Task Force report.[2] Briefly, among the 20 possible contrasts in these studies, 15 involved 1 type of surgery *versus* another; 2 compared surgery with a placebo or sham procedure; 1 compared surgery with usual care; 1 compared surgery with multimodal treatment; and 1 compared surgery with no treatment (Figure 2, available online through Article Plus). Additional studies focused on adverse reactions of cervical injections[10,17,41] and surgery.[21] Of all the intervention studies involving treatments for neck pain not associated with WAD, 16 included placebo or sham controls involving 29 possible contrasts. Ninety-one (91) additional treatment-group contrasts dealt with the relative effectiveness of nonplacebo or sham comparators. Out of a total 153 possible contrasts involving nonplacebo interventions, 31 (20%) involved manual therapies, 24 involved active exercise (16%), and an additional 11 included manual therapies plus exercise groups (7%). No treatment was included in 17 contrasts (11%), acupuncture in 10 contrasts (7%), and multimodal treatments and advice was included in 7 and 8 contrasts (5%), respectively.

Thirteen studies were performed entirely in populations of workers.[6,7,15,42–51] Detailed summaries of the accepted studies of noninvasive interventions for neck pain not associated with whiplash are given in Evidence Table 2 (available online through Article Plus).

Briefly, sample sizes ranged from 20 to over 3000; episode durations ranged from less than 2 weeks to more than a year; follow-up times ranged from immediate post-treatment to 6 years; and neck pain, disability, and perception of pain relief were the most frequently reported outcomes, with visual analogue or numerical pain scales being the most common outcome measures. Patients presenting for care with Grade I or II neck pain of at least 6 weeks' duration predominated in these studies; only 1 study included Grade III (neck pain with neurologic signs.[52]

Studies of Complications

We accepted 7 studies of complications: a case-control study of the possible association between chiropractic care and stroke,[20] 2 case series on cerebrovascular accidents and manipulation[18,19]; 3 large case series of complications associated with cervical injections[10,17,41]; and a large cohort of complications and mortality associated with surgery for degenerative disease of the cervical spine.[21] The surgical complications are reviewed in detail elsewhere in the Neck Pain Task Force report.[2] The results from the original research conducted by the Neck Pain Task Force on vertebral basilar stroke following chiropractic care[53,54] were included in the analysis of these intervention modalities.

Descriptive data on adverse reactions or "harms" and more severe complications ("adverse events") were included in many of the accepted intervention studies; however, in most of these studies, the small frequencies do not allow for meaningful inferences. We also screened several case reports and small case series that included data on harms and adverse events possibly related to interventions for neck pain, but because of inherent limitations in the data, we could not accept these reports in our best evidence synthesis.

Systematic Reviews

Of the 30 accepted systematic reviews, 9 were Cochrane Collaboration reviews; 2 were best evidence syntheses[1,55]; and 1 was a systematic review of systematic reviews.[56] One review dealt with surgery for cervical radiculopathy or radiculomyelopathy[57]; another looked at the efficacy of radiofrequency procedures.[58] Two reviews dealt with cervical interbody fusion techniques.[59,60] The reviews involving invasive interventions are discussed in a separate article of the Neck Pain Task Force report.[2]

Of the nonsurgical reviews, one focused on any interventions,[1] and 2 dealt with noninvasive interven-

Table 1. Clinically Relevant Differences in Pain or Disability Outcomes Between Intervention [Equal (=), Better (+), Worse (−)] and Comparator Included in Efficacy or Effectiveness Studies of Whiplash-Associated Disorders, by Intervention and Type of Comparator*

First Author (yr)	Episode Duration	Baseline N	Intervention	Outcomes†	Follow-Up (in wk)	Placebo or Sham	"Usual Care"	No Care
Barnsley (1994)[1]	>3 mo	42	Corticosteroid injection	Pain	20	(=)		
Pettersson (1998)[2]	<8 h	40	Methylprednisolone	Pain/recovery/sick leave	2, 6, 26	(=)		
Foley-Nolan (1992)[3]	<72 h		Pulsed electromagnetic therapy	Pain	12	(+)		
Borchgrink (1998)[4]	Acute	201	Immobilization with soft collar	Pain/sick leave	6, 26		(=)	
Scholten-Peeters (2006)[5]	≥4 wk	80	Multimodal physical therapy (advice, exercise therapy)	*Pain/HA/work ADLs*	8, 12, 26, 52		(=)	
Ferrari (2005)[6]	<72 h	112	Educational pamphlet	*Recovery*	13		(=)	
Cassidy (2007)[7]	<6 wk	6021	Fitness training plus usual care	*Recovery*	52		(=/−)	
Cassidy (2007)[7]	<6 wk	6021	Outpatient rehabilitation plus usual care	*Recovery*	52		(=/−)	
Cassidy (2007)[7]	<6 wk	6021	Multidisciplinary hospital rehabilitation plus usual care	*Recovery*	52		(=)	
Mealy (1986)[8]	Acute	61	Mobilization plus exercise	Pain	4, 8		(+)	
Rosenfeld (2000, 2003)[9,10]	<96 h	102	McKenzie-type exercises	Pain/recovery/sick leave/costs	26, 156		(+)	
McKinney (1989)[11]	Acute	247	Physical therapy (modalities) plus mobilization	Pain	4,8		(+)	
McKinney (1989)[12]	Acute	247	Advice, home exercises, and mobilization	Pain	4, 8		(+)	
Suissa (2006)[13]	>8 d	2163	Whiplash management model (coordinated multidisciplinary care)	Compensation time/costs	52		(+)	
Brison (2005)[14]	<24 h	405	20-min educational video sent to patient's home	*Pain*	24		(+)	
Oliveira (2006)[15]	Acute	126	12-min educational video at patient's bedside	Pain/disability	4, 13, 26		(+)	
Gennis (1996)[16]	<24 h	250	Soft collar	Pain	>6			(=)

References are appended in Table 5.
*(=) denotes lack of clinically relevant difference observed between intervention and comparator; (+) or (−) denotes clinically relevant difference between intervention and comparator.
†Primary in *italics*.
HA indicates headache; ADLs, activities of daily living.

tions[61,62] for WAD. All other reviews were of primarily non-WAD studies:

- conservative therapies for "mechanical" neck disorders[63,64]
- multidisciplinary rehabilitation for chronic "nonspecific" neck and shoulder pain[65]
- exercise therapy for "mechanical" neck disorders[66,67] or chronic pain[68]
- electrotherapy for acute, subacute, and chronic "mechanical" neck disorders[69,70]
- traction for neck pain[71,72]
- acupuncture interventions[72,73]
- low-level laser therapy[74]
- complementary/alternative therapies for tension-type and cervicogenic headache[75]
- spinal manipulative therapy (SMT) for cervicogenic headache[76] and for chronic headache[77,78]

Manipulation and mobilization for neck pain were dealt with in 5 reviews[55,79–85]; massage was the focus of another.[82,84]

A Cochrane review of medicinal and injection therapies included WAD patients as well as other "mechanical" neck disorder patients,[86,87] as did a review of treatments used by physiotherapists.[88]

The systematic review of systematic reviews focused on conservative management strategies for neck pain.[56] Detailed summaries of the accepted systematic reviews are given in Evidence Table 3 (available online through Article Plus).

Prevention Studies

We accepted only one study designed to evaluate (in part) the effectiveness of strategies for the prevention of neck pain or associated disorders.[46]

Studies of Noninvasive Interventions for Persons With Whiplash-Associated Disorders

Table 1 presents the efficacy and effectiveness studies of WAD by intervention and type of comparator (placebo, "usual care," or no treatment), and shows whether clinically important differences in pain or function were observed between each intervention and its comparator. Table 2 presents the relative effectiveness studies of WAD by pairs of interventions and shows whether clinically important differences in pain or function were observed between interventions in each pair.

Education or Advice. Twelve WAD studies included education or advice as components of the intervention, although only 4 studies had intervention arms where edu-

Table 2. Clinically Relevant Differences in Pain or Disability Outcomes Between One Intervention [Equal (=), Better (+)] and Another Intervention Among Intervention Pairs Included in Relative Effectiveness Studies of Whiplash-Associated Disorders*

First Author (yr)	Episode Duration	Baseline N	Outcomes†	Follow-up (in wk)	Intervention 1	Difference	Intervention 2
McKinney (1989)[11]	Acute	247	Pain	4, 8	Physical therapy (modalities) plus mobilization	(=)	Advice, home exercises, and mobilization
Kongsted (2007)[17]	<10 d	458	*Pain/disability/HA*	52	Rigid collar followed by exercise/mobilization	(=)	Advice focusing on fear reduction, staying active
Kongsted (2007)[17]	<10 d	458	*Pain/disability/HA*	52	Rigid collar followed by exercise/mobilization	(=)	Exercises/mobilization
Bunketorp (2006)[18]	6–13 wk	49	*Pain/disability* Sick leave	13, 39	Supervised training rehabilitation	(+) [13] (=) [39]	Instruction in home exercises
Provinciali (1996)[19]	<60 d	60	Pain/recovery/sick leave	26	Multimodal treatment (relaxation training, eye-fixation exercises, manual treatment)	(+)	Passive modalities (TENS, ultrasound)
Côté (2005)[20] and (2007)[21]	<30 d;<30 d	2486;1693	*Time to claim closure*	Variable	Low use (1–2 visits) GP care (2 studies)	(+) (+)	High use (>6 visits) DC care
Stewart (2007)[22]‡	13–52 wk	134	*Pain/function* Disability/perceived effect/work status	6, 52	Advice plus supervised and home exercises	(+/=) [6] (=) [52]	Advice alone

References are appended in Table 5.
*(=) denotes lack of clinically relevant difference observed between interventions in the pair; (+) denotes clinically relevant difference between interventions in the pair.
†Primary in *italics.*
‡Published after deadline for inclusion in best evidence synthesis.
TENS indicates transcutaneous electrical nerve stimulation; GP, general practitioner; DC, Doctor of Chiropractic.

cation or advice predominated, and among these studies, the mode of delivery varied.

For example, educational videos were used in 2 studies,[12,89] whereas pamphlets were distributed in others.[90,91] Ferrari *et al*[90] found no beneficial effect of a one-page pamphlet of evidence-based whiplash prevention information on patient perceived recovery at 2 weeks or 3 months. Pamphlets emphasizing the good prognosis of whiplash were distributed to all participants in the Kongsted *et al*[91] trial, which found no clinically meaningful differences between rigid collar, usual care with an emphasis on fear reduction and resuming normal activities, and active mobilization at 1 year.

In contrast, educational videos were shown to have beneficial effects on improvement in pain among acute whiplash patients in an RCT[89] and a pseudorandomized study,[12] although the differences between the usual care and video groups were much less dramatic in the RCT, in which patients were mailed the 20-minute video that provided reassurance, home exercises, and advice on early return to usual activities.[89] The pseudorandomized trial found that, compared with patients receiving usual care, patients who watched at bedside a 12-minute psychoeducational video emphasizing behavioral and home exercise interventions and breathing relaxation for muscle tension had lower pain ratings at 1, 3, and 6 months; they also used much less medication and had lower rates of health-care utilization.[12]

Exercise Interventions. None of the accepted studies of WAD patients assessed the effectiveness of exercise *per se*, although exercises were predominant components in 7 accepted studies.[8,91–97] On average, acute or subacute WAD patients in intervention groups that included eye fixation exercises or active McKenzie-type exercises had better prognoses than patients assigned to passive modalities or soft collars.

Patients receiving physical therapy care that included a large exercise component did not fare better than those receiving care from GPs who focused primarily on education.[97] However, 12 weeks after starting therapy, patients with subacute WAD (duration of 6 weeks to 3 months) who received supervised physical training were using less analgesic medication and showed greater improvements in self-efficacy, fear of movement, and pain-related disability than did the group instructed to exercise at home.[92] Differences were less apparent at 9 months, and the groups had comparable rates of sick leave. (These findings are supported by findings from a study published after our deadline, and therefore not reviewed. In that study, patients with 3 to 12 months of postinjury pain and disability who were assigned to advice plus 6 weeks of exercise sessions had slightly greater reductions in pain than those given advice alone at 6 weeks but not at 12 months. Changes in disability and quality of life were clinically similar, and there were no differences in employment status at either time point.[98])

Patients treated with mobilization exercises did not fare better than those given either rigid collars or advice in the aforementioned Kongsted trial.[91] Referral to fitness training or to outpatient or inpatient multidisciplinary rehabilitation programs for whiplash resulted in similar or slower self-reported recovery rates than usual care alone in a population-based cohort study.[8]

Medications. Two WAD studies evaluated the efficacy of medications.[99,100] Corticosteroid injections were not efficacious for patients with chronic zygapophysial joint pain; however, infusion of methylprednisone in acute whiplash patients took fewer sick days over 6 months and experienced less disabling pain than those in the placebo group. We were unable to identify any studies that evaluated the effectiveness of commonly used analgesic medications, including acetaminophen, nonsteroi-

dal anti-inflammatory drugs (NSAIDs), and narcotics, or studies of muscle relaxants and antidepressant medications in WAD. Medications were components of the "usual care" protocols in several studies, however.

Manual Therapies. Four studies (in 5 reports) evaluated the effectiveness of manual therapies for patients with WAD.[93–96,101] Interventions involving *mobilization* were more effective than usual care (including soft collars) or general advice. Compared with *passive* modalities, multimodal treatment—including relaxation training and manual treatment—resulted in quicker return to work and greater satisfaction with recovery.

Physical Modalities. Physical modalities were evaluated in 2 studies. One study found that acute WAD patients assigned to low-energy, high-frequency, PEMT had less pain and reduced use of analgesics compared with similar patients assigned to an inactive unit.[102] Another study found that passive modalities [*e.g.*, transcutaneous electrical nerve stimulation (TENS), ultrasound] were inferior to a package of physical and psychological interventions.[94]

Collars. Soft collars were included as components of interventions in several studies. These were found to be of either no benefit or less benefit when compared with active therapies, advice that patients should rest, and usual care. One nonrandomized intervention study showed that most whiplash patients experienced pain for 6 weeks or longer regardless of collar use.[9] Persons given sick leave and soft collars within 2 weeks of their whiplash injuries fared no better than those who were encouraged to engage in their usual activities.[103] Immobilization in rigid collars for 2 weeks followed by active mobilization was found to be no more effective than active mobilization within 72 hours of symptom onset in acute whiplash; nor was the use of rigid collars for 2 weeks found to be more effective than usual care.[91]

Combined Approaches. One study compared physical modalities for acute whiplash treatment with a multimodal package consisting of relaxation and postural training, psychological support, manual therapy, and eye fixation exercises. Researchers found the multimodal strategy resulted in greater patient satisfaction and a quicker return to work, although average pain reductions in both groups were similar.[94]

A coordinated multidisciplinary treatment approach for acute whiplash patients adapted from a model designed for injured workers was evaluated in a nonrandomized, population-based study. Compared to a "usual approach," this intervention resulted in reduced time on compensation, quicker time to file closure, and fewer average total costs.[13] However, another nonrandomized study, which studied the effectiveness of a province-wide rehabilitation program (based on recommendations of the Québec Task Force)[1] in an entire population, found that, compared with usual primary care alone, patients referred to in- or out-patient multidisciplinary rehabilitation programs did not do better in terms of self-reported recovery rates.[8] Differences in interventions, populations, compliance, and possible selection bias are among the factors that may explain the disparate findings.

Patterns of Care. Two population-based cohort studies in Saskatchewan looked at provider types and frequency of visits in the first 30 days following a traffic collision as predictors of "time to claim closure" as a proxy for recovery from whiplash injury.[32,33] In 1 cohort, GP patients with 1 or 2 visits had the fastest time to claim closure; chiropractic patients with more than 6 visits had the slowest time to claim closure.[32] In the other cohort, medical patients without chiropractic visits had the fastest time to claim closure; GP patients with more than 6 chiropractic visits had the slowest time to claim closure.[33] Because this was a large, population-based cohort study, it should be noted that the optimal type and frequency of health care visits (in the first 30 days postinjury) may not apply to individual cases; and it is likely that the optimal type and frequency of acute WAD health care varies by injury severity (*e.g.*, WAD Grade) and patient characteristics (*e.g.*, age, gender, health).

Safety of Interventions. No adverse reactions or serious adverse events were reported in any of the whiplash trials of noninvasive interventions. Minor self-limiting side effects were reported in a few studies.

Systematic Reviews. In 1995, the Québec Task Force on WAD published a best evidence synthesis of interventions for WAD.[1] This task force concluded that manual and physical therapies which facilitate mobilization, as well as certain prescription medications may be beneficial. They also concluded that surgery is rarely indicated, and that soft collars and rest may be harmful in whiplash-related disorders.

Since the publication of this landmark study, several other reviews have focused on the growing neck pain literature:

- A 1999 review of treatments used by physiotherapists also found evidence to support active and passive movements in the early stage after whiplash; but the review found weaker evidence for manipulative treatment.[88]
- In 2003, a review by Sarig-Bahat found "moderate" evidence for mobilization in acute whiplash, and conflicting evidence regarding the effectiveness of exercise as 1 component of multimodal care.[67]
- A decade after the Québec Task Force report, Conlin *et al*[61] reviewed the noninvasive intervention literature and concluded that mobilization may be the most effective of these interventions for reducing pain and increasing range of motion in acute WAD. The reviewers also concluded that exercise alone was of no benefit in increasing these patients' range of motion.
- A Cochrane review published in 2006 found that, relative to placebo, intravenous injection of methyl-

prednisolone reduced short-term (1 week) pain and sick leave, but no effect could be seen at long-term follow up (6 months).[86,87] With the exception of a possible immediate post-treatment benefit of pulsed electromagnetic field therapy, evidence for the effectiveness of electrotherapies in the treatment of acute neck pain was found lacking in a recent Cochrane review.[70]

- Despite an explosion of the neck-pain literature including several methodologically sound studies in the past decade, there remains limited or conflicting evidence for most of the therapies commonly given to WAD patients. Our best evidence synthesis, along with the most recent Cochrane Collaboration review, largely confirms this conclusion. In the latter systematic review, Verhagen *et al* found a trend toward active interventions being more effective than passive ones. But because of conflicting evidence and few high-quality studies, no firm conclusions could be drawn about the most effective noninvasive interventions for patients with chronic WAD.[62]

Cost and Cost-Benefit. Only 1 scientifically admissible study of WAD patients, a nonrandomized population-based intervention trial, included direct or indirect costs or health-care resource use data associated with diagnosis and treatment. Coordinated, multidisciplinary treatment (including active physical therapy, home exercise, reassessments as needed, and communication between disciplines) was associated with fewer costs than the usual treatment approach for patients with acute WAD.[13] Selection factors may have influenced cost differences between groups, however.

The 2 aforementioned population-based cohort studies found positive associations between high health-care utilization and slower rates of recovery from WAD.[32,33] This suggests that health care may promote passive coping. It may also mean that patients predisposed to passive coping or those who possess qualities linked to poorer prognosis may be inclined to use more health services.

Studies of Noninvasive Interventions for Persons With Other ("Nonspecific") Neck Pain and Associated Disorders

Table 3 presents the efficacy and effectiveness studies of other (often referred to in the literature as "nonspecific") neck pain and associated disorders by intervention and type of comparator (placebo, "usual care," or no treatment). It shows whether clinically important differences in pain or function were observed between each intervention and its comparator. Table 4 presents the relative effectiveness studies of other ("nonspecific") neck pain by pairs of interventions. It shows whether clinically important differences in pain or function were observed between interventions in each pair.

Education or Advice. Seventeen studies of "nonspecific" neck pain included education or advice as components of the intervention under investigation, although advice was not usually the major part of the intervention, and the type of education or advice varied from 1 study to the next (*e.g.*, ergonomic and postural *vs.* exercise and self care).

When referral to surgery was part of a multimodal physical therapy intervention for patients with Grade III neck pain, those who received ergonomic and postural advice fared better in the short-term than those receiving a collar.[52] (However, this difference might relate more to iatrogenic effect of the collar than to the effectiveness of the multimodal intervention.)

Advice geared toward self-efficacy with no physical therapeutic intervention yielded benefits when compared to usual physical therapy care (simple advice, modalities, mobilization, and exercise).[104] However, advice to stay active was less effective than naprapathic manual treatment at 7 and 12 weeks for persons with neck pain of at least 2 weeks' duration.[48]

Exercise Interventions. Intervention arms of exercise therapies were included in 12 trials (in 18 published reports) of "nonspecific" neck pain or associated disorders.[15,36,43,46,77,105–117] Because the exercise arms of many studies also included nonexercise components, exercise-specific effects are nonestimable in these trials. Here are some brief findings from the intervention arms of these exercise therapy studies:

- For nonacute neck pain, strengthening exercises alone or combined with SMT resulted in better pain and disability outcomes than did SMT alone after 1 and 2 years.[77,106]
- Compared with usual analgesic use, massage and at-home strength and mobility exercises reduced the intensity and number of trigger points among patients with chronic neck-shoulder trigger points.[107]
- Twelve weeks of isometric shoulder endurance *versus* shoulder strength training yielded equivalent clinical outcomes among females with work involving repetitive motion and gradual onset neck or shoulder pain.[43]
- In another study of females with chronic or recurrent neck pain, both endurance and strength training yielded better 12-month pain and disability outcomes than did an exercise advice control group[118] and only the training groups experienced increased pressure pain thresholds.[114]
- Twelve sessions of exercises as part of a 6-week physical therapy program were less effective than manual therapy but more effective than usual general practitioner care in the short-term for patients with "nonspecific" neck pain lasting 2 weeks or more.[36,108,109] However, compared with physiotherapy and chiropractic care, a 6-week program of intensive training of the cervical musculature resulted in greater endurance for chronic neck-pain patients, but there was no difference in pain and disability after 6 months.[110]
- In the aforementioned trial by Chiu *et al*, patients who received exercise and TENS fared similarly; both

Table 3. Clinically Relevant Differences in Pain or Disability Outcomes Between Intervention [Equal (=), Better (+), Worse (−)] and Comparator Included in Efficacy or Effectiveness Studies of Nonspecific Neck Pain or Associated Disorders, by Intervention and Type of Comparator*

First Author (yr)	Study Pop.	Episode Duration	Baseline N	Intervention	Outcomes†	Follow-Up (in wk)	Placebo or Sham	"Usual Care"	No Care
Hong (1982)[23]	Volunteers	>1 yr	101	Magnetic necklace	Pain	3	(=)		
Karppinen (1999)[24]	Workers		40	Occlusal adjustment	Pain/discomfort	6, 52, 260	(=)		
Koes (1991, 1992a,b,c; 1993)[25–27]	GP pts, gen. pop.	≥6 wk	64	Physical therapy (exercises, massage, modalities)	*Pain/disability/global effect*	3, 6, 12, 26, 52	(=)		
Koes (1991, 1992a,b,c; 1993)[25–27]	GP pts, gen. pop.	≥6 wk	64	Manual therapy (manipulation/ mobilization)	*Pain/disability/global effect*	3, 6, 12, 26, 52	(=)		
Gam (1998)[28]	Referrals to rheum.	>3 mo	67	Ultrasound, massage and exercises	Pain/tenderness	6, 42	(=)		
Wheeler (2001)[29]	Gen. pop. volunteers	≥3 mo	50	Botulinum toxin A	*Pain/disability*	Immediate	(=)		
					Harms	4, 8, 12, 16	(−) [harms]		
Ozdemir (2001)[30]	PM&R pts	?	60	Low level laser therapy	Pain/disability	10 d	(+)		
Ceccherelli (1989)[31]	Women	?	27	Low level laser therapy	Pain/disability	3, 13	(+)		
Gur (2004)[32]	Referrals	≥1 yr	60	Low level laser therapy	*Pain/disability* Improvement	2, 3, 12	(+)		
Chow (2006)[33]	GP pts	>3 mos	90	Low level laser therapy	*Pain* Disability/global improvement	7, 12	(+)		
Thorsen (1992)[34]	♀ Workers	≥1 yr	52	Low level laser therapy	*Pain/disability*	2, 4, 12	(=)		
Irnich (2002)[35]	PM&R, pain pts	>2 mo	36	Trigger-point therapy	Pain/global improvement	15–30 min	(=)		
Irnich (2002)[35]	PM&R, pain pts	>2 mo	36	Acupuncture	Pain/global improvement	15–30 min	(+)		
Vas (2006)[36]	Pri. care pain pts	>3 mos	123	Acupuncture (TENS placebo)	*Pain* Disability	4, 30	(+)		
Irnich (2001)[37]	GP referrals, gen. pop.	>1 mo	177	Acupuncture (laser acupuncture placebo)	*Pain* global improvement	4, 16	(=)		
He (2004, 2005)[38,39]	♀ Workers	≥3 mo	24	Acupuncture (body and electroacupuncture)	Pain/HA/disability	4, 30, 160	(+)		
Sterling (2001)[40]	Manip. PT pts	>3 mo	30	Mobilization [physical therapist]	Pain/pressure pain threshold	Immediate	(+)		
Høivik (1983)[41]	Patients	?	44	Orphenadrine/ paracetamol	Pain	8 d	(+)		
Yamamoto (1983)[42]	Patients	?	149	Piroxicam	Pain/physician-perceived improvement	1, 2	(+)		
Yamamoto (1983)[42]	Patients	?	149	Indomethicin	Pain/physician-perceived improvement	1, 2	(+)		
Berry (1981)[43]	Patients	≥3 mo	20	Benorylate alone (analgesic)	Pain/stiffness/sleep/ perceived effectiveness	4 wk	(+/=)		
Berry (1981)[43]	Patients	≥3 mo	20	Chlormezanone alone (muscle relaxant anxiolytic)	Pain/stiffness/sleep/ perceived effectiveness	4 wk	(+/=)		
Berry (1981)[43]	Patients	≥3 mo	20	Benorylate + chlormezanone	Pain/stiffness/sleep/ perceived effectiveness	4 wk	(+)		
White (2000)[44]	Patients	≥3 mo	68	Percutaneous neuromodulation therapy	Pain/disability/sleep	Immediate 1 d, 3 wk	(+)		
Cleland (2005)[45]	Pri. care refs to ortho PT	?	36	Thoracic manipulation [physical therapist]	Pain	<5 min	(+)		
Smania (2005)[46]	Patients	?	53	Magnetic stimulation	Pain/disability	10 d, 4, 13	(+)		
Smania (2005)[46]	Patients	?	53	TENS	Pain/disability	10 d, 4, 13	(+) [10 days] (=) [4,13]		
Gam (1998)[29]	Referrals to rheum.	>3 mo	67	Ultrasound, massage, and exercises	Pain/tenderness	6, 42		(=)	
Horneij (2001)[47]	♀ Workers	?	282	Individual physical training	Pain/disability	52, 78		(=)	
Horneij (2001)[47]	♀ Workers	?	282	Stress management program	Pain/disability	52, 78		(=)	

(*Continued*)

Table 3. Continued

First Author (yr)	Study Pop.	Episode Duration	Baseline N	Intervention	Outcomes†	Follow-Up (in wk)	Placebo or Sham	"Usual Care"	No Care
Koes (1991, 1992abc, 1993)[26–28]	GP pts, gen. pop.	≥6 wk	64	Manual therapy (manipulation/ mobilization) [manual therapist]	*Pain/disability/global effect*	3, 6, 12, 26, 52		(=)	
Hoving (2002, 2006)[48;49]/ Korthals-de Bos (2003)[50]	GP pts	≥2 wk	183	Manual therapy (mobilization) [manual therapist]	*Pain/disability/ perceived recovery* Costs (cost eff.)	7, 13, 26, 52		(+) [7,13] (+/ =) [26,52] (+) [CE]	
Koes (1991, 1992abc, 1993)	GP pts, gen. pop.	≥6 wk	64	Physical therapy (exercises, massage, modalities)	*Pain/disability/global effect*	3, 6, 12, 26, 52		(=)	
Hoving (2002, 2006)[26–28]/Korthals-de Bos (2003)[50]	GP pts	≥2 wk	183	Physical therapy (sessions of exercises)	*Pain/disability/ perceived recovery* Costs (cost eff.)	7, 13, 26, 52		(+) [7,13] (=) [26,52] (=) [CE]	
Ekberg (1994)[51]	Workers	≥2 mo	107	Active rehabilitation (exercises, education, information)	Pain/sick leave	52, 104		(=/−)	
Taimela (2000)[52]	Workers	>3 mo	76	Multimodal exercise plus relaxation, behavioral support	Pain/disability/ overall benefit	13, 52		(+) [13] (=) [52]	
Taimela (2000)[52]	Workers	>3 mo	76	Practical training on home exercises	Pain/disability/ overall benefit	13, 52		(+) [13] (=) [52]	
Witt (2006)[53]/Willich (2006)[54]	GP pts	>6 mo	3451	Acupuncture plus usual medical care	*Pain/disability* Harms Costs (cost eff.)	13, 26		(+) (+)[CE]	
Ylinen (2003, 2005)[55,56]	♀ Workers	>6 mo	179	Endurance training plus dynamic exercise	Pain/disability/ perceived recovery	52		(+)	
Ylinen (2003, 2005) [55,56]	♀ Workers	>6 mo	179	Strength training plus dynamic exercise	Pain/disability/ perceived recovery	52		(+)	
Zylbergold and Piper (1985)[57]	Physical med. pts	?	100	Static, intermittent, or manual traction plus moist heat and exercise program	Pain	≤6		(+/=)	
Viljanen (2003)[58]	♀ Workers	≥12 wk	393	Dynamic muscle training	Pain/disability/work ability	13, 26, 52			(=)
Viljanen (2003)[58]	♀ Workers	≥12 wk	393	Relaxation training	Pain/disability/work ability	13, 26, 52			(=)
Aaras (1998, 2001)[59,60]	Workers	?	181	Multiple ergonomic interventions	Pain	104, 312			(=)
Jull (2002)[61]/Stanton and Jull (2003)[62]	PT pts	1 HA/w for ≥ 2 mo	200	Manipulation/ mobilization [physical therapist]	*HA frequency* intensity/length/ neck pain/ perceived effect	52			(+)
Jull (2002)[61]/Stanton and Jull (2003)[62]	PT pts	1 HA/wk for ≥ 2 mo	200	Sessions of exercise therapy	*HA frequency* intensity/length/ neck pain/ perceived effect	52			(+)
Jull (2002)[61]/Stanton and Jull (2003)[62]	PT pts	1 HA/wk for ≥ 2 mo	200	Manipulation/ mobilization plus exercise therapy	*HA frequency* intensity/length/ neck pain/ perceived effect	52			(+)
Sterling (2001)[40]	Manip. PT pts	> 3 mo	30	Mobilization [physical therapist]	Pain/pressure pain threshold	Immediate			(+)
van den Heuvel (2003)[63]	Workers	≥2 wk	268	Computer software (forced work breaks)	*Perceived recovery* pain/sick leave	8			(+) [recovery] (=) [pain/ sick leave]
van den Heuvel (2003)[63]	Workers	≥2 wk	268	Computer software (forced work breaks) plus exercise	*Perceived recovery* pain/sick leave	8			(+) [recovery] (=) [pain/ sick leave]

References are appended in Table 5.
* (=) denotes lack of clinically relevant difference observed between intervention and comparator; (+) or (−) denotes clinically relevant difference between intervention and comparator.
†Primary in *italics.*
GP indicates general practitioner; PM&R, physical medicine and rehabilitation; PT, physical therapist; TENS, transcutaneous electrical nerve stimulation; HA, headache; CE, cost effectiveness.

Table 4. Clinically Relevant Differences in Pain or Disability Outcomes Between One Intervention [Equal (=), Better (+)] and Another Intervention Among Intervention Pairs Included in Relative Effectiveness Studies of Nonspecific Neck Pain or Associated Disorders*

First Author (yr)	Study Pop.	Episode Duration	Baseline N	Outcomes†	Follow-Up (in wk)	Intervention 1	Difference	Intervention 2
Brodin (1983)[64]	Patients	?	71	Pain	3, 4	Salicylate plus advice and mobilization	(+)	Salicylate only
Brodin (1983)[64]	Patients	?	71	Pain	3, 4	Salicylate plus advice and mobilization	(+)	Salicylate plus advice, massage, electrical stimulation, and traction
Brodin (1983)[64]	Patients	?	71	Pain	3, 4	Salicylate plus advice, massage, electrical stimulation, and traction	(+)	Salicylate only
David (1998)[65]	Pri. care, specialty refs	>6 wk	70	Pain/disability	6, 26	Acupuncture	(=)	Physical therapy (mobilization and traction)
Irnich (2001)[35]	GP referrals, gen. pop.	>1 mo	177	*Pain* Global improvement	4, 16	Acupuncture	(+)	Massage
Irnich (2002)[37]	PM&R, pain pts	>2 mo	36	Pain/global improvement	15–30 min	Acupuncture	(+)	Trigger point therapy
Yamamoto (1983)[42]	Patients	?	149	Pain/physician-perceived improvement	1, 2	Piroxicam	(=)	Indomethicin
Berry (1981)[43]	Patients	≥3 mo	20	Pain/stiffness/sleep/perceived effectiveness	4	Chlormezanone (muscle relaxant anxiolytic)	(=)	Benorylate (analgesic)
Berry (1981)[43]	Patients	≥3 mo	20	Pain/stiffness/sleep/perceived effectiveness	4	Chlormezanone + benorylate	(+/=)	Benorylate (analgesic)
Berry (1981)[43]	Patients	≥3 mo	20	Pain/stiffness/sleep/perceived effectiveness	4	Chlormezanone + benorylate	(+/=)	Chlormezanone (muscle relaxant anxiolytic)
Dziedzic (2005)[66]	GP refs to PT	>3 mo (77%)	350	*Disability* Global improvement/ sick leave	6, 26	Advice about coping, individualized home exercise program	(=)	Advice about coping, individualized home exercise program, and manual therapy (manip/ mobilization)
Dziedzic (2005)[66]	GP refs to PT	>3 mo (77%)	350	*Disability* Global improvement/ sick leave	6, 26	Advice about coping, individualized home exercise program	(=)	Advice about coping, individualized home exercise program, and shortwave diathermy
Dziedzic (2005)[66]	GP refs to PT	>3 mo (77%)	350	*Disability* Global improvement/ sick leave	6, 26	Advice about coping, individualized home exercise program, and manual therapy (manip/ mobilization)	(=)	Advice about coping, individualized home exercise program, and shortwave diathermy
Hagberg (2000)[67]	♀ Workers	≥3 mo	77	*Pain*	4, 8, 12, 16, 24	Endurance training	(=)	Strength training
Martinez-Segura (2006)[68]	Pri. care refs to PTs/DOs	≥1 mo	71	Pain	5 min	Manipulation [PT/DO]	(+)	Mobilization [PT/DO]
Hurwitz (2002)[69]	Pri. care, DC pts	Any length	336	Pain/disability/harms	2, 4, 6, 13, 26	Manipulation [DC]	(=) (−) [harms]	Mobilization [DC]
Koes (1991, 1992abc, 1993)[26–28]	GP pts, gen. pop.	≥6 wk	64	*Pain/disability/global effect*	3, 6, 12, 26, 52	Manual therapy (manip/mobilization) [manual therapist]	(=)	Physical therapy (exercises, massage, modalities)
Hoving (2002, 2006)[48,49]/ Korthals-de Bos (2003)[50]	GP pts	≥2 wk	183	*Pain/disability/perceived recovery* Costs (cost eff.)	7, 13 26, 52	Manual therapy (mobilization) [manual therapist]	(+) [7] (=) [13–52] (+) [CE]	Physical therapy (sessions of exercises)
Wood (2001)[70]	DC pts, gen. pop.	≥1 mo	30	Pain/disability	4, 8	Instrumental manipulation [DC]	(=)	High-velocity, low-amplitude manipulation [DC]
Hurwitz (2002)[69]	Pri. care, DC pts	Any length	336	Pain/disability/harms	2, 4, 6, 13, 26	Electrical muscle stimulation	(=)	No electrical muscle stimulation
Hurwitz (2002)[69]	Pri. care, DC pts	Any length	336	Pain/disability/harms	2, 4, 6, 13, 26	Moist heat	(=)	No moist heat

(*Continued*)

Table 4. Continued

First Author (yr)	Study Pop.	Episode Duration	Baseline N	Outcomes†	Follow-Up (in wk)	Intervention 1	Difference	Intervention 2
Jordan (1998)[71]	Refs to ortho. dept.	>3 mo	119	*Pain/disability/perceived effect/physician global assessment*	6, 17, 52	Advice and home exercises plus intensive training of cervical musculature	(=)	Advice and home exercises plus physical therapy (mobilization and traction)
Jordan (1998)[71]	Refs to ortho. dept.	>3 mo	119	*Pain/disability/perceived effect/physician global assessment*	6, 17, 52	Advice and home exercises plus intensive training of cervical musculature	(=)	Advice and home exercises plus manipulation [DC]
Jordan (1998)[71]	Refs to ortho. dept.	>3 mo	119	*Pain/disability/perceived effect/physician global assessment*	6, 17, 52	Advice and home exercises plus physical therapy (mobilization and traction)	(=)	Advice and home exercises plus manipulation [DC]
Klaber Moffett (2005)[72]/ Manca (2006)[73]	GP refs to PTs	≥2 wk	268	Pain/disability Costs (cost eff.)	13, 52	Brief intervention with cognitive behavioral principles	(=) [CE] (+)	Advice, mobilization, physical modalities, and exercise
Horneij (2001)[47]	♀ Workers	?	282	Pain/disability	52, 78	Individual physical training	(=)	Stress management program
Taimela (2000)[52]	Workers	>3 mo	76	Pain/disability/overall benefit	13, 52	Multimodal exercise plus relaxation, behavioral support	(=)	Practical training on home exercises
Ylinen (2003, 2005)[55,56]	♀ Workers	>6 mo	179	Pain/disability/perceived recovery	52	Endurance training	(=)	Strength training
van den Heuvel (2003)[63]	Workers	≥2 wk	268	*Perceived recovery* Pain/sick leave	8	Computer software (forced work breaks)	(+) [recovery] (=) [pain/ leave]	Computer software (forced breaks) plus exercise
Viljanen (2003)[58]	♀ Workers	≥12 wk	393	Pain/disability/work ability	13, 26, 52	Dynamic muscle training	(=)	Relaxation training
Bronfort (2001)[74]/Evans (2002)[75]	Gen. pop.	≥12 wk	191	Pain/disability	26, 52, 104	Strengthening exercises plus manipulation [DC]	(+)	Manipulation alone [DC]
Bronfort (2001)[74]/Evans (2002)[75]	Gen. pop.	≥12 wk	191	Pain/disability	26, 52, 104	Strengthening exercises	(+)	Manipulation [DC]
Chiu (2005)[76]	PT pts	≥3 mo	218	*Pain/disability*	6, 26	Intensive neck exercise	(+)	TENS
Chiu (2005)[76]	PT pts	≥3 mo	218	*Pain/disability*	6, 26	Intensive neck exercise	(+)	Advice on neck care
Revel (1994)[77]	Rheum. patients	>3 mo	60	Pain/perceived improvement	10	Neck exercises plus medication	(+)	Pain medication alone
Lavin (1997)[78]	Patients	≥1 mo	46	Pain/disability/sleep	2	Water pillow	(+)	Roll pillow
Lavin (1997)[78]	Patients	≥1 mo	46	Pain/disability/sleep	2	Water pillow	(+)	"Usual" pillow
Lavin (1997)[78]	Patients	≥1 mo	46	Pain/disability/sleep	2	Roll pillow	(=)	"Usual" pillow
Jull (2002)[61]/Stanton and Jull (2003)[62]	PT pts	1 HA/wk for ≥ 2 mo	200	*HA frequency* intensity/length/neck pain/perceived effect	52	Manipulation/ mobilization [physical therapist]	(=)	Sessions of exercise therapy
Jull (2002)[61]/Stanton and Jull (2003)[62]	PT pts	1 HA/wk for ≥ 2 mo	200	*HA frequency* *intensity/length/neck pain/perceived effect*	52	Manipulation/ mobilization plus exercise therapy	(=)	Sessions of exercise therapy
Jull (2002)[61]/Stanton and Jull (2003)[62]	PT pts	1 HA/wk for ≥ 2 mo	200	*HA frequency* *intensity/length/neck pain/perceived effect*	52	Manipulation/ mobilization [physical therapist]	(=)	Manipulation/ mobilization plus exercise therapy
Persson (1997)[79]	Refs to neurosurg. dept.	≥3 mo	81	Pain/disability/perceived effect	14–16, 65–69	Physical modalities, traction, mobilization, exercise, and advice	(+) [14–16] (=) [65–69]	Rigid collar
Smania (2005)[46]	Patients	?	53	Pain/disability	10 d, 4, 13	Magnetic stimulation	(=) [10 days] [4,13] (+)	TENS
Skillgate (2007)[80]	Workers	≥2 wk	265	*Pain/disability* Perceived recovery	3, 7, 12	Naprapathy (manipulation, mobilization, massage, stretching) [naprapath]	(=) [3] [7,12] (+)	Physician-provided advice and support to stay active

(*Continued*)

Table 4. Continued

First Author (yr)	Study Pop.	Episode Duration	Baseline N	Outcomes†	Follow-Up (in wk)	Intervention 1	Difference	Intervention 2
McReynolds and Sheridan (2005)[81]	Emerg. Dept. patients	<3 wk	58	Pain/patient perceived relief	1 h	Osteopathic manipulative treatment (HVLA thrust, muscle energy, soft tissue techniques) [DO]	(+/=)	Intramuscular ketorolac tromethamine, 30 mg

References are appended in Table 5.
* (=) denotes lack of clinically relevant difference observed between interventions in the pair; (+) denotes clinically relevant difference between interventions in the pair.
†Primary in *italics*.
GP indicates general practitioner; PM&R, physical medicine and rehabilitation; PT, physical therapist; DO, Doctor of Osteopathy; DC, Doctor of Chiropractic; CE, cost effectiveness; TENS, transcutaneous electrical nerve stimulation; HA, headache; HVLA, high velocity low amplitude.

modalities resulted in greater reductions in neck pain and disability compared with infrared irradiation during the 6-week treatment period and after 6 months' follow-up.[115,116]

- An intervention that included advice and exercise for patients with "nonspecific" neck pain was found to be just as effective as interventions that also included manual therapies or shortwave diathermy.[105]
- Compared with symptomatic care alone, exercises focusing on improving eye-neck coordination and proprioception resulted in much greater pain reduction and perceived improvement in patients with neck pain from baseline until the 10-week follow-up.[112]
- In the only study of exercises for cervicogenic headache, patients assigned to 8 to 12 sessions of low-load therapeutic exercise with or without cervical manipulation reported fewer headaches and better overall perceived effect after 1 year than patients assigned to manipulation alone or to a no-treatment control group.[111,113]
- Among female home-care nursing aides and assistants with or without neck or shoulder pain, a physical training program was no more effective than a stress management program or a nonintervention control for reducing or preventing neck and shoulder pain over 12 and 18 months.[46]
- Workers assigned to computer software-stimulated work breaks with or without physical exercise had similar improvement in neck pain as computer workers in a nonintervention control group; however, workers in the intervention groups were more likely to perceive recovery and less likely to perceive deterioration.[15]

Medications. Five studies assessed the efficacy or effectiveness of medications for patients with "nonspecific" neck pain or an associated disorder[119–123]:

- Mobilization plus salicylate was found superior to salicylate alone in the Brodin study; more patients improved after a week with daily orphenadrine and paracetamol than with placebo in the Høivik study; and no difference was detected after 2 weeks between daily piroxicam and indomethicin among patients with cervicobrachial syndrome.[123]
- In a randomized crossover trial, cervical spondylosis patients on benorylate (an analgesic) in combination with chlormezanone (a muscle relaxant anxiolytic) for 4 weeks perceived more pain reduction, improved sleep, and greater overall effectiveness than when on either drug alone or placebo, though clinical relevance is questionable.[119]
- Clinical relevance is also questionable in the only trial comparing NSAIDS with manual therapy[122]: osteopathic manipulative treatment (high-velocity, low-amplitude thrust, muscle energy, and soft tissue techniques) resulted in slightly greater pain reduction than intramuscular ketorolac tromethamine (30 mg) 1 hour post-treatment in acute (less than 3 weeks) neck pain patients presenting to emergency departments (mean difference in 10-point numerical rating scale = 1.1; 95% CI = 0.2–1.9). There were no other studies on the effectiveness of NSAIDs (other than salicylates, indomethicin, and ketorolac) and no studies on the use of acetaminophen or narcotic or antidepressant medications for patients with "nonspecific" neck pain.

Manual Therapies. Seventeen studies (reported in 27 articles) focused on manual therapies for "nonspecific" neck pain or associated disorders.[36,48,78,105–111,113,120,122,124–137]

- Cervical mobilization was more effective than salicylate alone or sham physical therapy in the abovementioned Brodin study[120]; GP, physiotherapy (exercises, massage, modalities), manual therapy (manipulation or mobilization), and sham treatment were essentially indistinguishable in the Koes *et al* trial[130–134] at 3, 12, and 52 weeks; strengthening exercises alone or in combination with SMT were more effective than SMT alone after 1 and 2 years[77,106]; and compared with usual analgesic use, myofascial massage therapy in combination with strengthening and stretching exercises reduced the number and intensity of trigger points but yielded no differences in neck pain.[107]

- Relative to an active regimen of physical therapy (exercise sessions) or usual GP care, mobilization resulted in better short-term (7 week) but not longer term (13 and 52 weeks) pain and functional outcomes for patients with "nonspecific" neck pain for at least 2 weeks.[36,108,109]
- In patients with chronic neck pain, massage was somewhat inferior to needle acupuncture 1 week after administration of treatments.[129] A physiotherapy intervention including mobilization resulted in 6-week and 6-month outcomes comparable to acupuncture[125]; no differences in short- or long-term outcomes were detected between chronic neck-pain patients assigned to intensive training, active physical therapy (mobilization and traction), or to chiropractic manipulation.[110]
- Among mostly subacute and chronic primary-care neck-pain patients enrolled in a factorial trial of physical modalities and manual therapies, chiropractic manipulation and mobilization resulted in comparable pain and disability outcomes through 6 months follow-up.[126–128] However, in another trial, mean pain reduction and cervical range of motion improvements were greater immediately following high-velocity, low-amplitude manipulation than following mobilization.[135]
- An intervention including advice, exercise, and manual therapy was found to be no more effective than advice and exercise alone or a combination of advice, exercise and shortwave diathermy; outcomes were similar in all 3 groups.[105]
- Reductions in neck pain were greater immediately after thoracic manipulation than they were following a sham manipulation among manipulation-naïve patients with "mechanical" neck pain.[124]
- Favorable effects on pain, pressure pain threshold, and skin conductance were observed immediately following passive mobilization *versus* placebo and control (no physical contact) procedures in a crossover trial in persons with mid- or lower cervical pain lasting more than 3 months.[136]
- In persons with neck pain lasting at least a month, series of mechanically assisted (instrumental) manipulations and high-velocity, low-amplitude cervical spine manipulations yielded similar improvements in neck pain and disability and also in cervical range of motion during the 1-month treatment period and 1 month later.[137]
- A 6-week series of naprapathic manual treatments (manipulation, mobilization, massage, and stretching) for persons with neck pain of at least 2 weeks' duration was the only study of its kind accepted into our best evidence synthesis. Researchers found these treatments to be more effective —in terms of pain and disability reduction and perceived improvement— than physician-delivered advice and support to stay active and exercise at 7 and 12 weeks from baseline.[48] This finding is generally consistent with the aforementioned trial comparing osteopathic manipulative treatment with intramuscular ketorolac for patients with acute neck pain, although only short-term outcomes were reported in the latter study.[122]
- A study looking at 4 groups of cervicogenic headache patients found no difference in headache outcomes after 12 months among those assigned to manipulative therapy (8–12 sessions), to exercise therapy, or to a combination of both. However, outcomes in all 3 treatment groups were superior to those in the no-treatment control group.[111,113]

Physical Modalities. Eight trials assigned neck-pain patients to receive 1 or more physical treatment modalities, including ultrasound, diathermy, hydrotherapy, electrical muscle stimulation, traction, percutaneous neuromodulation therapy, TENS, and infrared irradiation.[105,107,115,116,120,126,138–140]

- Mobilization fared better than physical modalities in the Brodin study[120]; and sham and active ultrasound resulted in equivalent outcomes in the Gam study.[107]
- Neck-pain patients with or without radiation assigned to static, intermittent, or manual neck traction had similar pain and range of motion outcomes after 6 weeks, and only slightly better outcomes than patients in the control (nontraction) group.[140]
- Cervical disc disease patients on dermatomally applied percutaneous neuromodulation therapy reported greater immediate post-treatment decreases in pain and improved sleep and more physical activity after 3 weeks in a crossover trial.[139]
- In the aforementioned factorial trial that included physical modalities, chiropractic patients assigned to heat therapy improved slightly more during the first 2 weeks than patients not assigned to heat, although the differences were clinically negligible; electrical muscle stimulation was also clinically ineffective.[126]
- An intervention that combined advice, exercise and shortwave diathermy was found to be no more effective than advice and exercise alone or advice and exercise combined with manual therapy.[105]
- In a trial involving myofascial pain patients, neck pain and disability reductions were greater in the TENS group than in the placebo group after the 10-day intervention period; but this was not the case 1 and 3 months later, when repetitive magnetic stimulation showed benefits relative to both TENS and placebo.[138]
- In the Chiu *et al* (2005) trial, patients in the TENS and exercise groups had greater mean reductions in pain and disability than those in the infrared irradiation group during 6 weeks of treatment and after 6 months.[115,116] The clinical significance of the differences observed in this trial and the trial by Smania *et al*[138] are questionable, however.

Acupuncture. Six trials of subacute or chronic neck-pain patients included acupuncture arms.[44,45,125,129,141–143]

- Short-term clinical outcomes favored needle acupuncture *versus* massage in the Irnich *et al* study, but little difference was observed between patients undergoing needle and sham laser acupuncture 3 months post-treatment.[129]
- Immediate post-treatment pain and perceived improvement outcomes favored needle acupuncture *versus* myofascial trigger point therapy or sham laser acupuncture in a crossover trial.[141]
- Patients assigned to weekly treatments of acupuncture and manual therapy fared similarly over 6 months,[125] although in a placebo-controlled RCT of persons with neck pain of more than 3 months' duration, mean decreases in neck pain intensity were greater in the acupuncture group between baseline and 1 week and at 6 months post treatment.[142]
- Among female sedentary office workers, a 10-session, 3-to-4 week protocol of body acupuncture and electroacupuncture, along with ear acupressure yielded greater reductions in neck, shoulder, and headache pain than did sham electroacupuncture during the treatment period. These differences remained or had grown by the 3-year follow-up assessment.[44] Pain-related social and psychological outcomes also favored the active group at both short- (6-month) and long-term follow up.[45]
- General practice patients with neck pain of more than 6 months' duration experienced much greater reductions in neck pain and disability (from baseline to 3-months) when randomized to a 3-month course of up to 15 sessions of needle acupuncture. More than twice as many acupuncture patients improved by 20% or more (56.5% *vs.* 21.6%).[143] However, all participants were patients of physicians who practiced acupuncture, and so patient expectations may have influenced outcomes.

Laser and Magnetic Therapy. Seven studies tested the effectiveness of laser or magnetic therapies, including magnetic necklace,[144] low-level laser therapy (LLLT),[50,145–148] and repetitive magnetic stimulation.[138]

- Wearing magnetic and nonmagnetic necklaces reduced the intensity and frequency of pain equally well among persons with chronic (1 year or more) neck or shoulder pain during a 3-week intervention period.[144]
- LLLT was comparable to placebo with respect to pain and function for patients with trigger points in a double-blind randomized crossover trial.[50] However, mean pain and disability reductions were greater in osteoarthritis patients assigned to low-power laser therapy than to placebo after 10 consecutive days of therapy in a parallel-group RCT.[148]
- A double-blind, placebo-controlled RCT of patients with myofascial pain syndrome of the neck and shoulders found that LLLT was associated with greater reductions in pain and disability, fewer trigger points, and better quality of life scores after 2, 3, and 12 weeks.[147] Another double-blind RCT of patients with neck pain (more than 3 months' duration) found that, after 12 weeks, pain reduction and self-assessed global improvement were also greater in the LLLT group *versus* the placebo group.[146]
- Pulsed infrared diode laser therapy for patients with myofascial pain resulted in greater pain reductions than placebo, both during the 24-day intervention period and 2 months later.[145]
- In a 3-arm RCT comparing repetitive magnetic stimulation and TENS to placebo for persons with myofascial pain syndrome, mean pain and disability improvements, both post-treatment and at 1 and 3 months from baseline, were greater in the repetitive magnetic stimulation group than the placebo group; this was similar to TENS post-treatment but better than TENS at 1 and 3 months.[138] The clinical significance of these differences is questionable, however.

Combined Approaches. Interventions encompassing various combinations of single treatment modes, packages of individualized care or comprehensive rehabilitation programs were included as arms in 4 studies.[42,49,52,107]

- Patients with neck, shoulder, or upper arm pain who took part in an active multidisciplinary rehabilitation program had comparable sick-leave outcomes compared to patients who received other care (including physiotherapy, medication, and other "as-needed" treatment). However, patients in the rehabilitation program experienced improved mobility over 2 years, whereas those receiving other care did not.[42]
- Pain and global outcomes were observed among patients with neck-shoulder trigger points; some received active or sham ultrasound along with treatment which consisted of massage and home exercises; a control group was treated with analgesic pain relievers.[107] After 6 months, no differences were observed on pain and global outcomes among all 3 groups; however, those who received ultrasound plus massage and home exercise, and those who received sham ultrasound plus massage and home exercise had fewer and less intense trigger points than the group using analgesic medications only.
- Outcomes that included reductions in neck symptoms and improvements in work ability were studied in 3 groups of workers with recurrent or chronic neck pain. Those who were assigned to a 12-week program of stabilization and relaxation training and behavioral support did better than those given advice on exercises with or without 2 sessions of practical training.[49]
- For patients with chronic cervicobrachial pain, those receiving individually adapted physiotherapy modalities (traction, mobilization, exercises, ergonomic, and postural advice) for 3 months did as well as those who underwent surgery with no physiother-

apy for 3 months. Outcomes were comparable with respect to 3-month pain and functional outcomes and better than outcomes with a cervical collar, but differences among all groups after 15 to 16 months were negligible.[52]

Other Interventions. Other treatments included among the scientifically admissible studies were occlusal adjustment,[47] various pillows,[149] cervical collar,[52] a brief physiotherapist intervention involving cognitive-behavior therapy principles,[104] botulinum toxin A,[150] and, in a pilot study, applied relaxation.[151]

- Occlusal adjustment was ineffective for persons with chronic neck or shoulder pain.[47]
- Compared with a usual or roll pillow, a water pillow resulted in increased pain relief and improved sleep quality among patients with neck pain with or without cervicogenic headache.[149]
- Patients with subacute or chronic neck pain who underwent several sessions of usual physiotherapy fared only slightly better than those assigned to a brief cognitive-behavior intervention. Patients who said they preferred the brief therapy did at least as well as those assigned to physiotherapy after 12 months of follow-up.[104]
- A double-blind, placebo-controlled RCT looked at using botulinum toxin A *versus* placebo in the treatment of people with disabling neck pain of at least 3 months' duration. The study found similar decreases in mean neck pain and disability scores and increases in trigger point pressure thresholds in both groups over 16 weeks post-treatment; however, adverse reactions were much more frequent in the botulinum toxin A group.[150]
- Patients with chronic cervicobrachial pain assigned to wear a rigid cervical collar for 3 months did not improve, whereas those assigned to surgery or to multimodal care showed reductions in pain and increases in function; however, after 15 to16 months, clinical outcomes were similar across all 3 groups.[52]
- In the randomized pilot study, patients with neck pain of greater than 3 months' duration who were randomized to 7 weekly sessions of applied relaxation focusing on body awareness and active coping perceived more control over their pain and consumed fewer analgesics after 20 weeks than patients assigned to 11 physiotherapy sessions.[151]

Workplace Interventions

- Computer software programs designed to stimulate regular work breaks were not effective at reducing the intensity or frequency of neck symptoms or sick leave among subjects with work-related neck disorders. However, workers in the intervention groups were more likely to report recovery, were more productive, and were less likely to report deterioration.[15]
- In a nonrandomized (cohort) study, male video display unit users given multiple ergonomic interventions had clinically irrelevant reductions in neck pain intensity and frequency, whereas those not given the interventions had increases in pain 2 years after the interventions.[6] The differences observed between groups may be more reflective of the poor ergonomic environment in the control group rather than the effectiveness of the interventions, however.
- In the aforementioned RCT of female home-care nursing aides and assistants with or without neck or shoulder pain, physical training, or stress management was no more effective in preventing or reducing neck and shoulder pain than no intervention at all over 12 and 18 months.[46]

Safety of Interventions. The vast majority of intervention-related adverse reactions were reported in case studies or case series. Such studies were excluded from our best evidence synthesis because it is not possible to make causal inferences from the resulting data. There are, however, a number of case reports and case series which show temporal associations between interventions and potentially serious complications (*e.g.*, Martienssen and Nilsson, 1989; Haldeman, 1999).[18,19] These temporal relationships do raise the question about the potential of side effects from most noninvasive interventions. This is a field that deserves considerable further study and, as part of its mandate, the Neck Pain Task Force studied the relationship between chiropractic treatment and vertebrobasilar artery (VBA) strokes (these findings are summarized below).[54]

In a population-based case-control study, Rothwell *et al*[20] showed an increased risk of VBA dissection within a week of a chiropractic visit among persons under age 45 years (odds ratio = 5.03, 95% CI = 1.32, 43.87). As part of the Neck Pain Task Force mandate, Cassidy *et al* extended these findings using both a case-control and case-crossover research design (a research design in which cases serve as their own controls until the event). This study confirmed an increased risk of VBA, but found a similar increase in risk of this form of stroke after visiting a primary care physician for neck pain. These findings suggest that the increased risk of VBA stroke associated with chiropractic and primary care physician visits is likely due to patients with headache and neck pain from VBA dissection (in the prodromal stage) seeking care before their stroke.[54] Thus, although cervical spine manipulation cannot be ruled out as a potential cause of some VBA strokes, any potential risk is very small.

We also included a case series involving fluoroscopically guided interlaminar cervical epidural injections; it showed that the overall risk for complications was 16.8%[17] All complications were transient and did not require hospitalization.

Another case series of 151 patients and 306 cervical and lumbosacral selective nerve root injections detected no major complications (*e.g.*, death, paralysis, infection, nerve root injury), although 40% of patients reported transient side effects following the injection.[10]

Another study comparing the risks of adverse reactions following manipulation and mobilization found that participants assigned to manipulation were almost twice as likely to report transient minor discomfort during the initial treatment period (16% *vs.* 8.7%).[126–128]

In the trial comparing osteopathic manipulative treatment with intramuscular ketorolac for acute neck pain, minor side effects (*e.g.*, dizziness, drowsiness, lightheadedness, nausea) were reported more frequently by patients receiving ketorolac than osteopathic manipulative treatment (28% *vs.* 3%).[122]

Systematic Reviews. We accepted 25 systematic reviews and 1 systematic review of systematic reviews of noninvasive interventions for persons with "nonspecific" neck pain or associated disorders published between 1995 and 2006.[55,56,63–72-74,76,79–88]

- In 1 of the earliest systematic reviews that included neck pain treatments, no conclusions could be drawn regarding the efficacy of manipulation despite several published trials.[79]
- Largely for similar reasons (*e.g.*, poor quality studies), no judgment could be made regarding the effectiveness of cervical traction in 1995.[71]
- Cervical manipulation or mobilization was found to have some benefit over alternative treatments for neck pain in a 1996 review[85]; a finding largely upheld in a systematic review of treatments used by physiotherapists,[88] and in the most recent (2004) best evidence synthesis.[55]
- In their systematic reviews, Aker,[63]and Gross[64] both found support for manual therapies in combination with other treatments for short-term neck-pain relief.
- A 2002–2003 Cochrane review found evidence favoring short- and long-term benefits from manipulation or mobilization plus exercise for subacute or chronic "mechanical" neck disorders with or without headache.[81,83] However, manipulation and mobilization alone (*i.e.*, without exercise) were not beneficial, either compared with each other or with other treatments.
- In two 2001 reviews, Mior reviewed manipulation and mobilization for chronic pain in 1 paper and exercise for chronic pain in another, concluding that evidence is limited or conflicting for these interventions.[68,80]
- A review of 16 trials found "strong" evidence for proprioceptive exercises and dynamic resisted strengthening exercises for chronic or recurrent neck pain, but little or no support for group exercise or neck schools.[67]
- A 2001 Cochrane review found little evidence for the effectiveness of multidisciplinary rehabilitation for chronic neck pain.[65]
- Because evidence was lacking, limited, or conflicting, the authors of a Cochrane review of electrotherapy for "mechanical" neck disorders were unable to make any definitive conclusions regarding the effectiveness of electrotherapies alone or in combination with other treatments for neck pain.[69,70]
- A 1999 review found inconsistent evidence for acupuncture[73]; however, a recent Cochrane review that included trials published through February 2006 found "moderate" evidence in favor of acupuncture for short-term pain relief among persons with chronic neck pain with or without radicular symptoms.[72]
- A 2006 Cochrane review of medicinal and injection therapies found that intramuscular injection of lidocaine was superior to placebo in the short-term for patients with chronic "mechanical" neck pain.[86,87] Some evidence was found for epidural methylprednisolone and lidocaine for chronic "mechanical" neck pain with radicular findings. There was little evidence for the effectiveness of intramuscular botulinum toxin (Botox A) injections for chronic pain with or without radiation or headache.[86,87]
- Despite the fact that 19 trials of massage interventions were included in a recent Cochrane review, the authors made no recommendations for or against massage for "mechanical" neck disorders because of poor study quality and inconclusive results.[82,84]
- The systematic review of systematic reviews looking at conservative treatment for neck pain found reviews were inconsistent with respect to mobilization and acupuncture, and consistent with respect to the inconclusive evidence for manipulation, traction, immobilization, and laser therapies.[56] However, a 2005 systematic review of 5 trials of LLLT found limited evidence for the use of laser therapy with infrared wavelengths in the short-term management of neck pain.[74]
- A systematic review of randomized clinical trials through mid-1998 found that, besides electrotherapy for tension-type headache, no complementary or alternative therapies (*e.g.*, acupuncture, manipulation, physiotherapy, massage, homeopathy) were efficacious for cervicogenic (nonmigrainous) headache.[75] However, using a slightly different set of studies, Bronfort found "moderate" evidence that SMT was more efficacious than massage for cervicogenic headache.[77] On the basis of results from 2 randomized trials, Fernandez-delas-Penas (2005) concluded there was "strong" evidence for the effectiveness of SMT in reducing cervicogenic headache intensity, duration, and related medication intake; evidence was "limited" that SMT reduced headache frequency.[76]

Cost and Cost-Benefit. Three scientifically admissible studies included cost-effectiveness analyses.[36–38]

- Cost effectiveness ratios and cost utility ratios showed that manual therapy was less costly and more effective than physiotherapy or GP care neck pain, according to the Korthals-de Bos trial of physiotherapy (exercise sessions), manual therapy (mobilization), and GP care.[36] This suggests that mobilization

is more effective and less costly for treating neck pain than physiotherapy or care by a GP.

- Manca found that brief physiotherapy intervention for neck pain patients resulted in lower costs and lower quality-adjusted life years (QALYs) than usual physiotherapy (advice, modalities, mobilization, exercise) (incremental cost per QALY for usual physiotherapy = £68,000).[37]
- In a cost-effectiveness analysis of acupuncture for chronic neck pain, Willich found higher costs with acupuncture compared with 3 months of routine care (925.53 *vs.* £648.06; ICER = €12,469 per QALY gained).[38] Using conventional criteria for assessing cost effectiveness, usual physiotherapy *versus* brief physiotherapy would not be considered cost effective, whereas the addition of acupuncture to routine medical care would be considered cost effective. Given the clinical population from this latter study (patients of physician-acupuncturists), the external validity is questionable.

■ Discussion

We identified 156 articles reporting on 80 primary studies and 30 systematic reviews that were deemed scientifically admissible and accepted in our best evidence synthesis of interventions for neck pain and associated disorders. Our synthesis shows that neck pain is one of the most commonly reported symptoms in primary medical care and among chiropractic patients. Complementary therapies are frequently used, either alone or in conjunction with conventional treatments, although many persons with neck pain do not seek care. Of those who do seek care, many have non-neck musculoskeletal pain and episodes of care for pain in other sites.

Persons with neck pain or one of its associated disorders have the option of dealing with it on their own (self-care) or seeking treatment. Our literature screening did not identify and our synthesis did not include any studies designed to evaluate the efficacy or relative effectiveness of self-care approaches (*e.g.*, over-the-counter medications) used by persons who do not seek care. Similarly, we did not identify or accept any studies of community-based interventions for the prevention or amelioration of neck pain or associated disorders. We accepted only 1 prevention study and only a handful of studies designed to estimate the costs, cost effectiveness, and frequencies of complications associated with noninvasive interventions.

The vast majority of scientifically admissible studies included persons with "nonspecific" or "mechanical" neck pain (Grades I or II) who sought care or were recruited *via* advertisements for participation. Thirteen studies comprised workers, although only 2 studies evaluated workplace interventions *per se*. Persons with possible neurologic signs (Grade III neck pain) or headache were included in only 5 and 3 studies, respectively, and only 1 study had patients with definite Grade III neck pain.[52] Cervicogenic headache and radiculopathy are vastly underrepresented in the accepted noninvasive intervention literature.

Table 5 shows the noninvasive interventions for whiplash and other neck-associated disorders, by type of population and, based on our synthesis of the literature, the likelihood of each intervention being helpful in the short-term. For all interventions, treatment courses were generally short (12 weeks or less), effects (if any) were small, and clear evidence of effectiveness in the long-term (6 months or longer) is lacking for all noninvasive interventions. There is no evidence of "dose-response" (*i.e.*, the greater the frequency of care, the greater the effect) or "duration-response" (*i.e.*, the longer the duration of care, the better the effect) with any noninvasive treatment. In fact, there is some evidence that excessive treatment may be counter-productive for those with a recent whiplash injury, although it is unclear exactly what amount of treatment is optimal. This evidence suggests that the best course for patients seeking treatment for a recent WAD may be to start with minimal treatment. This treatment could consist of a brief course of mobilization and/or the other treatments for which there is evidence of effectiveness (see summary below). Since both the risks and the benefits among these treatment options are very similar, it seems reasonable that patient preference should be an important guide in choice of treatment.

Summary of Results

Whiplash-Associated Disorders

- PEMT was found in a single study to be of short-term benefit compared with placebo for patients with WAD.
- Corticosteroids were largely ineffective in 2 placebo-controlled studies.
- Combined interventions involving mobilization and exercises or supervised training and rehabilitation demonstrated short-term effectiveness when compared with conventional medical care or care involving physical modalities, collars, or simple advice or referral to exercise.
- Educational videos that included exercises and aimed at getting patients back to work and other daily activities as soon as possible after acute whiplash injury also proved effective.
- High health-care utilization within a month of whiplash injury may result in slower recovery. There is no evidence that a longer course of care or care initiated earlier *versus* later improves prognosis.
- Lack of scientifically acceptable evidence precludes summary statements on cervical and thoracic manipulation, traction, and NSAIDS and other medications in the treatment of WAD.

"Nonspecific" Neck Pain and Associated Disorders

- Medications (orphenadrine/paracetamol, piroxicam, indomethicin, benorylate/chlormezanone), per-

Table 5. Noninvasive Interventions for Whiplash-Associated Disorders (WAD) and Other Neck Disorders, by Type of Population and Likelihood of Being Helpful in the Short Term: The Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders

Population	Likely Helpful (Worth Considering)	Possibly Helpful (Might Consider)	Likely Not Helpful (Not Worth Considering)	Not Enough Evidence to Make Determination
Acute WAD (Grade I or II neck pain)	Educational video Mobilization Exercises Mobilization + exercises	Pulsed electromagnetic therapy	Pamphlet/neck booklet alone Collars Passive modalities (heat, cold, diathermy, hydrotherapy) Referral to fitness or rehab program Frequent early health-care use Methylprednisolone	Manipulation Traction NSAIDS Other drugs
Non-acute WAD (Grade I or II neck pain)	—	Supervised exercises Coordinated multidisciplinary care	Passive modalities (TENS, ultrasound) Corticosteroid injections	Manipulation Traction NSAIDS Other drugs
Neck pain not associated with WAD (Grade I or II)	Manipulation Mobilization Supervised exercises Manual therapy (manipulation, mobilization, massage) plus exercises Acupuncture Low-level laser therapy Analgesics	Percutaneous neuromodular therapy Brief intervention using cognitive behavioral principles	Advice alone Collars Passive modalities (heat therapy, ultrasound, TENS, electrical muscle stimulation) Exercise instruction Botulinum toxin A	Magnetic stimulation Massage Traction NSAIDS Other drugs
Neck pain with radiation or cervical radiculopathy (Grade III)	—	—	—	All interventions
Cervicogenic headache	—	Manipulation Mobilization Supervised exercises Manipulation or mobilization plus supervised exercises Water pillow	—	Passive modalities Traction NSAIDS Other drugs
Neck pain in workers (Grade I or II)	—	Supervised exercises plus strength or endurance training and/or relaxation training with behavioral support	Ergonomic interventions Forced work breaks Rehabilitation programs Stress management programs Relaxation training Physical training Exercise instruction	—

NSAIDS indicates nonsteroidal anti-inflammatory drugs; TENS, transcutaneous electrical nerve stimulation.

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(*Continued*)

Table 5. Continued

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cutaneous neuromuscular therapy, mobilization, and LLLT were found efficacious in the short-term when compared with placebo or sham interventions.

- Evidence from placebo-controlled trials for acupuncture in treating "nonspecific" neck pain was inconsistent; botulinum toxin A was found ineffective and harmful in 1 placebo-controlled trial. Strength or endurance training with dynamic exercises, mobilization, and acupuncture appeared to be beneficial in the short-term, compared with primary medical care or care involving unspecified interventions.
- Physical modalities, ergonomic interventions, and physical and stress management programs have not been proven effective for "nonspecific" neck pain.
- Active exercise, combined with education emphasizing self management and return to normal function, was more beneficial than manual therapy, TENS, neck collar, or simple advice (singly or as part of a multimodal intervention) for patients with "nonspecific" neck pain. There were few if any differences between the effectiveness of endurance *versus* strength training, manipulation *versus* mobilization, manual therapies *versus* acupuncture, and various passive multimodal approaches without active exercise components.
- There is no information to suggest that one medication is superior to any other medication or to other nonmedication interventions for "nonspecific" neck pain.
- Finally, there is no evidence that a longer *versus* shorter duration of care or particular course of care with any intervention improves prognosis for neck disorders.
- Limited or no acceptable evidence precludes summary statements on magnetic stimulation, massage, and traction in the treatment of "nonspecific" neck pain or cervicogenic headache. Acceptable evidence regarding the effectiveness of any noninvasive interventions for persons with radicular symptoms or neurologic signs (Grade III neck pain) is entirely lacking.

Limitations of the Literature

Methodologic Considerations. Most of the intervention studies identified but not included in our best evidence synthesis were case series or small clinical cohorts, which cannot be used to estimate effectiveness or relative effectiveness. Other studies were not accepted because of likely bias due to selection, information, or confounding. Possibly because of introduction of the CONSORT guidelines for clinical trials in 2001,[152] the proportion of intervention studies rated as scientifically admissible has increased dramatically in the past 10 years, from 25% in 1995 to 66% for studies published in 2005.[153] Because confounding is less likely to occur in large randomized clinical trials (*vs.* small randomized or nonrandomized intervention studies, cohort studies, and case-control studies), large RCTs are the most appropriate design for testing the safety and effectiveness of interventions in

primary study populations. Therefore, the RCT is the most prevalent study design in our best evidence synthesis.

But even among the accepted randomized studies, there are several problems that limit their usefulness. For example:

- unclear source, target, and study populations
- heterogeneity of interventions (*e.g.*, different modes, durations, and intensities of care)
- failure to account for baseline differences in prognosis
- no apparent distinction between primary *versus* other outcomes (pain, functional status, overall health, global improvement, participation, range of motion, resource use)
- cointerventions and compliance not monitored
- proportions and differences in proportions of patients with clinically meaningful levels of improvement not considered or reported

Clinical Considerations. In addition to the problems mentioned above, several issues affecting the clinical interpretation of findings deserve greater attention. For example:

- Various packages of interventions preclude estimation of effects of each package component.
- There is heterogeneity of outcome measures.
- Diagnostic criteria are unclear.
- Side effects are not monitored.
- There is a lack of clarity on the clinical relevance of effect estimates.
- There is heterogeneity of follow-up times (immediate to 3+ years).

Reporting Considerations. The way studies were reported and outcomes described precluded pooling of data. Even though many of the most recently published trials followed CONSORT guidelines when reporting results,[152] there remains much room for improvement. For example, the following reporting flaws were frequent in the literature we appraised:

- diagnostic criteria not reported
- description, frequency and duration of interventions, and length of episodes of care not reported
- raw data with estimates of variability not reported
- use of histograms and other figures instead of tables for reporting outcome data (which often don't include specific estimates with measures of variability)
- data on side effects and adverse events not consistently reported[154]
- external validity not discussed

Gaps in the Literature. Although many noninvasive interventions for neck pain and its associated disorders are well studied, there is a dearth of literature on many others. Gaps are most apparent in the following areas:

- self-diagnosis and self-care of neck pain
- preventive interventions
- the effects of societal and environmental factors on access to interventions and on care-seeking decisions among people with neck pain
- patient preferences for neck pain treatment
- cultural factors influencing perceptions of pain and perceived effectiveness of interventions
- safety and risk-benefit of neck pain interventions
- cost benefit and cost effectiveness of neck pain interventions
- interventions for neck pain with radiation into upper extremities and neurologic signs (Grade III neck pain)
- interventions for cervicogenic headache
- clinical prediction rules for risks and benefits of neck pain interventions

Research Recommendations. Given the gaps in—and problems with—the current nonsurgical neck-pain intervention literature, we suggest more high-quality experimental and observational research be done in the following areas: the use and effectiveness of self-care approaches in the treatment of neck disorders; the effectiveness of strategies designed to prevent incident and recurrent neck pain and associated disorders; treatment for neck pain with radicular signs or symptoms (Grade III neck pain); interventions for cervicogenic headache; and research involving clinically homogenous subgroups.

Considering the mostly small differences between interventions in terms of efficacy, effectiveness and relative effectiveness, especially in the long-term, future work should focus on patients' preferences, cost and cost-benefit, risk and risk-benefit, and on developing and evaluating novel preventive and therapeutic interventions appropriate to the community and workplace. Because influential societal and environmental factors vary across communities, interventions successfully applied in 1 locale may not be effective in others. For example, as the conceptual model illustrates, workers' compensation and litigation issues play roles in care-seeking decisions and may influence outcomes. However, these issues are relevant mainly in certain industrialized countries and much less relevant in other nations and in less developed parts of the world. In all parts of the world, the relative roles of health-care interventions applied to individuals *versus* interventions and policies applied at the population level need much greater elucidation.

To date, clinical interventions have received the lion's share of attention and resources. Perhaps, it is now appropriate to devote more time and energy to strategies that can be applied at the population level and that may have a larger impact on the community *vis-à-vis* reducing risk and improving prognosis (*i.e.*, decreasing incidence and prevalence, and thus the burden of neck pain and its associated disorders on society).

For example, the current neck-pain literature provides little evidence for or against potential primary preventive approaches. Yet evidence in the literature

on back pain suggests that a population-based intervention can favorably influence beliefs, both among the general population and among clinicians, and that such an intervention may have a sustained impact on related disability.[155–157]

Similarly, we know the provision of health services is affected by local health policies, but we know little about how these policies influence utilization, costs, and outcomes at the population level. We do know, however, that certain health-care strategies may prolong recovery. Uncharted territory includes the roles of preferences, expectations, and diagnostic labels, and the provision of care consistent with patients' health goals and values.

■ Conclusion

For WAD, (a) mobilization and exercises appear more beneficial than usual care or physical modalities, (b) collars and high health-care utilization may delay recovery, and (c) an educational video focusing on self efficacy in addition to usual medical care appears promising.

For other neck disorders without radicular signs or symptoms (Grades I and II), the evidence suggests that manual (manipulation or mobilization) and exercise interventions, LLLT, and perhaps acupuncture are more effective than no treatment, sham, or alternative interventions; however, none of these treatments is clearly superior to any other in either the short- or long-term.

For both WAD and neck disorders without trauma, the evidence favors supervised exercise sessions with or without manual therapy over usual or no care. Of the manual therapies, manipulation and mobilization yield comparable clinical outcomes. The risk of minor transient adverse effects appears higher with cervical manipulation than with mobilization. Of more concern, however, are major adverse events. Of specific concern are VBA strokes, which are extremely rare, but have been reported to be associated with chiropractic visits.[20,54] However, the association between chiropractic visits (which frequently include cervical manipulation) and VBA stroke is similar to the association between physician visits and VBA stroke. This suggests that, on average, patients who seek chiropractic care for neck pain or headaches, and who then developed a VBA stroke may have actually been in the prodromal phase of a stroke when consulting the chiropractor; that is, the neck pain or headaches, which lead them to seek care were early symptoms of a VBA stroke.[54] This, in turn, suggests that the choice between mobilization or manipulation should depend on patient preference. It should be noted that the safety and efficacy of thoracic manipulation as a promising alternative to cervical manipulation has recently been investigated and deserves further examination.[35]

The risk for serious side effects from NSAIDs is negligible; however, minor side effects may be much more frequent. There is no evidence that a particular course of care (longer *vs.* shorter, early *vs.* late) with any intervention improves prognosis or appreciably affects the natural history of neck disorders, and some evidence that "less is more" when it comes to WAD care. The evidence does not support episodes of care longer than 6 to 8 weeks with any 1 or combination of noninvasive interventions.

Because of the lack of scientifically acceptable studies on acute nontraumatic neck disorders and disorders with radiation and neurologic signs (Grade III neck pain), we cannot make any conclusions regarding the risks and benefits of noninvasive interventions for these conditions. Evidence for the effectiveness of neck-pain prevention strategies in the workplace and elsewhere is lacking. Future efforts should focus on the design and evaluation of neck-pain prevention strategies, and on intervention strategies for persons with acute nontraumatic neck disorders, disorders with radicular symptoms, and cervicogenic headache.

■ Evidence Statements

Whiplash-Associated Disorders

Education or Advice

1. There is evidence from one RCT that an educational pamphlet was not associated with recovery in persons with acute WAD when compared with usual care alone.[90]
2. There is consistent evidence from one RCT[89] and one nonrandomized study[12] that an educational video in combination with usual emergency or urgent care was positively associated with lower pain ratings at 24 to 26 weeks in persons with acute WAD when compared with usual care alone.

Exercise Interventions

3. There is inconsistent evidence from 5 RCTs and a cohort study that interventions including an exercise component were positively associated with more favorable prognoses in the short- or long-term in persons with acute or subacute WAD when compared with passive interventions including education, or to primary care.[8,92–97]
4. There is evidence from one RCT that supervised and home exercise plus advice was marginally more effective than advice alone in the short-term (6 weeks) but not in the long-term (12 months) in persons with WAD-related neck pain and disability of between 3 and 12 months.[98]

Medications

5. There is evidence from one placebo-controlled RCT that cervical zygapophysial joint corticosteroid injections were not associated with greater pain reduction in the short-term (20 weeks) in persons with post-WAD of more than 3 months.[99]
6. There is evidence from one placebo-controlled RCT that infusion of methylprednisolone was not associated with greater pain reduction or recov-

ery in the short-term (2–26 weeks) in persons with acute WAD.[100]

Manual Therapies

7. There is consistent evidence from 4 RCTs that active therapies involving mobilization were associated with greater pain reduction in the short-term among persons with acute WAD when compared with usual care, soft collars, passive modalities, or general advice.[93–96,101]
8. There is evidence from one RCT that immobilization in a rigid collar for 2 weeks followed by active mobilization or active mobilization within 72 hours of injury was as effective as usual care (focused on reducing fear and staying active) for persons with acute WAD after 12 months of follow up.[91]

Physical Modalities

9. There is evidence from 2 RCTs that passive modalities (TENS, ultrasound, diathermy) alone or in combination with mobilization were not associated with better pain outcomes in the short-term (4–26 weeks) when compared with care involving exercises and manual therapies for persons with acute or subacute WAD.[94,101]

Collars

10. There is consistent evidence from 2 RCTs and one nonrandomized study[9] that soft or rigid collars alone or in combination with other treatments were not associated with greater pain or disability reduction in the short- or long-term (up to 1 year) in persons with acute WAD when compared with advice to rest, exercises, and mobilization, and usual or no care.[9,91,103]

Combined Approaches

11. There is evidence from one nonrandomized intervention study that a coordinated multidisciplinary management approach was positively associated with quicker claim closure in persons with WAD when compared with usual care.[13]
12. There is evidence from one nonrandomized intervention study that referrals to fitness training or in- or out-patient rehabilitation plus usual care was not associated with quicker self-reported recovery rates in persons with acute WAD when compared with usual care alone.[8]

Patterns/Course of Care

13. There is consistent evidence from 2 population-based cohort studies that high health-care utilization in the 30 days after a traffic collision was associated with slower times to claim closure in persons with WAD.[32,33]
14. There is no evidence from any studies that a particular course of care (*e.g.*, longer *vs.* shorter, early *vs.* late) with any one or combinations of noninvasive interventions for WAD is associated with a better short- or long-term prognosis.

Safety of Interventions

15. There is no evidence from any studies that any one or combinations of noninvasive interventions for WAD are positively or negatively associated with clinically important adverse outcomes in the short- or long-term when compared with other noninvasive interventions for neck pain.

Cost and Cost-Benefit

16. There is evidence from one nonrandomized intervention study that a coordinated multidisciplinary management approach with active interventions were less costly than "usual care" for patients with acute WAD.[13]

Prevention

17. There is no evidence from any studies that any one or combinations of noninvasive interventions were associated with the prevention of incident or recurrent WAD.

"Nonspecific" Neck Pain

Education or Advice

1. There is no evidence from any studies that any one type of advice or educational intervention is better than any other advice or educational intervention or other noninvasive intervention in the short- or long-term for persons with "nonspecific" neck pain.

Exercise Interventions

2. There is consistent evidence from 3 RCTs that a neck exercise program alone or in combination with spinal manipulation was positively associated with reduced pain and disability in the short-term (6 to 13 weeks) in persons with subacute or chronic or recurrent neck pain when compared to spinal manipulation alone, TENS, or usual GP care.[36,78,106,108,109,115,116]
3. There is evidence from one RCT that manual therapy or pulsed shortwave diathermy in addition to neck exercises and advice about coping with neck pain and staying active was not associated with reduced pain-related disability or greater global improvement in the short-term (6–26 weeks) in patients with subacute or chronic "nonspecific" neck pain when compared to exercise and advice alone.[105]
4. There is consistent evidence from 2 RCTs that, compared with endurance exercises, strengthening exercises were not associated with better clinical outcomes in the short- or long-term in female workers with subacute, chronic, or recurrent neck pain.[43,117]

Medications

5. There is evidence from one placebo-controlled RCT that orphenadrine and paracetamol were associated with greater pain reduction in the short-term (8 days) in patients with subacute or chronic neck pain.[121]
6. There is evidence from one RCT that piroxicam did not reduce pain more than indomethicin in the short-term (1–2 weeks) in patients with cervicobrachial syndrome pain.[123]
7. There is evidence from one RCT that advice and mobilization, in addition to salicylates, was associated with greater pain reduction in the short-term (3–4 weeks) in patients with cervical pain when compared to salicylates alone or to salicylates with advice, massage, electrical stimulation, and traction.[120]
8. There is evidence from one placebo-controlled RCT that botulinum toxin A was not associated with better short-term (16 weeks) pain and disability outcomes in people with subacute or chronic neck pain.[150]
9. There is evidence from one RCT that intramuscular ketorolac tromethamine (30 mg) was not associated with greater pain reduction or patient perception of pain relief 1 hour post-treatment for neck pain of less than 3 weeks' duration.[122]
10. There is no evidence from any studies that other medications including NSAIDs (other than salicylates, indomethicin, and ketorolac), narcotics, or antidepressant medications are positively or negatively associated with clinically important outcomes in the short- or long-term when compared with other medications, to other noninvasive interventions, or to no treatment or sham interventions.

Manual Therapies

11. There is consistent evidence from 4 RCTs that cervical spine manipulation alone or with advice and home exercises was not associated with greater pain or disability reduction in the short- or long-term in persons with subacute or chronic neck pain when compared with mobilization with or without traction, to strengthening exercises, or to instrumental manipulation.[77,106,110,126,137]
12. There is consistent evidence from 4 RCTs that mobilization or exercise sessions alone or in combination with medication was positively associated with better pain and functional outcomes in the short-term (4–13 weeks) in people with subacute or chronic neck pain when compared to usual GP care, pain medications, or advice to stay active.[36,48,108,109,112,120]
13. There is evidence from 2 RCTs that manipulation or mobilization was not associated with better pain or disability outcomes (3–12 months) in people with subacute or chronic neck pain when compared with exercises alone or to exercise combined with massage or passive modalities.[36,79,108,109,130–134]

Physical Modalities

14. There is consistent evidence from 6 RCTs that passive modalities alone or in combination with other passive treatments or medication were not associated with clinically better pain and functional outcomes in the short- or long-term in people with subacute or chronic neck pain when compared with mobilization, to other modalities, to GP care, or to sham interventions.[79,107,115,116,120,126,130,130–132,134,138]
15. There is evidence from one randomized, placebo-controlled crossover study that percutaneous neuromodulation therapy was associated with greater immediate post-treatment decreases in pain and improved sleep and with more physical activity after 3 weeks in cervical disc disease patients experiencing chronic pain.[139]

Acupuncture

16. There is inconsistent evidence from 3 RCTs and a double-blind crossover trial that acupuncture was associated with better short- and long-term clinical outcomes in people with subacute or chronic neck pain when compared with sham acupuncture.[44,45,129,141,142]
17. There is evidence from one RCT that acupuncture was associated with better short-term (4–16 weeks) pain outcomes in patients with subacute or chronic neck pain when compared with massage.[129]
18. There is evidence from one RCT that acupuncture was not associated with better short-term (6–26 weeks) pain and disability outcomes in patients with subacute or chronic neck pain when compared with mobilization and traction.[125]

Laser Therapy and Magnetic Therapy

19. There is consistent evidence from 4 double-blind placebo-controlled RCTs that LLLT was associated with improvements in pain and function in the short-term (10 days to 12 weeks) in persons with subacute or chronic neck or shoulder pain.[145–148]
20. There is evidence from one RCT that magnetic stimulation was associated with better pain and disability outcomes in the short-term (4–13 weeks) in patients with myofascial pain syndrome when compared with placebo or TENS.[138]

Combined Approaches

21. There is inconsistent evidence from 5 RCTs and a cohort study that multimodal interventions (including combinations of exercises, manual thera-

pies, and education) were positively associated with reduced sick leave or better pain and disability outcomes in the short- or long-term in people with subacute or chronic neck or cervicobrachial pain when compared to usual or GP care, surgery, cervical collar, or advice to stay active.[37,42,49,52,79,104,107,130–134]

Workplace or Employee Interventions

22. There is evidence from one cohort study that multiple ergonomic interventions were not associated with reduced neck pain intensity or frequency over a 2 to 6-year period in video display unit users.[6,7]
23. There is evidence from one RCT that computer software-stimulated work breaks, which included rest or exercises, was associated with perceived recovery and productivity, but not associated with pain reduction or sick leave over an 8-week period in computer users with neck, shoulder or upper extremity symptoms.[15]
24. There is consistent evidence from 2 RCTs and a cohort study[42] that active neck exercise programs alone or in combination with education, relaxation, and behavioral support were not associated with better 1-year pain and disability outcomes or reduced sick leave in employees with subacute, chronic, or recurrent neck pain when compared with advice and information, ordinary activity, relaxation training, or to physiotherapy and medications.[42,49,51]
25. There is evidence from one RCT that endurance or strength training in combination with dynamic exercises involving upper and lower extremities was associated with better 1-year pain and disability outcomes in female office workers with chronic or recurrent neck pain when compared with advice to perform exercises.[117]
26. There is evidence from one RCT that physical training and stress management programs were not associated with prevention of neck or shoulder pain in the short- or long-term (12–18 months) in female home-care nursing aides and assistants when compared with a nonintervention control.[46]

Patterns/Course of Care

27. There is no evidence from any studies that a particular course of care (*e.g.*, longer *vs.* shorter, early *vs.* late) with any one or combinations of noninvasive interventions for "nonspecific" neck pain was associated with a better short- or long-term prognosis.

Safety of Interventions

28. There is evidence from 2 population-based case-control studies and a case-crossover study that chiropractic care was associated with a very small increased risk of posterior circulation stroke in people under age 45; however, because this increased risk is also seen in those seeking health care from their primary care physician, this association is likely due to patients with headache and neck pain from VBA dissection seeking care before their stroke.[8,20]
29. There is evidence from one RCT that manipulation (*vs.* mobilization) was associated with an increased risk of minor adverse reactions in patients with mostly subacute or chronic neck pain.[126–128]
30. There is evidence from one RCT that intramuscular ketorolac tromethamine (30 mg) was associated with a greater frequency of reported minor adverse reactions than osteopathic manipulative treatment 1 hour post-treatment in patients with neck pain of less than 3 weeks' duration.[122]
31. There is evidence from one placebo-controlled RCT that botulinum toxin A was associated with an increased risk of adverse reactions in people with subacute or chronic neck pain.[150]
33. There is no evidence from any studies that any one or combinations of noninvasive interventions for neck pain are positively or negatively associated with clinically important adverse outcomes in the short- or long-term when compared with other noninvasive interventions for "nonspecific" neck pain.

Cost and Cost-Benefit

34. There is evidence from one RCT that manual therapy (mobilization) was more cost effective in patients with subacute or chronic neck pain when compared with physical therapy (sessions of active exercises) and usual care by a general practitioner.[36]
35. There is evidence from one RCT that the addition of acupuncture to routine medical care for patients with chronic neck pain was cost effective.[38]
36. There is evidence from one RCT that, compared to a brief physiotherapy intervention focusing on self efficacy, several sessions of usual physiotherapy (advice, mobilization, modalities, exercises) for subacute or chronic neck pain was not cost effective.[37]

Prevention

37. There is evidence from one RCT that physical training and stress management programs were not associated with prevention of neck or shoulder pain in the short- or long-term (12–18 months) in female home-care nursing aides and assistants when compared with a nonintervention control.[46]
38. There is no evidence from any studies that any one or combinations of noninvasive interventions are associated with the prevention of incident or recurrent "nonspecific" neck pain or associated disorders.

Other Neck Pain Associated Disorders

Cervicogenic Headache

39. There is evidence from one RCT that therapeutic exercise with or without manipulation or mobilization was associated with fewer headaches and a better global outcome after 1 year in patients with cervicogenic headache when compared with no treatment.[111,113]
40. There is evidence from one crossover trial that using a water pillow was associated with increased pain relief and improved sleep quality in patients with neck pain (with or without cervicogenic headache) when compared with using a usual or roll pillow.[149]

Neck Pain With Radicular Symptoms or Cervical Radiculopathy

41. There is no evidence from any studies that any one or combinations of noninvasive interventions for neck pain with radicular symptoms or cervical radiculopathy are positively or negatively associated with clinically important outcomes in the short- or long-term when compared with other noninvasive interventions or to no treatment or sham interventions.

■ Key Points

• We conducted a best evidence synthesis of the literature (1980–2006) on noninvasive interventions for neck pain and associated disorders. Of the 359 intervention articles, 170 (47%) articles were deemed scientifically admissible. Of these, 139 related to noninvasive interventions and were included in the best evidence synthesis.
• For WAD, educational videos, mobilization, and exercises appear more beneficial than usual care or physical modalities; for other neck pain, the evidence suggests that manual and supervised exercise interventions, low-level laser therapy, and perhaps acupuncture are more effective than no treatment, sham, or alternative interventions. However, none of the active treatments is clearly superior to any other in the short- or long-term.
• There is (1) no evidence that a particular course of care with any intervention improves the prognosis for whiplash or other neck disorders; (2) some evidence that high rates of health-care use may slow recovery from whiplash; and (3) little data on cost effectiveness.
• Future research efforts should focus on neck-pain prevention strategies in the community and workplace, and on noninvasive interventions for persons with radicular symptoms.

tables

black & white images

Tables and Figures available online through Article Plus.

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