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Neck Pain: Revision 2017

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association

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Summary of Recommendations*

PATHOANATOMICAL FEATURES/DIFFERENTIAL DIAGNOSIS

A Clinicians should perform assessments and identify clinical findings in patients with neck pain to determine the potential for the presence of serious pathology (eg, infection, cancer, cardiac involvement, arterial insufficiency, upper cervical ligamentous insufficiency, unexplained cranial nerve dysfunction or fracture), and refer for consultation as indicated.

IMAGING

A Clinicians should utilize existing guidelines and appropriateness criteria in clinical decision making regarding referral or consultation for imaging studies for traumatic and nontraumatic neck pain in the acute and chronic stages.

EXAMINATION – OUTCOME MEASURES

A Clinicians should use validated self-report questionnaires for patients with neck pain, to identify a patient's baseline status and to monitor changes relative to pain, function, disability, and psychosocial functioning.

EXAMINATION – ACTIVITY LIMITATIONS AND PARTICIPATION MEASURES

F Clinicians should utilize easily reproducible activity limitation and participation restriction measures associated with the patient's neck pain to assess the changes in the patient's level of function over the episode of care.

EXAMINATION – PHYSICAL IMPAIRMENT MEASURES

B When evaluating a patient with neck pain over an episode of care, clinicians should include assessments of impairments of body function that can establish baselines, monitor changes over time, and be helpful in clinical decision making to rule in or rule out (1) neck pain with mobility deficits, including cervical active range of motion (ROM), the cervical flexion-rotation test, and cervical and thoracic segmental mobility tests; (2) neck pain with headache, including cervical active ROM, the cervical flexion-rotation test, and upper cervical segmental mobility testing; (3) neck pain with radiating pain, including neurodynamic testing, Spurling's test, the distraction test, and the Valsalva test; and (4) neck pain with movement coordination impairments, including cranial cervical flexion and neck flexor muscle endurance tests. Clinicians should include algometric assessment of pressure pain threshold for classifying pain.

DIAGNOSIS/CLASSIFICATION

C Clinicians should use motion limitations in the cervical and upper thoracic regions, presence of cervicogenic headache, history of trauma, and referred or radiating pain into an upper extremity as useful clinical findings for classifying a patient with neck pain into the following categories:

- Neck pain with mobility deficits
- Neck pain with movement coordination impairments (including whiplash-associated disorder [WAD])
- Neck pain with headaches (cervicogenic headache)
- Neck pain with radiating pain (radicular)

INTERVENTIONS: NECK PAIN WITH MOBILITY DEFICITS

Acute

For patients with **acute** neck pain with mobility deficits:

B Clinicians should provide thoracic manipulation, a program of neck ROM exercises, and scapulothoracic and upper extremity strengthening to enhance program adherence.

C Clinicians may provide cervical manipulation and/or mobilization.

Subacute

For patients with **subacute** neck pain with mobility deficits:

B Clinicians should provide neck and shoulder girdle endurance exercises.

C Clinicians may provide thoracic manipulation and cervical manipulation and/or mobilization.

Chronic

For patients with **chronic** neck pain with mobility deficits:

B Clinicians should provide a multimodal approach of the following:

- Thoracic manipulation and cervical manipulation or mobilization
- Mixed exercise for cervical/scapulothoracic regions: neuromuscular exercise (eg, coordination, proprioception, and postural training), stretching, strengthening, endurance training, aerobic conditioning, and cognitive affective elements
- Dry needling, laser, or intermittent mechanical/manual traction

C Clinicians may provide neck, shoulder girdle, and trunk endurance exercise approaches and patient education and counseling strategies that promote an active lifestyle and address cognitive and affective factors.

INTERVENTIONS: NECK PAIN WITH MOVEMENT COORDINATION IMPAIRMENTS

Acute

For patients with **acute** neck pain with movement coordination impairments (including WAD):

B Clinicians should provide the following:

- Education of the patient to
  - Return to normal, nonprovocative preaccident activities as soon as possible
  - Minimize use of a cervical collar
  - Perform postural and mobility exercises to decrease pain and increase ROM
- Reassurance to the patient that recovery is expected to occur within the first 2 to 3 months.

Summary of Recommendations* *(continued)*

B Clinicians should provide a multimodal intervention approach including manual mobilization techniques plus exercise (eg, strengthening, endurance, flexibility, postural, coordination, aerobic, and functional exercises) for those patients expected to experience a moderate to slow recovery with persistent impairments.

C Clinicians may provide the following for patients whose condition is perceived to be at low risk of progressing toward chronicity:

- A single session consisting of early advice, exercise instruction, and education
- A comprehensive exercise program (including strength and/or endurance with/without coordination exercises)
- Transcutaneous electrical nerve stimulation (TENS)

F Clinicians should monitor recovery status in an attempt to identify those patients experiencing delayed recovery who may need more intensive rehabilitation and an early pain education program.

Chronic

For patients with **chronic** neck pain with movement coordination impairments (including WAD):

C Clinicians may provide the following:

- Patient education and advice focusing on assurance, encouragement, prognosis, and pain management
- Mobilization combined with an individualized, progressive submaximal exercise program including cervicothoracic strengthening, endurance, flexibility, and coordination, using principles of cognitive behavioral therapy
- TENS

INTERVENTIONS: NECK PAIN WITH HEADACHES

Acute

For patients with **acute** neck pain with headache:

B Clinicians should provide supervised instruction in active mobility exercise.

C Clinicians may provide C1-2 self-sustained natural apophyseal glide (self-SNAG) exercise.

Subacute

For patients with **subacute** neck pain with headache:

B Clinicians should provide cervical manipulation and mobilization.

C Clinicians may provide C1-2 self-SNAG exercise.

Chronic

For patients with **chronic** neck pain with headache:

B Clinicians should provide cervical or cervicothoracic manipulation or mobilizations combined with shoulder girdle and neck stretching, strengthening, and endurance exercise.

INTERVENTIONS: NECK PAIN WITH RADIATING PAIN

Acute

For patients with **acute** neck pain with radiating pain:

C Clinicians may provide mobilizing and stabilizing exercises, laser, and short-term use of a cervical collar.

Chronic

For patients with **chronic** neck pain with radiating pain:

B Clinicians should provide mechanical intermittent cervical traction, combined with other interventions such as stretching and strengthening exercise plus cervical and thoracic mobilization/manipulation.

B Clinicians should provide education and counseling to encourage participation in occupational and exercise activities.

*These recommendations and clinical practice guidelines are based on the scientific literature published prior to August 2016.

List of Abbreviations

ACR: American College of Radiology
AMSTAR: assessment of multiple systematic reviews
APTA: American Physical Therapy Association
CCFT: cranial cervical flexion test
CCR: Canadian cervical spine rule
CFRT: cervical flexion-rotation test
CI: confidence interval
CPG: clinical practice guideline
CROM: cervical range of motion
CT: computed tomography
GRADE: Grading of Recommendations Assessment, Development and Evaluation
ICC: intraclass correlation coefficient
ICD: International Classification of Diseases and Related Health Problems
ICF: International Classification of Functioning, Disability and Health

List of Abbreviations *(continued)*

ICON: International Collaboration on Neck Pain
IFOMPT: International Federation of Orthopaedic Manipulative Physical Therapists
***JOSPT*:** *Journal of Orthopaedic & Sports Physical Therapy*
LOINC: Logical Observation Identifiers Names and Codes
LR: likelihood ratio
MDC: minimal detectable change
MDT: Mechanical Diagnosis and Therapy
MRI: magnetic resonance imaging
MVC: motor vehicle collision
NDI: Neck Disability Index
NEXUS: National Emergency X-Radiography Utilization Study
NSAID: nonsteroidal anti-inflammatory drug
PAIVM: passive accessory intervertebral motion
PICOT-SD: population, problem, or patients (P), intervention (I), comparison or control (C), outcome (O), time (T), study design (SD)
PSFS: Patient-Specific Functional Scale
RCT: randomized controlled trial
ROM: range of motion
SEM: standard error of measurement
SF-36: Medical Outcomes Study 36-Item Short-Form Health Survey
SIGN: Scottish Intercollegiate Guidelines Network
SNAG: sustained natural apophyseal glide
SR: systematic review
TENS: transcutaneous electrical nerve stimulation
VAS: visual analog scale
WAD: whiplash-associated disorder

Introduction

AIM OF THE GUIDELINES

The Orthopaedic Section of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based clinical practice guidelines (CPGs) for orthopaedic physical therapy evaluation and management of adult patients with musculoskeletal impairments described in the World Health Organization's International Classification of Functioning, Disability and Health (ICF).[242]

The purposes of these clinical guidelines are to:

- Describe evidence-based physical therapy practice including diagnosis, prognosis, intervention, and assessment of outcome for musculoskeletal disorders commonly managed by orthopaedic physical therapists
- Classify and define common musculoskeletal conditions using the World Health Organization's terminology related to impairments of body function and body structure, activity limitations, and participation restrictions
- Identify interventions supported by current best evidence to address impairments of body function and structure, activity limitations, and participation restrictions associated with common musculoskeletal conditions
- Identify appropriate outcome measures to assess changes resulting from physical therapy interventions in body function and structure as well as in activity and participation of the individual
- Provide a description of the practice of orthopaedic physical therapists to policy makers
- Provide information for patients, payers, and claims reviewers regarding the practice of orthopaedic physical therapy for common musculoskeletal conditions
- Create a reference publication for orthopaedic physical therapy clinicians, academic instructors, clinical instructors, students, interns, residents, and fellows regarding the best current practice of orthopaedic physical therapy

STATEMENT OF INTENT

These guidelines are not intended to be construed or to serve as a standard of medical care. Standards of care are determined on the basis of all clinical data available for an individual patient and are subject to change as scientific knowledge and technology advance and patterns of care evolve. These parameters of practice should be considered guidelines only. Adherence to them will not ensure a successful outcome in every patient, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgment regarding a particular clinical procedure or treatment plan must be made based on clinician experience and expertise in light of the clinical presentation of the patient, the available evidence, available diagnostic and treatment options, and the patient's values, expectations, and preferences. However, we suggest that significant departures from accepted guidelines should be documented in the patient's health records at the time the relevant clinical decision is made.

Methods

Content experts were appointed by the Orthopaedic Section of the APTA to conduct a review of the literature and to develop an updated neck pain CPG as indicated by the current state of the evidence in the field. The aims of the revision were to provide a concise summary of the evidence since publication of the original guideline and to develop new recommendations or revise previously published recommendations to support evidence-based practice. The authors of this guideline revision worked with research librarians possessing expertise in systematic reviews to perform a systematic search for concepts associated with neck pain in articles published from 2007 to August 2016 related to classification, examination, and intervention strategies for neck pain consistent with previous guideline development methods related to ICF classification.[29] Primary electronic search methods were performed using a standard structured approach from January 2007 to August 2016 in the following databases: PubMed, Cochrane Library, Web of Science, CINAHL, ProQuest Dissertations and Abstracts, PEDro, ProQuest Nursing and Allied Health Sources, and Embase, by research librarians. The search strategy guided by PICOT-SD (Population, problem, or patients [P], Intervention [I], Comparison or control [C], Outcome [O], Time [T], Study design [SD]) was designed to locate systematic reviews, meta-analyses, or narrative reviews that addressed 6 clinical areas (classification, examination, intervention, harms, prognosis, and outcome measures), when applicable contrasting with a control or comparison treatments, and used at least 1 measurement property of an outcome measure in adult patients with neck pain or musculoskeletal neck conditions in primary to tertiary settings from immediate posttreatment to long-term follow-up. The study designs included reviews on interventions and cohort/case-control trials for prognosis, diagnostic, and outcome measurement studies. Secondary reviews were identified through several grey literature sources (references within eligible citations screened for any additional references, personal files from the investigative team, and content experts). See **APPENDIX A** for example search strategies and **APPENDIX B** for example search dates and results, available at www.orthopt.org.

In addition, the guideline revision team worked with, and benefited greatly from, the efforts of members of the International Collaboration on Neck Pain (ICON), a multidisciplinary group currently producing an extensive review of the literature on neck pain.[179] Bridging methods and decision rules were guided by recommendations established by Whitlock et al[237] and Robinson et al.[173,174] Additionally, recent publications on the lived experiences of people with neck pain were reviewed[126] as part of our deliberations and implementation when creating the final recommendations. The potential organizational and implementation barriers in applying the recommendations were discussed and considerations were folded into the expert opinion section following each evidence table. The guideline has been piloted among end users through International Federation of Orthopaedic Manipulative Physical Therapists (IFOMPT) member organizations, and through APTA, Inc through a public posting.

The guideline development group members declared relationships and developed a conflict management plan that included submitting a Conflict of Interest form to the Orthopaedic Section, APTA, Inc. Articles that were authored by a group member were assigned to an alternate member for assessment. Partial funding was provided to the CPG development team for travel and expenses for CPG training and development; the content of this guideline was not influenced by this funding. The CPG development team maintained editorial independence. A list of competing interests, conflicts of interest, and author contributions is available at www.orthopt.org. Group members believe the guideline process and development of recommendations were free from influence from competing interests and conflicts of interest.

In the Impairment/Function-Based Diagnosis and the Examination sections, a narrative review is provided with emphasis placed on systematic reviews and meta-analyses when available. In the Interventions section, only systematic reviews and meta-analyses were considered in this revision. When there was a systematic review of reviews, those appraisals were used, and literature was searched for systematic reviews and meta-analyses published since the end date of the published review of reviews. If a systematic review or meta-analysis published prior to January 2007 and not included in the 2008 CPG, or published after August 2016, was identified by the authors during writing, then that article was also appraised and included using methods similar to those recommended by Robinson et al.[173] Articles contributing to recommendations were reviewed based on specified inclusion and exclusion criteria with the goal of identifying evidence relevant to physical therapist clinical decision making for adult persons with noncancer (neuromusculoskeletal) neck pain. The titles and abstracts of each article were reviewed independently by 2 members of the CPG development team for inclusion. See **APPENDIX C** for inclusion and exclusion criteria (available at www.orthopt.org). The full texts were then similarly appraised to obtain the final set of articles for contribution to recommendations. The team leader (P.R.B.) provided the final decision for rare (less than 10) discrepancies that were not resolved by the review team. The

Methods *(continued)*

ratings of the primary sources contained in the systematic reviews or meta-analyses were used by the team in making recommendations. If the systematic reviews or meta-analyses did not provide the necessary information (eg, study quality,[77] participant characteristics, stage of disorder) or there were discrepancies between the reviews, the reviewers obtained the information directly from the primary source. Quality ratings used in the systematic reviews came from a variety of tools (eg, Cochrane Risk of Bias, PEDro). Rating of the body of evidence came from other tools (eg, Grading of Recommendations, Assessment, Development and Evaluation [GRADE], Cochrane Collaboration Back and Neck Review Group[218]), and the CPG team calibrated these ratings into high, moderate, low, and very low quality. Very low-quality evidence was not considered in this revision. Ratings of systematic reviews came from 2 tools (AMSTAR[187] or the closely related SIGN[185]), and these ratings were also calibrated into high, acceptable, low, and very low categories. Very low-quality reviews and findings from very low-quality primary sources were not considered in this revision. See **APPENDIX D** for a flow chart of articles and **APPENDIX E** for articles included in recommendations (available at www.orthopt.org). Articles on topics that were not immediately relevant to the development of these recommendations, such as shockwave therapy or injection, were not subject to the systematic review process and were not included in the flow chart.

This guideline was issued in 2017 based on the published literature up to August 26, 2016. This guideline will be considered for review in 2021, or sooner if new evidence becomes available. Any updates to the guideline in the interim period will be noted on the Orthopaedic Section of the APTA website (www.orthopt.org).

LEVELS OF EVIDENCE

Since the original neck pain CPG was published in 2008, publication of the results of a large number of trials has coincided with an increased number of systematic reviews and reviews of reviews. The current update appraises high-level systematic reviews using updated criteria for levels of evidence and recommendations consistent with contemporary research methodology. The authors encourage the reader to note these changes in interpreting the guideline recommendations.

Individual systematic reviews, meta-analyses, and reviews of reviews were graded according to criteria adapted from the Centre for Evidence-Based Medicine, Oxford, United Kingdom for diagnostic, prospective, and therapeutic studies (www.cebm.net). In 4 teams of 2, each reviewer independently evaluated the quality of each article using a critical appraisal tool and assigned a level of evidence. A description of the grading system is provided in **TABLE 1**. See also **APPENDIX F** for evidence level criteria details on procedures used for assigning

TABLE 1 Levels of Evidence*

Level	Intervention/Prevention	Pathoanatomic/Risk/ Clinical Course/Prognosis/ Differential Diagnosis	Diagnosis/ Diagnostic Accuracy	Prevalence of Condition/ Disorder	Exam/ Outcomes
I	• High-quality SR† containing consistent findings from multiple high-quality primary sources‡	• SR of prospective cohort studies • High-quality prospective cohort study§	• SR of high-quality diagnostic studies • High-quality diagnostic study‖ with validation	• SR, high-quality cross-sectional studies • High-quality cross-sectional study¶	• SR of prospective cohort studies • High-quality prospective cohort study
II	• High- or acceptable-quality SR containing mostly consistent findings from generally high-quality primary sources, or • Consistent findings from at least 1 high-quality large (n>100 in each arm) RCT, or • Consistent findings from more than 1 small, high-quality RCT	• SR of retrospective cohort study • Lower-quality prospective cohort study • High-quality retrospective cohort study • Consecutive cohort • Outcomes study or ecological study	• SR of exploratory diagnostic studies or consecutive cohort studies • High-quality exploratory diagnostic studies • Consecutive retrospective cohort	• SR of studies that allows relevant estimate • Lower-quality cross-sectional study	• SR of lower-quality prospective cohort studies • Lower-quality prospective cohort study

Table continues on page A7.

Methods *(continued)*

TABLE 1 Levels of Evidence* (continued)

Level	Intervention/Prevention	Pathoanatomic/Risk/ Clinical Course/Prognosis/ Differential Diagnosis	Diagnosis/ Diagnostic Accuracy	Prevalence of Condition/ Disorder	Exam/ Outcomes
III	• High- or acceptable-quality SR containing mostly consistent findings from moderate primary sources, or • Mostly consistent findings from 1 high-quality RCT or more than 1 moderate-quality RCT	• Lower-quality retrospective cohort study • High-quality cross-sectional study • Case-control study	• Lower-quality exploratory diagnostic studies • Nonconsecutive retrospective cohort	• Local nonrandom study	• High-quality cross-sectional study
IV	• High- or acceptable-quality SR where higher-quality primary sources tend to favor a clear direction, or • Inconsistent findings from case-control studies or retrospective studies, or inconsistent findings from RCTs where the higher-quality trials tend to favor a clear direction (even when lower-quality trials favor the opposite), or • Consensus statements from content experts	• Case series	• Case-control study	...	• Lower-quality cross-sectional study
V	• Inconsistent evidence drawn from a low-rated (score of 5 or below on AMSTAR or SIGN scales) SR that may indicate the balance of evidence favoring one direction but with very low confidence, regardless of the quality of the primary sources, or • Case series or individual expert opinion, or direct or indirect evidence from physiology, bench research, or theoretical constructs	• Individual expert opinion	• Individual expert opinion	• Individual expert opinion	• Individual expert opinion

Abbreviations: AMSTAR, assessment of multiple systematic reviews; RCT, randomized clinical trial; SIGN, Scottish Intercollegiate Guidelines Network; SR, systematic review.

Adapted from Phillips B, Ball C, Sackett D, et al. Oxford Centre for Evidence-based Medicine - Levels of Evidence (March 2009). Available at: http://www.cebm.net/index.aspx?o=1025. Accessed August 4, 2009. See also* **APPENDIX F.

†SRs were rated using AMSTAR or SIGN criteria, where 8 or higher received a "high," 6 to 7 received an "acceptable," 4 to 5 received a "low," and below 4 received a " very low" score. Very low–quality reviews were not used.

‡Quality of the primary sources was calibrated to "high," "moderate," "low," and "very low" levels. Results from very low–quality primary sources were not used.

§Quality cohort study includes greater than 80% follow-up.

‖High-quality diagnostic study includes consistently applied reference standard and blinding.

¶High-quality prevalence study is a cross-sectional study that uses a local and current random sample or censuses.

levels of evidence (available at www.orthopt.org). Systematic review AMSTAR scores are available in **APPENDIX G**, and articles containing very low-quality primary sources are listed in **APPENDIX H** (available at www.orthopt.org).

The levels of evidence were assigned with alignment to the definitions contained in **TABLE 1**.

Weaker diagnostic criteria and reference standards, improper randomization, no blinding, and less than 80% follow-up may add bias and threats to validity.

When available, a second factor, the magnitude of effect versus harm, contributed to the recommendation, and was characterized according to **TABLE 2**.

Methods *(continued)*

TABLE 2 Magnitude of Effect Versus Harm: Grades of Recommendation

Beneficial Effect		Neutral Effect	Harmful Effect	
Strong	**Weak**	**None**	**Weak**	**Strong**
Desirable consequences clearly outweigh undesirable consequences. This considers the magnitude of effect (none, small, medium, large), numbers needed to treat, probability of harms, resources and patient burden, etc. A strong grade requires a medium to large effect with low risk of harms and low patient burden	Desirable consequences probably outweigh undesirable consequences (small to moderate effect, some risk of harms, higher burden)	Consequences equally balanced or uncertain (none or small effect, unclear harms, unclear burden)	Undesirable consequences probably outweigh desirable consequences (probability of harms likely outweighs any small-to-moderate effect, burden might be high)	Undesirable consequences clearly outweigh desirable consequences (small effect, clear probability of harms or high patient burden)

TABLE 3 Method of Assigning Confidence to Recommendations

Grade	Strength of Evidence	Basis of Strength Assignment
A	Strong	One or more level I systematic reviews support the recommendation, providing evidence for a strong magnitude of effect
B	Moderate	One or more level II systematic reviews or a preponderance of level III systematic reviews or studies support the recommendation, providing evidence for a mild to moderate magnitude of effect
C	Weak	One or more level III systematic reviews or a preponderance of level IV evidence supports the recommendation, providing minimal evidence of effect
D	Conflicting	Higher-quality studies conducted on this topic disagree with respect to their conclusions and effect. The recommendation is based on these conflicting studies
E	Theoretical/foundational evidence	A preponderance of evidence from animal or cadaver studies, from conceptual models or principles, or from basic science or bench research supports the recommendation, providing theoretical/foundational evidence of effect
F	Expert opinion	Best practice to achieve a beneficial effect and/or minimize a harmful effect, based on the clinical experience of the guidelines development team

GRADES OF RECOMMENDATION

The strength of the recommendation was graded according to the confidence in the evidence and the magnitude of effect as indicated in **TABLE 3**.

SYMPTOM STAGES AND FOLLOW-UP PERIODS

Following a review of included studies, results were assigned a stage related to symptom duration: acute (less than 6 weeks), subacute (6-12 weeks), or chronic (greater than 12 weeks). Time periods for follow-up results were characterized according to **TABLE 4**.

TABLE 4 Follow-up Periods

Follow-up	Time Interval
Immediate	Closest to immediately following intervention
Short term	Closest to 1 mo
Intermediate term	Closest to 6 mo
Long term	Closest to 12 mo or longer

Methods *(continued)*

GUIDELINE REVIEW PROCESS AND VALIDATION

Experts in neck pain reviewed these CPGs' content and methods for integrity, accuracy, and representation of the condition. The draft was also reviewed by: (1) representatives of member organizations of IFOMPT and members of the Orthopaedic Section of the APTA, Inc through a public posting, and (2) a panel of consumer/patient representatives and external stakeholders, such as claims reviewers, medical coding experts, academic educators, clinical educators, physician specialists, and researchers. All comments, feedback, and suggestions were considered for revision. Additionally, a panel of experts in physical therapy practice guideline methodology annually review the Orthopaedic Section of the APTA's ICF-based Clinical Practice Guidelines Policies and provide feedback and comments to the Clinical Practice Guidelines Coordinator and editors to improve the APTA's guidelines development and implementation processes.

DISSEMINATION AND IMPLEMENTATION TOOLS

In addition to publishing these guidelines in the *Journal of Orthopaedic & Sports Physical Therapy* (*JOSPT*), these guidelines will be posted on the CPG areas of both the *JOSPT* and the Orthopaedic Section of the APTA websites for free access and will be submitted for posting on the Agency for Healthcare Research and Quality's website (www.guideline.gov). The implementation tools planned to be available for patients, clinicians, educators, payers, policy makers, and researchers, and the associated implementation strategies, are listed in **TABLE 5**.

CLASSIFICATION

The primary International Classification of Diseases-10 (ICD-10) codes and conditions associated with neck pain include **M54.2 Cervicalgia**, **M54.6 Pain in the thoracic spine**, **R51 Cervicogenic headache**, **M53.0 Cervicocranial syndrome**, **M53.1 Cervicobrachial syndrome**, **M53.2 Spinal instability**, **S13.4 Sprain of ligaments of cervical spine**, **S13.8 Sprain of joints and ligaments of other parts of neck**, **M54.1x Dorsalgia with cervical radiculopathy**, **M47.2x Cervical spondylosis with radiculopathy**, **M47.1x Cervical spondylosis with myelopathy**, **M50.x Cervical disc disorders**, **M62.5 Muscle wasting and atrophy**, **M79.1 Myalgia**, and **M99.01 Segmental and somatic dysfunction**.[241]

Andelic et al[5] linked ICF categories to functional problems reported on the Patient-Specific Functional Scale (PSFS) by 249 participants with neck pain in Norway. Agreeing with a previous study by Tschiesner et al,[210] Andelic et al[5] found that categories linking to 10% or more functional problems were labeled as "more frequent" and that those linking to fewer

TABLE 5 Planned Strategies and Tools to Support the Dissemination and Implementation of This Clinical Practice Guideline

Tool	Strategy
"Perspectives for Patients"	Patient-oriented guideline summary available on www.jospt.org and www.orthopt.org
Mobile app of guideline-based exercises for patients/clients and health care practitioners	Marketing and distribution of app using www.orthopt.org and www.jospt.org
Clinician's quick-reference guide	Summary of guideline recommendations available on www.orthopt.org
Read-for-credit continuing education units	Continuing education units available for physical therapists and athletic trainers through *JOSPT*
Educational webinars for health care practitioners	Guideline-based instruction available for practitioners on www.orthopt.org
Mobile and web-based app of guideline for training of health care practitioners	Marketing and distribution of app using www.orthopt.org and www.jospt.org
Physical Therapy National Outcomes Data Registry	Support the ongoing usage of data registry for common musculoskeletal conditions of the head and neck region
Logical Observation Identifiers Names and Codes mapping	Publication of minimal data sets and their corresponding Logical Observation Identifiers Names and Codes for the head and neck region on www.orthopt.org
Non-English versions of the guidelines and guideline implementation tools	Development and distribution of translated guidelines and tools to *JOSPT*'s international partners and global audience via www.jospt.org

Methods *(continued)*

than 10% were labeled as "less frequent." The more frequent categories of body function to which they were linked included **b134 Sleep functions** (27.2%) and **b710 Mobility of joint functions** (26.2%). The most frequent categories of activity and participation were **d850 Remunerative employment** (15%), **d640 Doing housework** (14%), **d920 Recreation and leisure activities** (13%), and **d430 Lifting and carrying objects** (10%).[5]

Additional ICF body function codes associated with neck pain are (1) sensory functions related to pain, and (2) movement functions related to joint motion and control of voluntary movements. These body function codes include **b28010 Pain in neck and head**, **b2803 Radiating pain in a dermatome**, **b2804 Radiating pain in a segment or region**, **b7101 Mobility of several joints**, and **b7601 Control of complex voluntary movements**.

Additional ICF activities and participation codes associated with neck pain include **d4108 Changing a basic body position**, **d4158 Maintaining a body position**, and **d4452 Reaching**.

ICF body structure codes associated with neck pain include **s7103 Joints of head and neck**, **s7104 Muscles of head and neck region**, **s7105 Ligaments and fascia of head and neck region**, **s76000 Cervical vertebral column**, and **s1201 Spinal nerves**.

ICF codes can be accessed at http//apps.who.int/classifications/icfbrowser/. A comprehensive list of codes was published in the previous guideline.[29]

ORGANIZATION OF THE GUIDELINES

For each topic, the summary recommendation and grade of evidence from the 2008 guideline are presented, followed by a synthesis of the recent literature with the corresponding evidence levels. Each topic concludes with the 2017 summary recommendation and its updated grade of evidence.

CLINICAL GUIDELINES

Impairment/Function-Based Diagnosis

PREVALENCE

2008 Summary

Pain and impairment of the neck is common. It is estimated that 22% to 70% of the population will have neck pain some time in their lives.[16,18,37,38,57,123,159] In addition, it has been suggested that the incidence of neck pain is increasing.[153,243] At any given time, 10% to 20% of the population reports neck problems,[16,39,88,215] with 54% of individuals having experienced neck pain within the last 6 months.[37] Prevalence of neck pain increases with age and is most common in women around the fifth decade of life.[7,16,40,128,201]

Although the natural history of neck pain appears to be favorable,[48,99] rates of recurrence and chronicity are high.[12,90] One study reported that 30% of patients with neck pain will develop chronic symptoms, with neck pain of greater than 6 months in duration affecting 14% of all individuals who experience an episode of neck pain.[16] Additionally, a recent survey demonstrated that 37% of individuals who experience neck pain will report persistent problems for at least 12 months.[39] Five percent of the adult population with neck pain will be disabled by the pain, representing a serious health concern.[16,97] In a survey of workers with injuries to the neck and upper extremity, Pransky et al[162] reported that 42% missed more than 1 week of work and 26% experienced recurrence within 1 year. The economic burden due to disorders of the neck is high, and includes costs of treatment, lost wages, and compensation expenditures.[13,168] Neck pain is second only to low back pain in annual workers' compensation costs in the United States.[243] In Sweden, neck and shoulder problems account for 18% of all disability payments.[153] Jette et al[98] reported that individuals with neck pain make up approximately 25% of patients receiving outpatient physical therapy care. Additionally, patients with neck pain frequently are treated with nonsurgical interventions by primary care and physical therapy providers.[15,48,99]

EVIDENCE UPDATE

I The Global Burden of Disease Injuries and Risk Factors 2010 study measured population health through disability-adjusted life years and years of life lived in less than ideal health, measured as years lived with disability. Years lived with disability is the number of incident cases, multiplied by the average duration of the condition (average number of years that the condition lasts until remission or death), multiplied by the disability weight. In this large study, neck pain ranked 21st overall in global cause of disability-adjusted life years[144] and fourth overall in years lived with disability.[230] The 2013 data indicated a worsening problem, with neck pain ranking 19th overall in global cause of disability-adjusted life years.[143]

I In a systematic review by Haldeman et al,[80] prevalence depended on the definitions used; for neck pain, the 1-year prevalence ranged from 30% to 50% in the general population. For neck pain with associated disability, the 1-year prevalence ranged from 2% to 11% in the general population, and from 11% to 14% in workers who reported being limited in their activities because of neck pain.[80]

II March et al[129] reported on neck pain without referral into the upper limbs that lasted at least 1 day. The global point prevalence in 2010 was estimated to be 4.9% (females, 5.8%; males, 4.0%).[129]

II Hoy et al[91] published a systematic review of epidemiologic studies of activity-limiting neck pain, including neck-related upper-limb pain and head and/or trunk pain lasting at least 1 day. The 1-year incidence of neck pain was 10.4% to 21.3%. The 1-year remission rate ranged from 33% to 65%. The 1-year prevalence of neck pain in the general population was on average 25.8% (range, 4.8%-79.5%), with a point prevalence of 14.4% (range, 0.4%-41.5%).[91]

IV Goode et al[67] performed a telephone survey of 141 individuals in North Carolina, and found the estimated prevalence of chronic neck pain among non-institutionalized individuals for the state of North Carolina to be 2.2% (95% confidence interval [CI]: 1.7%, 2.6%). Individuals with chronic neck pain were largely middle aged (mean age, 48.9 years) and the majority were females (56%) and non-Hispanic whites (81%).[67]

2017 SUMMARY

Significant variation exists in the definition of neck pain and the research methods employed within the epidemiological

literature on neck pain. This variation limits the ability to compare or combine data across studies to arrive at consensus; however, there is agreement that neck pain is common and increasing worldwide in both the general population and in specific subgroups.

RISK FACTORS

2008 Recommendation

Clinicians should consider age greater than 40, coexisting low back pain, a long history of neck pain, cycling as a regular activity, loss of strength in the hands, worrisome attitude, poor quality of life, and less vitality as predisposing factors for the development of chronic neck pain. (Recommendation based on moderate evidence.)

For the purposes of this CPG, the term *risk* will be reserved specifically for risk factors for new onset of neck pain, while *prognosis* (discussed below) will refer to the predicted course of the condition after onset.

Evidence Update

McLean et al[137] conducted a systematic review of risk factors for the onset of new neck pain across different populations. Of 14 independent studies (13 rated high quality), the following risk factors for new-onset neck pain were identified: female sex, older age, high job demands, being an ex-smoker, low social or work support, and a previous history of neck or low back disorders. Paksaichol et al[158] conducted a similar review of 7 independent cohorts (5 rated high quality) focused on office workers,[158] with results indicating that only the female sex and prior history of neck pain were strong risk factors of new-onset neck pain in this population.

2017 Summary

Evidence from 2 recent systematic reviews indicates that the female sex and prior history of neck pain are the strongest and most consistent risk factors for new-onset neck pain in office workers and the general population. Older age, high job demands, smoking history, low social/work support, and prior history of low back pain may also be risk factors.

CLINICAL COURSE AND PROGNOSIS

Clinical Course

Risk and prognosis are ideally considered in the context of the "natural course" of a condition, assuming no intervention, or the "clinical course" a condition can be expected to take in response to a specific intervention. Clinical prognosis is based on 2 important pieces of information: what is known about the clinical course of the condition, and the presence or absence of factors that may lead to deviation from that course.

Evidence Update

Six systematic reviews addressed the clinical course of neck pain.[12,25,26,78,105,165] The reviews commonly included studies using observational research designs in which the type of intervention is not controlled; therefore, the individuals included in these reviews can be assumed to have participated in a range of interventions, including medical, surgical, physical therapy, and chiropractic treatments, among others. Results of this research can most logically be interpreted as "the average rate of recovery—in this cohort—under this clinical context." It is also worth noting that reported outcomes are rarely consistent across studies (eg, pain intensity, self-rated disability scale, work status, medication usage[232]), rendering meta-synthesis very difficult.

In general, the reviews in the field have arrived at a similar conclusion: the clinical course of neck pain is variable and not entirely favorable. Kamper et al[105] used a meta-analytic approach to synthesize recovery data following acute whiplash-associated disorder (WAD).[105] Their results indicate that recovery is slow when the outcome is pain intensity, requiring 6 months or more for average pain intensity to achieve the clinically meaningful reduction of 20%. When self-rated disability was the outcome, recovery fared no better. Standardized mean scores did not reach 20% improvement over the 12 months for which data were available. A similar conclusion was reached by Hush et al,[94] who focused on individuals with acute idiopathic neck pain, with the additional finding that idiopathic neck pain does not resolve further after the first 6.5 weeks.[94] Sterling et al[194] reported recovery trajectories for outcomes of neck disability and posttraumatic stress following acute traumatic neck pain. Three trajectories were identified: mild disability/posttraumatic stress (40% to 45% of individuals), initially moderate improving to mild (39% to 43% of individuals), and chronic severe problems (16% to 17% of individuals). For neck disability and posttraumatic stress, recovery appears to happen most rapidly within the first 6 to 12 weeks postinjury, with the rate of recovery slowing considerably after that critical window.[194] Casey et al[27] conducted a similar study and again found 3 trajectories for outcomes measured using the Functional Rating Index (low-moderate-severe continued disability for 47%, 31%, and 22% of individuals, respectively), Pain Catastrophizing Scale (55%, 32%, and 13%), and Mental Component Score of the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) (40%, 42%, and 18%, respectively).[27] Casey et al[27] collected data at baseline, 12 months, and 24 months, so lacked the precision of the study by Sterling et al[194] to identify important inflection points in recovery, but reported no further recovery between 12 and 24 months.[27] The newer data generally appear consistent with earlier reviews from the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders that approximately 50%

will fully recover within 1 year following WAD.[24] It is worth noting that these estimates may be highly dependent on the definition of recovery used.[232]

Chronic or insidious neck pain follows a clinical course described best as "recurrent" or "episodic,"[78] suggesting that complete resolution of such symptoms is the exception rather than the rule. An early review by Borghouts et al[12] reported the median frequency of "general improvement" in people with nonspecific neck pain to be 47% (range, 37% to 95%, depending on outcome) within 6 months.

Rao[165] reported the results of a knowledge synthesis for cervical myelopathy with or without radiculopathy. While much of the evidence synthesis came from very early research of the 1950s and 1960s, the most recent evidence regarding cervical myelopathy suggested a course of neck pain that could show periods of functional stability (neither decreasing nor increasing) or a gradual worsening. That synthesis found that only 18% of individuals report improvements in neck disability, while 67% report progressive deterioration over time, regardless of intervention. Those who underwent surgical management showed better outcomes than those managed nonsurgically.[165]

Thoomes et al[208] reported that little is known about the natural course of cervical radiculopathy. They reported on a single 1963 study of 51 patients, reporting that 43% of cases had no further symptoms after a few months, with 29% and 27% having mild and more disabling pain, respectively, at a follow-up of up to 19 years.[121] Across several more recent studies, Thoomes et al[208] reported low-level evidence of a more favorable natural course, with resolution of symptoms over weeks to months.

2017 Summary

The overall balance of evidence supports a variable view of the clinical course of neck pain. In acute traumatic conditions, clinicians can expect individuals to follow 1 of 3 likely trajectories: mild problems with rapid recovery (approximately 45% of individuals depending on outcome), moderate problems with some but incomplete recovery (approximately 40% of individuals), and severe problems with no recovery (approximately 15% of individuals). Regardless of the outcome, recovery appears to occur most rapidly in the first 6 to 12 weeks postinjury, with considerable slowing after that and little recovery after 12 months.[194] Less evidence is available for acute nontraumatic (idiopathic) neck pain, but clinicians can still expect recovery to slow considerably after 6 to 12 weeks from onset. In chronic conditions, the course may be stable or fluctuating, but in most cases can be best classified as recurrent, characterized by periods of relative improvement followed by periods of relative worsening.[78] For many patients with acute cervical radiculopathy, the clinical course appears favorable, with resolution of symptoms occurring over weeks to months. As described below, monitoring for worsening of clinical status is advised during nonsurgical management.

CLINICAL PROGNOSIS

Evidence Update

In the context of neck pain, prognostic factors are most commonly evaluated in acute trauma-related conditions (eg, WAD). This is likely due to the ability to identify a clear start time (time of whiplash injury) for the onset of the condition and offers the potential to quantify the magnitude of the inciting event (eg, motor vehicle collision [MVC]). A derived and validated clinical prediction rule for prognosis for individuals with WAD exists.[170,171] Insidious-onset conditions, such as degenerative disc disease or postural syndromes, offer a less accurate onset date or magnitude of event, making prognostic research more difficult.

Since the Quebec Task Force monograph of 1995,[191] several primary research studies and systematic reviews on the topic of prognosis following WAD have been published. An overview of systematic reviews sought to identify consistencies in the pool of literature from January 2000 to March 2012 and quantify confidence in the prognostic value of more than 130 different factors.[233] The results of that procedure led to high or moderate confidence that each of the following were risk factors for persistent problems when captured in acute or subacute WAD (less than 6 weeks from injury): (1) high pain intensity, (2) high self-reported disability scores (Neck Disability Index [NDI]), (3) high posttraumatic stress symptoms, (4) strong catastrophic beliefs, and (5) cold hyperalgesia. In work-related or nonspecific neck pain, only older age and a prior history of other musculoskeletal disorders offered the same level of confidence.

Factors that were not supported as useful for establishing a prognosis were: (1) angular deformity of the neck (eg, scoliosis, flattened lordosis), (2) impact direction, (3) seating position in the vehicle, (4) awareness of the impending collision, (5) having a headrest in place at the time of collision, (6) stationary versus moving when hit, and (7) older age (note the difference between WAD and nonspecific neck pain). For nonspecific neck pain, a preinjury history of regular physical activity was not a useful prognostic factor.[233]

Walton et al[235] used meta-analytic techniques to quantify the prognostic utility of many of these factors as reported in previous primary evidence. Their results are presented in **TABLE 6** below, and indicate that high pain intensity and high self-reported disability offer the greatest prognostic value. However, this may simply be a function of research using

TABLE 6 Recommended Tools for Developing a Prognosis

Construct	Recommended Tool
High pain intensity	Numeric rating scale (0-10): consider score of 6 or greater a useful cut score for prognosis
High self-reported disability	Neck Disability Index, original[225] or shorter adaptations[1]: consider greater than 30% as a useful cut score for prognosis
High pain catastrophizing	Pain Catastrophizing Scale[198,214]: consider score of 20 or greater a useful cut score for prognosis
High acute posttraumatic stress symptoms	Impact of Events Scale-Revised: consider score of 33 or greater a useful cut score for prognosis.[199] High posttraumatic distress is not uncommon in acute injuries; here, this scale is used to predict symptom chronicity, not to assess for posttraumatic stress disorder
Cold hyperalgesia	The TSA-II – NeuroSensory Analyzer (Medoc Ltd, Ramat Yishai, Israel) is largely considered the gold standard. However, the cost of such equipment may render it impractical for clinicians. Alternatives include the cold pressor task as a test of cold endurance (similar but not identical to cold pain threshold), use of an ice cube,[133,166] or use of cold metal bars

pain and disability as the predicted outcomes, meaning that the predictive value of these factors may be different when the outcome to be predicted is something else, such as work status or health care usage.[235]

Two more narrowly focused systematic reviews in the area of traumatic neck pain prognosis were published, but not included in the overviews by Walton et al.[235] Goldsmith et al[66] reviewed the evidence for cold hyperalgesia as a prognostic variable, and found consistent moderate-grade evidence (4 cohorts) that cold hyperalgesia holds prognostic value. Daenen et al[43] conducted a systematic review of cervical motor dysfunction as a prognostic variable and found inconclusive results (4 cohorts), preventing endorsement of such tests as being prognostic.

A systematic review by Kelly et al[112] explored the readiness for clinical adoption of 15 formalized prognostic clinical prediction rules for early identification of the patient at risk of transitioning to chronic neck pain. Of those, 11 remained in the derivation stage, lacking external validation. Four had undergone some degree of external validation, but none were at the stage of readiness to be endorsed for widespread clinical adoption.[112,171]

For nontraumatic neck pain, Carroll et al[25] reported that between 50% and 85% of people who experience neck pain will report neck pain 1 to 5 years later, but it is unclear whether this is persistence of the initiating event, recurrence following a refractory period, or new-onset neck pain. Older age was a consistent but not strong predictor of neck pain at follow-up after an initial event. Generally, poor physical health showed moderate association with ongoing neck pain, but this was not a consistent finding. One study even found that regular cycling was associated with worse outcomes. Similar to that in WAD, poorer psychological health was a consistent predictor of neck pain at follow-up, as were lower social support and preference for passive coping strategies. Regarding neck pain in workers specifically, Carroll et al[24] found relatively little evidence upon which to base prognostic decisions. Workplace decision-making capacity (control over work) had a small but significant association with worse outcomes, and white collar workers generally fared better than their blue collar counterparts, but the evidence was not strong for either. Poor prior health (lack of exercise, prior neck pain, prior sick leave) showed some additional promise as a prognostic factor.[24]

2017 Summary

Moderate- to high-level evidence indicates that the female sex and/or prior history of neck pain are consistent risk factors for new-onset neck pain. Low- to moderate-level evidence suggests that older age, high job demands, being an ex-smoker, low support, and prior history of low back pain may also be risk factors.

Moderate- to high-level evidence indicates that clinicians should collect and consider pain intensity, level of self-rated disability, pain-related catastrophizing, posttraumatic stress symptoms (traumatic onset only), and cold hyperalgesia when establishing a prognosis for their patients. These constructs and related recommended tools are summarized in **TABLE 6**. Prior health, including regular exercise, neck pain, and sick leave, may offer some additional prognostic value, more so in nontraumatic neck pain in the general population or in workers. **TABLE 6** offers a list of sample tools that can be used to capture these variables. For nonspecific neck pain, age and prior history of musculoskeletal problems may offer prognostic value. There is still relatively little guidance regarding the combination of risk factors and how those should be interpreted and managed. New research focusing on more integrated complex models or prediction rules may shed light on this challenge in the near future.

PATHOANATOMICAL FEATURES/ DIFFERENTIAL DIAGNOSIS

2008 Summary

Although the cause of neck pain may be associated with degenerative processes or pathology identified during diagnostic imaging, the tissue that is causing a patient's neck pain is most often unknown. Thus, clinicians should assess for impaired function of muscle, connective, and nerve tissues associated with the identified pathological tissues when a patient presents with neck pain.

Evidence Update

There are numerous anatomical structures in the cervical region that can be sources of nociception, including zygapophyseal joints, vertebrae, muscles, ligaments, neural structures, and the intervertebral disc.[42,115,165,188,239] However, evidence is lacking to support the hypothesis that these pathoanatomical features are a primary source of mechanical neck pain across the age spectrum in the majority of patients.[86] The source of neck symptoms may on occasion be something more serious; therefore, screening for clinical conditions such as cervical myelopathy, cervical ligamentous instability, fracture, neoplasm, vascular insufficiency, or systemic disease is required.[80,183,239]

Space-occupying lesions (eg, osteophytosis or herniated cervical disc) are commonly associated with cervical spondylotic myelopathy and central canal stenosis.[206] These may be secondary to acquired degenerative processes, and can give rise to signs and symptoms in the neck and/or upper or lower quarter as well as potentially bowel or bladder problems or neurologic deficits. Congenital narrowing of the spinal canal may also increase the risk for developing spinal canal stenosis later in life.[106] Magnetic resonance imaging (MRI) is useful in determining the diagnosis of myelopathy.[114] Clinical tests used in the diagnostic process for cervical myelopathy generally have low sensitivity; therefore, they should not be used when screening for and diagnosing this condition.[35] While cervical disc herniation and spondylosis are most commonly linked to cervical myelopathy, the patient's ultimate presentation may reflect pain mechanisms beyond these discrete pathoanatomical findings.[2,80,106]

Little consensus exists on the definition of cervical radiculopathy related to the exact location, intensity, or duration of painful symptoms in patients. Therefore, it is suggested that pain radiating into the arm coupled with motor, reflex, and/or sensory changes in the upper limb, including paresthesia or numbness, be considered in making clinical determination for cervical radiculopathy.[207] Limited evidence suggests that neurodynamic testing of the median nerve, but not the radial nerve, is clinically useful in determining the presence/absence of cervical radiculopathy.[150]

The 2012 IFOMPT "International Framework for Examination of the Cervical Region for potential of Cervical Arterial Dysfunction prior to Orthopaedic Manual Therapy Intervention" provides a decision-making pathway for assessment of suspected arterial insufficiency and upper cervical ligamentous integrity.[177] Because clinicians cannot rely on the results of any single test, including imaging,[146] the framework provides a tool to guide assessment of both risk factors and clinical presentation, and to make patient-centered, evidence-driven decisions on management. One high-quality systematic review by Hutting et al[95] revealed poor diagnostic accuracy for all upper cervical ligament integrity tests evaluated. Generally, these tests have sufficient specificity and can rule in upper cervical ligamentous insufficiency, but extent of sensitivity varied.

The Valsalva maneuver, previously described in the Physical Impairment section of the 2008 neck pain guidelines, may also be a useful screen for serious intracranial pathology in patients presenting with headache that worsens with exertion, and may be used to assist in deciding whether referral for neuroimaging is appropriate (positive likelihood ratio [LR] = 2.3; 95% CI: 1.4, 3.8).[47] Clinicians should refer to the American College of Radiology (ACR) Appropriateness Criteria guidelines to decide which type of imaging to use.[3]

Clinicians should utilize the Canadian cervical spine rule (CCR)[32,196,197] and/or the National Emergency X-Radiography Utilization Study (NEXUS) criteria[85,160] (**APPENDIX H**) to rule out the need for radiographic study in clinical conditions of suspected trauma-related fracture.

The National Institute for Health and Care Excellence produced a guideline that lists signs, symptoms, and conditions that should be considered when deciding the need for additional screening in patients who present with a headache in addition to neck pain.[149]

2017 Summary

Direct pathoanatomical causes of mechanical neck pain are rarely identifiable. Clinicians should inquire and test for clinical findings (red flags) in patients with neck pain to help determine the potential for the presence of serious pathology, such as infection, cancer, and cardiac involvement,[65] and the need for referral. Clinicians should also be alert for and assess patients with neck pain for signs and symptoms of serious pathology, including suspected arterial insufficiency, upper cervical ligamentous insufficiency, unexplained cranial nerve dysfunction, and fracture. Clinicians should utilize existing guidelines and appropriateness criteria (CCR, NEXUS, and ACR recommendations) in clinical decision making regarding imaging studies for traumatic and nontraumatic neck pain in the acute and chronic stages.

2017 Recommendation

A Clinicians should perform assessments and identify clinical findings in patients with neck pain to determine the potential for the presence of serious pathology (eg, infection, cancer, cardiac involvement, arterial insufficiency, upper cervical ligamentous insufficiency, unexplained cranial nerve dysfunction, or fracture), and refer for consultation as indicated.

IMAGING STUDIES

As noted in the 2008 CPG, alert and stable adult patients with cervical pain precipitated by trauma should be classified for risk level based on the CCR[197] or the NEXUS criteria[69] (**APPENDIX H**). The ACR Appropriateness Criteria should also be used for suspected spine trauma and chronic neck pain.[148] According to the CCR, patients are considered high risk if they (1) are greater than 65 years of age, (2) have had a dangerous mechanism of injury, or (3) have paresthesias in the extremities. Those classified as high risk should undergo computed tomography (CT) or cervical radiography. Furthermore, the following low-risk factors indicate that safe cervical range of motion (ROM) assessment can be done: if the patient (1) is able to sit in the emergency department, (2) has had a simple rear-end MVC, (3) is ambulatory at any time, (4) has had a delayed onset of neck pain, or (5) does not have midline cervical spine tenderness. Finally, if able to actively rotate the head 45° in each direction, the patient is classified as low risk. Imaging in the acute stage is not required for those who are classified as low risk.

The NEXUS low-risk criteria suggest that cervical spine radiography is indicated for patients with trauma unless they meet the following: (1) no posterior midline cervical spine tenderness; (2) no evidence of intoxication; (3) a normal level of cognition, orientation, and alertness; (4) no focal neurologic deficit; and (5) no painful distracting injuries. A recent systematic review suggests that the CCR appears to have better diagnostic accuracy than the NEXUS criteria (**APPENDIX H**).[139]

While this section focuses on imaging in the adult population, noteworthy is the paucity of available literature to help guide decision making for imaging in the pediatric population. Adult risk classification features should be applied in children greater than 14 years of age. Due to the added radiation exposure of CT, the ACR recommends plain radiography (3 views) in those under 14 years of age, regardless of mental status.[148]

Guidelines on use of diagnostic imaging in patients with acute or chronic (traumatic or nontraumatic) neck pain exist.[148] However, in view of the frequency of abnormal findings, and the lack of prognostic value,[147] routine imaging, such as ultrasonography, CT, and MRI, in patients without neurologic insult (or deficits) or other disease processes may not be warranted.[147]

Following are issues in imaging specific to the subcategories of neck pain. Neck pain classification categories are discussed later in these clinical guidelines.

Neck Pain With Mobility Deficits

As this is described in terms of acute or chronic neck pain, in the absence of red flag signs, no imaging is indicated.[80]

Neck Pain With Radiating Pain

Patients with normal radiographs and with neurologic signs or symptoms should undergo cervical MRI that includes the cranial cervical junction and the upper thoracic region. If there is a contraindication to the MRI examination such as, but not limited to, a cardiac pacemaker or severe claustrophobia, CT myelography with multiplanar reconstruction is recommended.[3]

Magnetic resonance imaging is usually the preferred first imaging modality for patients with nonresolving radiculopathy or progressing myelopathy. Gadolinium contrast administration is preferred when oncological, infectious, inflammatory, or vascular causes of myelopathy are suspected.[148]

In the case of traumatic myelopathy, the priority is to assess mechanical stability of the spine. While radiographs are useful for this purpose, a higher probability of identifying bony injury or ligamentous disruption in the cervical spine is realized with CT.[148] Magnetic resonance imaging is usually appropriate for problem solving or operative planning, and is most useful when injury is not explained by bony fracture.[3]

Neck Pain With Movement Coordination Impairment

Johansson et al[100] investigated imaging changes in individuals with acute WAD from an MVC. They assessed whether the presence of a cervical spine kyphotic deformity on MRI in the acute stage (approximately 10 days following the MVC) was associated with greater severity of baseline symptoms and a worse 1-year prognosis as compared to lordotic or straight postures following a whiplash injury. Findings suggest that kyphotic deformity is not significantly associated with chronic whiplash-associated pain.

High-resolution proton density-weighted MRI has identified abnormal signal intensity (indicative of tissue damage) in both the alar and transverse ligaments in some individuals with chronic WAD.[117] Separate studies initially indicated a strong relationship between alar ligament damage, head position (turned) at time of impact, and disability levels (as measured with the NDI).[101,102,116] However, a 2011 study by

Vetti et al[227] demonstrated that alar and transverse ligament signal within 1 year of injury most likely reflected normal variation. More recent evidence suggests that MRI signal changes of alar and transverse ligaments are not caused by whiplash injury, and MRI examination of alar and transverse ligaments should not be used as the routine workup of patients with whiplash injury.[122,145,146,228]

Previous work in chronic WAD from an MVC demonstrated that female patients (18-45 years of age) with persistent WAD (grade II Quebec Task Force rating: neck pain, tenderness to palpation, and limited neck ROM) have increased fat infiltration of the neck extensors[50] and flexors[55] on conventional MRI. These changes in muscle structure were significantly less in individuals with chronic insidious-onset neck pain or healthy controls,[53] suggesting that traumatic factors may play a role. The differential development of neck muscle fatty infiltrates was observed in individuals with varying levels of functional recovery following whiplash injury. Findings identified longitudinal structural muscle pathology with T1-weighted MRI. These findings were used to differentiate between those with varying levels of functional recovery, establishing a relationship between muscle fat at 6 months postinjury, and initial pain intensity, as well as signs/symptoms of posttraumatic stress disorders. Posttraumatic stress disorders have been identified as a strong factor in the prediction of recovery following whiplash, and these findings were recently replicated in a separate longitudinal study in Australia.[52] In a later study, the receiver operating characteristic analysis indicated that muscle fat levels of 20.5% or above resulted in a sensitivity of 87.5% and a specificity of 92.9% for predicting level of recovery at 3 months.[54] These results provide further evidence that muscle degeneration occurs in tandem with known predictive risk factors (older age, pain-related disability, and posttraumatic stress). An independent cross-sectional replication study from Sweden suggests similar findings.[107] The mechanisms by which changes in muscle structure occur, or respond to rehabilitation strategies, remain largely unknown.

There remains uncertainty about whether changes in the relative cross-sectional area (square millimeters) of the cervical paraspinal musculature are related to functional recovery following whiplash injury. Elliott et al[51] observed a consistent pattern of larger cross-sectional area with MRI in the multifidus muscles of those with persistent WAD. The larger cross-sectional area was believed to represent larger amounts of fatty infiltrate. Effectively, removal of fat signal from the MRI measures in these patients revealed that the majority of the muscles were not larger; rather, they were atrophied when compared with healthy controls and those with idiopathic neck pain.[56] In contrast, others have shown that atrophy of the neck muscles with MRI is not associated with long-term functional outcomes.[6,131,213]

Longitudinal observations (10 years or more) of modic signs (degenerative changes of the vertebral bone marrow adjacent to the end plates) and degenerative changes in the cervical intervertebral discs are common in patients with WAD. However, they occur with a similar frequency in healthy controls and are not significantly associated with changes in clinical symptoms, suggesting they may be more the result of the physiological aging process rather than pathological findings related to the whiplash injury.[96,132]

2017 Summary

Clinicians should utilize existing guidelines and appropriateness criteria (CCR, NEXUS, and ACR recommendations) in clinical decision making regarding imaging studies for traumatic and nontraumatic neck pain in the acute and chronic stages. Imaging studies often fail to identify any structural pathology related to symptoms in patients with whiplash injury. Although MRI can easily visualize ligamentous structures in the upper cervical spine, there is little evidence that MRI examination of alar and transverse ligaments should be used as the routine workup of patients with whiplash injury. Evidence is available for changes in muscle morphology; however, more high-quality prospective and cross-sectional research is needed to confirm these changes and to identify potential underlying causes and influence on recovery rates.[46] Magnetic resonance imaging is the preferred choice of imaging in painful and traumatic myelopathy. In the absence of neurological signs or symptoms, patients with normal radiographic findings or evidence of spondylosis need no further imaging studies.

2017 Recommendation

A Clinicians should utilize existing guidelines and appropriateness criteria in clinical decision making regarding referral or consultation for imaging studies for traumatic and nontraumatic neck pain in the acute and chronic stages.

CLINICAL GUIDELINES

Examination

OUTCOME MEASUREMENT

2008 Recommendation

A Clinicians should use validated self-report questionnaires, such as the NDI and the PSFS, for patients with neck pain. These tools are useful for identifying a patient's baseline status relative to pain, function, and disability and for monitoring a change in a patient's status throughout the course of treatment.

Evidence Update

Outcome tools can be used for at least 3 purposes: (1) evaluation (including determining change over time), (2) prognosis, and (3) diagnosis. Tools for evaluation are addressed below, tools for prognosis are described in the section on risk, and tools for diagnosis are described in the section on diagnosis.

II Many patient-reported outcome tools for neck pain are described in the literature. For the most part, these are not validated and the measurement properties of these scales remain uncertain. A notable exception is the most commonly used patient-reported functional outcome tool, the NDI.[127] In a 2012 moderate-quality systematic review of patient-reported outcome measures, Schellingerhout et al[181] focused on 8 different tools. Of these, the NDI was the most extensively studied over a variety of neck pain conditions and has been translated into many languages.[180,181,224] The NDI was also extensively assessed for its psychometric properties. Schellingerhout et al[181] found the measurement properties of the NDI to be adequate, except for reliability, and provisionally recommended its use. In an earlier low-quality review, Holly et al[87] found the NDI, the PSFS, and the North American Spine Society scale to be reliable, valid, and responsive for assessing radiculopathy for nonsurgical interventions. Further, a high-quality clinical guideline strongly recommended the use of the NDI, SF-36, Medical Outcomes Study 12-Item Short-Form Health Survey (SF-12), and visual analog scale (VAS) for assessing treatment of cervical radiculopathy arising from degenerative disorders.[11] Other scales, including the modified Prolo, the Modified Million Index, the PSFS, the Health Status Questionnaire, the Sickness Impact Profile, the McGill Pain Scores, and the Modified Oswestry Disability Index, were rated lower, but were still recommended outcome measures for assessing treatment of cervical radiculopathy arising from degenerative disorders. An acceptable-quality review by Horn et al[89] found the PSFS to have greater reliability than the NDI in patients with cervical dysfunction or cervical radiculopathy. Ferreira et al[60] found that the NDI, along with the Neck Bournemouth Questionnaire and the Neck Pain and Disability scale, demonstrated a balanced distribution of items across the ICF components.

II Fairbairn et al[58] used a thematic analysis technique to map patient-generated items on the PSFS to ICF components. From 283 neck-related items on the PSFS, they classified 29.3% of the items into body functions and structures, 57.6% of the items into activity, 8.5% into participation, and 4.6% into a combination of activity and participation.

V While not a measure of function, pain has an effect on function and can be used as an evaluative tool. Fillingim et al[61] recommended assessing 4 components of pain: (1) pain intensity (eg, numeric pain-rating scale[84]), (2) other perceptual qualities of pain (eg, asking the patient to describe the character of the pain), (3) bodily distribution of the pain (eg, by using a body chart), and (4) temporal features of pain (eg, asking the patient how the pain fluctuates with activity and rest, and over a day, week, or month). In some patients, Fillingim et al[61] also recommended considering the use of a mechanism-based approach, such as screening tools for neuropathic pain. Quantitative sensory testing, including tuning forks, monofilaments,[61] and tools for cold hyperalgesia described earlier, also could play a role in the assessment of a patient's pain. Finally, Fillingim et al[61] recommended that pain assessment be combined with other domains such as physical and psychosocial functioning. A review by Turk et al[212] provides an overview of measures and procedures to assess a set of key psychosocial and behavioral factors that could be important in chronic pain.

2017 Recommendation

A Clinicians should use validated self-report questionnaires for patients with neck pain, to identify a patient's baseline status and to monitor changes relative to pain, function, disability, and psychosocial functioning.

ACTIVITY LIMITATION AND PARTICIPATION RESTRICTION MEASURES

Evidence Update

III The Spinal Function Sort tool is used to measure a person's perceived ability to engage in functional activities by rating his or her ability on a series of

50 functional tasks graphically depicted and simply described.[130] Each task is rated on a 0-to-4-point scale, yielding a range of scores from 0 to 200. Although the Spinal Function Sort tool shows promise in predicting return to work in people with chronic low back pain,[14,154] it was not useful in predicting return to work at follow-up periods longer than 1 month in people with subacute WAD.[209]

V The measures identified in the 2008 neck pain CPG continue to be options that a clinician may use to assess changes in a patient's level of function over an episode of care. In addition, clinicians may ascertain activity limitations or participation restrictions through a physical task analysis approach on activities associated with the individual's daily living, employment, and leisure pursuits.

2008 and 2017 Recommendation

F Clinicians should utilize easily reproducible activity limitation and participation restriction measures associated with the patient's neck pain to assess the changes in the patient's level of function over the episode of care.

PHYSICAL IMPAIRMENT MEASURES

Evidence Update

I In a high-quality review, Snodgrass et al[189] studied cervical ROM as an outcome measure following cervical mobilization/manipulation. Of 36 studies, they found the cervical range of motion (CROM) device (Performance Attainment Associates, Lindstrom, MN), the standard goniometer, and the inclinometer to be the most commonly used tools to measure cervical ROM. It was suggested, based on limited evidence, that cervical ROM assessment was potentially a valuable tool in the screening/diagnostic process related to cervicogenic headache, cervical radiculopathy, and cervical spinal injury.

I In a 2010 acceptable-quality review, Williams et al[238] reviewed 46 articles on reliability and 21 articles on validity of cervical ROM assessment, finding "good" reliability and validity for the CROM device, the single inclinometer method, and the Spin-T goniometer. However, it should be noted that 32 of the 46 articles included in this review used asymptomatic individuals; application of these results to patients with neck pain should be done cautiously.

I An acceptable-quality review by Rubio-Ochoa et al[176] included 9 studies that assessed diagnostic utility of physical examination measures in individuals with cervicogenic headache compared to asymptomatic controls or individuals with other headache types. The most commonly used measures were cervical active ROM, passive accessory intervertebral motion (PAIVM) from C0 to C3, and the cervical flexion-rotation test (CFRT), and the authors determined that all of these tests demonstrated good utility in differential diagnosis of headache. The CFRT exhibited the strongest diagnostic metrics; kappa values ranged from 0.67 to 0.85, and intraclass correlation coefficients (ICCs) were 0.95 (95% CI: 0.90, 0.98) for CFRT right and 0.97 (95% CI: 0.94, 0.99) for CFRT left. Sensitivity/specificity ranged from 0.70/0.70 to 0.91/0.91, with positive and negative LRs of 2.3 to 10.65 and 0.095 to 0.43. The authors suggest that given the high specificity and positive LR, clinicians should use the CFRT near the end of the examination to rule in cervicogenic headache. Reliability and diagnostic accuracy were also reported for C0-C3 PAIVM testing in identifying cervicogenic headache. Kappa values ranged from 0.53 to 0.72, and the most common symptomatic segment was C1-2. Values for sensitivity were between 0.59 and 0.65, specificity between 0.78 and 0.87, positive LR from 2.9 to 4.9, and negative LR from 0.43 to 0.49. Interestingly, 1 high-quality study in the review clustered cervical active ROM, PAIVMs, and the cranial cervical flexion test (CCFT), with a resulting sensitivity of 0.94 and specificity of 1.00.[176]

I A high-quality review by Stanton et al[192] examined evidence of impaired proprioception in individuals with chronic, idiopathic neck pain and concluded that these individuals are worse than asymptomatic controls at head-to-neutral repositioning tests. However, due to a lack of studies evaluating the diagnostic accuracy of the repositioning tests, the authors did not draw conclusions about these measures.[192]

II In an acceptable-quality systematic review of 7 articles,[217] the interexaminer reliability of determining passive intervertebral motion of the cervical spine was poor to fair, and assessment of C1-2 and C2-3 motion segments was fair. Reliability tended to be higher (percent agreement ranging from 68% to 90%) when assessed on symptomatic versus asymptomatic individuals.

II An acceptable-quality systematic review by Rubinstein et al[175] evaluated the Spurling test, neck distraction test, Valsalva test, shoulder abduction test, and the neurodynamic test [upper-limb tension test] for the median nerve. A positive Spurling test (sensitivity, 0.50; specificity, 0.86-0.93), traction/neck distraction test (sensitivity, 0.44; specificity, 0.90-0.97), and Valsalva test (sensitivity, 0.22; specificity, 0.94) may suggest cervical radiculopathy, while a negative neurodynamic test (sensitivity, 0.17-0.78; specificity, 0.72-0.83) may rule it out. Caution should be used when considering any of these physical impairment measures independently. Clinicians should look for patterns between patient-reported and physical examination findings that rule

in or rule out a particular diagnostic classification for a patient.

This revision of the neck pain CPGs adds 2 additional physical impairment measures to the list presented in the 2008 guidelines: the CFRT and algometric assessment of pressure pain threshold.

Cervical Flexion-Rotation Test

- ICF category: measurement of impairment of body function; movement of several joints
- Description: measurement of passive rotation ROM at the C1-2 segment
- Measurement method: the patient lies supine while the clinician passively flexes the cervical spine maximally to end range. The clinician then passively rotates the head left and right. The end ROM in rotation is determined either by patient report of onset of pain or firm resistance felt by the clinician, whichever comes first. The clinician quantifies the ROM either by visual estimate or use of the CROM device. A positive test has been defined as a restriction of rotation ROM with a cutoff of less than 32° of rotation,[81,155] or a 10° reduction in the visually estimated range to either side.[82]
- Nature of variable: continuous
- Units of measurement: degrees
- Measurement properties: mean ROM was 39° to 45° in healthy individuals and 20° to 28° in patients with cervicogenic headache.[81,82,155] Reliability was excellent, as indicated by interrater agreement (κ = 0.81)[155] and test-retest reliability ($ICC_{2,1}$ = 0.92).[82] The standard error of measurement (SEM) is 2 ° to 3°, with a minimal detectable change (MDC_{90}) of 4.7° to 7°.[82]
  - Sensitivity, 0.90-0.95[81,82,155]; negative LR = 0.11-0.27[81,155]
  - Specificity, 0.90-0.97[81,82,155]; positive LR = 9.0-9.4[81,155]
- Instrument variations: clinicians may use visual estimate or goniometry

Algometric Assessment of Pressure Pain Threshold

- ICF category: measurement of impairment of body function; pain in head and neck
- Description: measurement of local pressure pain threshold in the upper trapezius
- Measurement method: the patient is seated. A digital pressure algometer is applied perpendicular to the muscle at the angle of the upper fibers of the trapezius muscle (approximately 5 to 8 cm superomedial to the superior angle of the scapula), with pressure increasing at a rate of approximately 4 to 5 N/s (40-50 kPa/s). Patients are instructed to push a button or tell the examiner the precise moment the sensation changes from pressure to pain. The examiner then repeats the test on the opposite side, and 3 tests of each site are conducted, with a minimum 30-second interval between tests
- Nature of variable: continuous
- Units of measurement: pressure (eg, N/cm^2, psi, or kPa)
- Measurement properties: reference values are established for patients with acute and chronic neck pain. Lowered values seen locally (about the neck) suggest a local mechanical hypersensitivity. Widespread lowered values (eg, about the neck and lower extremity) raise the possibility of a central nociceptive processing disorder. Reliability is excellent for intrarater agreement ($ICC_{2,1}$ = 0.96; 95% CI: 0.91, 0.98),[236] interrater agreement (0.89; 95% CI: 0.83, 0.93),[234,236] and 2- to 4-day test-retest reliability (0.83; 95% CI: 0.69, 0.91)[234]
  - SEM intrarater, 20.5 kPa; interrater, 50.3 kPa[234,236]
  - MDC_{90} intrarater, 47.2 kPa; interrater, 117-156 kPa[236,234]

2017 Recommendation

B When evaluating a patient with neck pain over an episode of care, clinicians should include assessments of impairments of body function that can establish baselines, monitor changes over time, and be helpful in clinical decision making to rule in or rule out (1) neck pain with mobility deficits, including cervical active ROM, the cervical flexion-rotation test, and cervical and thoracic segmental mobility tests; (2) neck pain with headache, including cervical active ROM, the cervical flexion-rotation test, and upper cervical segmental mobility testing; (3) neck pain with radiating pain, including neurodynamic testing, Spurling's test, the distraction test, and the Valsalva test; and (4) neck pain with movement coordination impairments, including cranial cervical flexion and neck flexor muscle endurance tests. Clinicians should include algometric assessment of pressure pain threshold for classifying pain.

DIAGNOSIS/CLASSIFICATION

The 2008 neck pain clinical practice guidelines classified neck pain into 4 categories linked to the treatment-based model proposed by Fritz and Brennan[62]: (1) neck pain with mobility deficits, (2) neck pain with movement coordination impairments, (3) neck pain with headache, (4) neck pain with radiating pain. Classification/diagnostic criteria were described in the 2008 recommendations.

Evidence Update

II In a high-quality systematic review of 5 trials, Takasaki and May[202] compared the effectiveness of the Mechanical Diagnosis and Therapy (MDT) approach to other therapeutic approaches or a "wait and see" approach in a wide variety of types of neck pain. Treatments were provided by therapists who had moderate training in the MDT approach. Results on pain intensity and function had wide CIs, and the authors concluded that any benefit from the MDT approach over other therapeutic approaches

or a "wait and see" approach may not be clinically relevant for pain, and was not clinically relevant for function.[202]

III Bergström et al[9] studied the effectiveness of different types of intervention on patients with cervicothoracic or low back pain. They classified patients using the Swedish version of the Multidimensional Pain Inventory into the following categories: adaptive copers (n = 62), interpersonally distressed (n = 52), and dysfunctional (n = 80). The types of intervention were: (1) behavioral-oriented physical therapy for approximately 20 hours per week; (2) cognitive behavioral therapy for approximately 14 hours per week; (3) behavioral medicine rehabilitation, which was a combination of the other 2 interventions, for approximately 40 hours per week; and (4) treatment as usual, consisting of no treatment offered. The outcome measure was sickness absence measured in days. Overall attendance rate for treatment alternatives was 62%. Outcomes indicated that the multidisciplinary behavioral medicine rehabilitation intervention resulted in decreased sickness absence more than treatment as usual in the adaptive coper and interpersonally distressed groups.

III In a retrospective analysis, Verhagen et al[222] failed to find significant differences in outcomes or prognostic factors between nonspecific neck pain associated with traumatic (WAD) and nontraumatic neck pain. Patients with headache were included in both the WAD (prevalence, 49/63) and nontraumatic (prevalence, 268/395) groups. Patients received an individualized, nonstandardized program, which could include medication, advice, education, exercises, modalities, and/or manual therapy. Based on nonsignificant differences in outcomes or prognostic factors, Verhagen et al[222] concluded that patients postwhiplash should not be considered a separate subgroup from patients with nontraumatic neck pain.

V Similar to a previously developed classification system for WAD, Guzman et al[78] classified all neck pain into 4 categories depending on signs, symptoms, and the extent of interference with activities of daily living. Currently, this classification system does not have the level of specificity necessary to guide decisions on choice of interventions.[78]

TREATMENT-BASED CLINICAL PREDICTION RULES FOR NECK PAIN

Clinical prediction rules may prove helpful toward identifying patients who may respond well to a certain treatment. However, clinical prediction rules must go through a 3-step validation process before a clinician can use them with high confidence in clinical practice: (1) the rule must be derived properly, (2) it must be tested or validated, and (3) it must pass a clinical impact phase.[135] The 2008 neck pain CPG described clinical prediction rules at the derivation phase for manipulation of the cervical spine,[211] for manipulation of the thoracic spine,[31] and for the use of cervical spine traction.[164]

II A systematic review by Kelly et al[112] explored the readiness for adoption of 11 formalized prescriptive clinical prediction rules in the development or validation stage for early identification of patients response to a certain intervention for neck pain, including the 3 identified in the 2008 neck pain CPG. The authors concluded none of the identified prescriptive clinical prediction rules were at the stage of readiness to be endorsed for clinical adoption.[112]

2017 Recommendation

C Clinicians should use motion limitations in the cervical and upper thoracic regions, presence of cervicogenic headache, history of trauma, and referred or radiating pain into an upper extremity as useful clinical findings for classifying a patient with neck pain into the following categories:

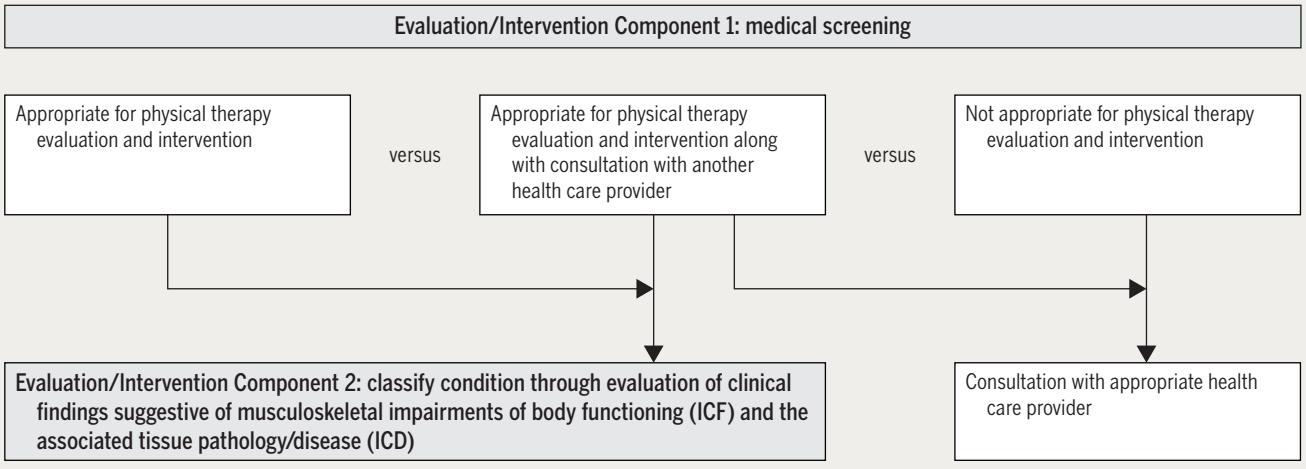
- Neck pain with mobility deficits
- Neck pain with movement coordination impairments (including WAD)
- Neck pain with headaches (cervicogenic headache)
- Neck pain with radiating pain (radicular)

With recognition that these categories will not be exclusive or exhaustive, the assignation of an individual patient into the category that "best fits" the patient's current clinical picture relies on clinical reasoning and judgment of the clinician.

The proposed model for examination, diagnosis, and treatment planning for patients with neck pain uses the following components[111]: (1) evaluation/intervention component 1, medical screening; (2) evaluation/intervention component 2, classify condition through evaluation of clinical findings suggestive of musculoskeletal impairments of body functioning (ICF) and associated tissue pathology/disease (ICD); (3) evaluation/intervention component 3, determination of condition stage (acute/subacute/chronic); (4) evaluation/intervention component 4, intervention strategies for patients with neck pain. This model is depicted in the **FIGURE**.

Component 1[111]

Medical screening incorporates the findings of the history and physical examination to determine whether the patient's symptoms originate from a condition that requires referral to another health care provider. The 2012 IFOMPT International Framework for Examination of the Cervical Region, the CCR, and the NEXUS criteria, all discussed earlier, are examples of tools that may be helpful in this decision-making process. In



Neck Pain With Mobility Deficits

Common symptoms
- Central and/or unilateral neck pain
- Limitation in neck motion that consistently reproduces symptoms
- Associated (referred) shoulder girdle or upper extremity pain may be present

Expected exam findings
- Limited cervical ROM
- Neck pain reproduced at end ranges of active and passive motions
- Restricted cervical and thoracic segmental mobility
- Intersegmental mobility testing reveals characteristic restriction
- Neck and referred pain reproduced with provocation of the involved cervical or upper thoracic segments or cervical musculature
- Deficits in cervicoscapulothoracic strength and motor control may be present in individuals with subacute or chronic neck pain

Neck Pain With Movement Coordination Impairments (WAD)

Common symptoms
- Mechanism of onset linked to trauma or whiplash
- Associated (referred) shoulder girdle or upper extremity pain
- Associated varied nonspecific concussive signs and symptoms
- Dizziness/nausea
- Headache, concentration, or memory difficulties; confusion; hypersensitivity to mechanical, thermal, acoustic, odor, or light stimuli; heightened affective distress

Expected exam findings
- Positive cranial cervical flexion test
- Positive neck flexor muscle endurance test
- Positive pressure algometry
- Strength and endurance deficits of the neck muscles
- Neck pain with mid-range motion that worsens with end-range positions
- Point tenderness may include myofascial trigger points
- Sensorimotor impairment may include altered muscle activation patterns, proprioceptive deficit, postural balance or control
- Neck and referred pain reproduced by provocation of the involved cervical segments

Neck Pain With Headache (Cervicogenic)*

Common symptoms*
- Noncontinuous, unilateral neck pain and associated (referred) headache
- Headache is precipitated or aggravated by neck movements or sustained positions/postures

Expected exam findings
- Positive cervical flexion-rotation test
- Headache reproduced with provocation of the involved upper cervical segments
- Limited cervical ROM
- Restricted upper cervical segmental mobility
- Strength, endurance, and coordination deficits of the neck muscles

Neck Pain With Radiating Pain (Radicular)

Common symptoms
- Neck pain with radiating (narrow band of lancinating) pain in the involved extremity
- Upper extremity dermatomal paresthesia or numbness, and myotomal muscle weakness

Expected exam findings
- Neck and neck-related radiating pain reproduced or relieved with radiculopathy testing: positive test cluster includes upper-limb nerve mobility, Spurling's test, cervical distraction, cervical ROM
- May have upper extremity sensory, strength, or reflex deficits associated with the involved nerve roots

Figure continues on page A23.

FIGURE. Proposed model for examination, diagnosis, and treatment planning for patients with neck pain. *Clinicians are encouraged to refer to the International Classification of Headache Disorders[83] for a more inclusive list of headache types/classifications (https://www.ichd-3.org/how-to-use-the-classification/), and to The National Institute for Health and Care Excellence[149] for signs, symptoms, and conditions that should be considered in patients who present with a headache in addition to neck pain.

Evaluation/Intervention Component 3: determination of condition stage (acute/subacute/chronic)

Acute, subacute, and chronic stages are time-based stages helpful in classifying patient conditions. Time-based stages are helpful in making treatment decisions only in the sense that in the acute phase, the condition is usually highly irritable (pain experienced at rest or with initial to mid-range spinal movements: before tissue resistance); in the subacute phase, the condition often exhibits moderate irritability (pain experienced with mid-range motions that worsen with end-range spinal movements: with tissue resistance); and chronic conditions often have a low degree of irritability (pain that worsens with sustained end-range spinal movements or positions: overpressure into tissue resistance). There are cases where the alignment of irritability and the duration of symptoms does not match accordingly, requiring clinicians to make judgments when applying time-based research results on a patient-by-patient basis

Evaluation/Intervention Component 4: intervention strategies for patients with neck pain

Neck Pain With Mobility Deficits

Acute
- Thoracic manipulation
- Cervical mobilization or manipulation
- Cervical ROM, stretching, and isometric strengthening exercise
- Advice to stay active plus home cervical ROM and isometric exercise
- Supervised exercise, including cervicoscapulothoracic and upper extremity stretching, strengthening, and endurance training
- General fitness training (stay active)

Subacute
- Cervical mobilization or manipulation
- Thoracic manipulation
- Cervicoscapulothoracic endurance exercise

Chronic
- Thoracic manipulation
- Cervical mobilization
- Combined cervicoscapulothoracic exercise plus mobilization or manipulation
- Mixed exercise for cervicoscapulothoracic regions—neuromuscular exercise: coordination, proprioception, and postural training; stretching; strengthening; endurance training; aerobic conditioning; and cognitive affective elements
- Supervised individualized exercises
- "Stay active" lifestyle approaches
- Dry needling, low-level laser, pulsed or high-power ultrasound, intermittent mechanical traction, repetitive brain stimulation, TENS, electrical muscle stimulation

Neck Pain With Movement Coordination Impairments (WAD)

Acute if prognosis is for a quick and early recovery
- Education: advice to remain active, act as usual
- Home exercise: pain-free cervical ROM and postural element
- Monitor for acceptable progress
- Minimize collar use

Subacute if prognosis is for a prolonged recovery trajectory
- Education: activation and counseling
- Combined exercise: active cervical ROM and isometric low-load strengthening plus manual therapy (cervical mobilization or manipulation) plus physical agents: ice, heat, TENS
- Supervised exercise: active cervical ROM or stretching, strengthening, endurance, neuromuscular exercise including postural, coordination, and stabilization elements

Chronic
- Education: prognosis, encouragement, reassurance, pain management
- Cervical mobilization plus individualized progressive exercise: low-load cervicoscapulothoracic strengthening, endurance, flexibility, functional training using cognitive behavioral therapy principles, vestibular rehabilitation, eye-head-neck coordination, and neuromuscular coordination elements
- TENS

Neck Pain With Headache (Cervicogenic)

Acute
- Exercise: C1-2 self-SNAG

Subacute
- Cervical manipulation and mobilization
- Exercise: C1-2 self-SNAG

Chronic
- Cervical manipulation
- Cervical and thoracic manipulation
- Exercise for cervical and scapulothoracic region: strengthening and endurance exercise with neuromuscular training, including motor control and biofeedback elements
- Combined manual therapy (mobilization or manipulation) plus exercise (stretching, strengthening, and endurance training elements)

Neck Pain With Radiating Pain (Radicular)

Acute
- Exercise: mobilizing and stabilizing elements
- Low-level laser
- Possible short-term collar use

Chronic
- Combined exercise: stretching and strengthening elements plus manual therapy for cervical and thoracic region: mobilization or manipulation
- Education counseling to encourage participation in occupational and exercise activity
- Intermittent traction

FIGURE. Proposed model for examination, diagnosis, and treatment planning for patients with neck pain. *Clinicians are encouraged to refer to the International Classification of Headache Disorders[83] for a more inclusive list of headache types/classifications (https://www.ichd-3.org/how-to-use-the-classification/), and to The National Institute for Health and Care Excellence[149] for signs, symptoms, and conditions that should be considered in patients who present with a headache in addition to neck pain.

addition to these conditions, clinicians should screen for the presence of psychosocial issues that may affect prognostication and treatment decision making for rehabilitation. For example, elevated scores on the Impact of Events Scale have been associated with other severe symptoms and a longer recovery in individuals with neck pain after whiplash injury.[195] Accordingly, identifying cognitive behavioral tendencies during the patient's evaluation can direct the therapist to employ specific patient education strategies to optimize patient outcomes to physical therapy interventions and potentially provide indications for referring the patient for consultation with another medical or mental health practitioner.[8]

Component 2[111]

Differential evaluation of musculoskeletal clinical findings is used to determine the most relevant physical impairments associated with the patient's reported activity limitations and medical diagnosis. Clusters of these clinical findings, which commonly coexist in patients, are described as impairment patterns in the physical therapy literature[4] and for neck pain are classified according to the key impairment(s) of body function, along with the characteristic and distribution of pain associated with that classification. The ICD-10 and primary and secondary ICF codes associated with neck pain are provided in the 2008 ICF-based neck pain CPG.[29] These classifications are useful in determining interventions focused on normalizing the key impairments of body function, which in turn strive to improve the movement and function of the patient and lessen or alleviate pain and/or activity limitations. Key clinical findings to differentiate the classifications are shown in the **FIGURE**. In addition, when it comes to neck-related headaches, clinicians are encouraged to refer to the International Classification of Headache Disorders[83] for a more inclusive list of headache types/classifications (https://www.ichd-3.org/how-to-use-the-classification/), and to The National Institute for Health and Care Excellence[149] for additional signs, symptoms, and conditions that should be considered in patients who present with a headache in addition to neck pain. Overall, classification is critical for matching the intervention strategy that is most likely to provide the optimal outcome for a patient's condition. However, it is important for clinicians to understand that patients with neck pain often exhibit signs and symptoms that fit more than 1 classification, and that the most relevant impairments of body function and the associated intervention strategies often change during the patient's episode of care. Thus, continual re-evaluation of the patient's response to treatment and the patient's emerging clinical findings is important for providing the optimal interventions throughout the patient's episode of care.

Component 3[111]

For research purposes, acute, subacute, and chronic stages are time-based stages helpful in classifying patient conditions and in making treatment decisions. In part, they define the stage of healing: in the acute phase, the condition is usually more irritable; in the subacute phase, the condition often exhibits moderate irritability; chronic conditions often have a lower degree of irritability. There are cases where the alignment of irritability and the duration of symptoms does not match, requiring clinicians to make judgments when applying time-based research results on a patient-by-patient basis. Irritability is a term used by rehabilitation practitioners to reflect the tissue's ability to handle physical stress,[142] and is presumably related to physical status and the extent of inflammatory activity that is present. Assessment of tissue irritability relies on clinical judgment, and is important for guiding the clinical decisions regarding treatment frequency, intensity, duration, and type, with the goal of matching the optimal dosage of treatment to the status of the tissue being treated. There are other biopsychosocial elements that may relate to staging of the condition, including, but not limited to, the level of disability reported by the patient, extent of interrupted sleep, medication dosage, and activity avoidance.[34]

Component 4

Interventions are listed by category of neck pain, and ordered by stage (acute/subacute/chronic). Because irritability level often reflects the tissue's ability to accept physical stress, clinicians should match the most appropriate intervention strategies to the irritability level of the patient's condition.[34,45,110,111] Additionally, clinicians should attend to influences from psychosocial[86] and altered pain processing elements[151] in patients with conditions in all stages of recovery.

CLINICAL GUIDELINES

Interventions

The literature concerning nonsurgical interventions for neck pain rarely describes subject populations with terms synonymous with the 4 categories of the 2008 neck pain CPG[29] and carried forward in this revision. As such, the results of the literature can rarely be applied exclusively and exhaustively to these separate categories. Additionally, the evidence is very weak regarding the differential effectiveness of many interventions for neck pain based on subpopulations (eg, age, sex, ethnicity). Reporting of intervention dosage in terms of intensity, duration, and frequency is variable and may not allow confident translation into practice. One method of arriving at possible intervention dosage is to combine original trial dosage descriptions with clinical judgment, including principles of exercise, movement, and pain science, and patient preferences.

This CPG attempts to differentiate the effects of interventions as they may be applied to the categories of neck pain. When available, information regarding stage (acute, less than 6 weeks; subacute, 6 to 12 weeks; or chronic, greater than 12 weeks), comparison group, and follow-up (immediate, within 1 day; short term, closest to 4 weeks; intermediate term, closest to 6 months; and long term, closest to 12 months) is provided. The concepts of immediate, short, intermediate, and long-term follow-up are research-based periods and do not represent duration of care, but do provide an estimate of the duration of the treatment effects. Similarly, the concepts of acute, subacute, and chronic stages represent unequal periods, and it is acknowledged that the duration of symptoms may be less relevant than the characteristics of the condition to a patient's progression from one stage to the next stage.

The 2008 intervention recommendations and literature syntheses were not specifically aligned to the ICF-based neck pain categories, but some guidance in this regard can be gained from **TABLE 4** of that document.[29] In this revision, the tables presenting the evidence update are organized first by intervention type (eg, manual therapy, exercise, multimodal, education, and physical agents), then by stage (eg, acute, subacute, and chronic), and finally by comparison group and effect (eg, benefit compared to control, benefit compared to an alternate treatment, no benefit compared to control, and no benefit compared to an alternate treatment). In general, the interventions described below have a low risk profile for causing adverse events. While major adverse events can and do occur on a patient-by-patient basis, as evidenced by case reports and medicolegal documents, reports of serious events in randomized controlled trials are ostensibly absent. Nonetheless, clinicians should apply a benefit to harm screening protocol, such as the IFOMPT framework for risk assessment,[177] prior to performing any intervention.

NECK PAIN WITH MOBILITY DEFICITS

2008 Recommendations

The intervention literature analyses were not specifically aligned to the neck pain categories, but the recommendations were made for cervical mobilization/manipulation, thoracic mobilization/manipulation, stretching exercises, and coordination, strengthening, and endurance exercises.

Evidence Update

Identified were 43 systematic reviews investigating physical therapy interventions on patients who could be classified as having neck pain with mobility deficits. Levels of evidence assigned to systematic reviews in this section were assessed according to **TABLE 1**. Primary sources were generally of high or moderate methodological quality with low risk of bias, but had numbers of participants that were considered small. This resulted in downgrading the strength of the evidence by 1 or 2 levels due to imprecision and limited directness (**TABLE 1**).[63] **TABLE 7** details the levels of evidence of included studies with underpinning evidence statements. Consideration of the trade-offs between desirable and undesirable consequences (important adverse events) was made. Adverse events or side effects were rarely reported in the studies, and when reported were minor, transient, and of short duration. For manual therapy or exercise, the only consistently reported problem was a mild transient exacerbation of symptoms.[36,93] For manipulation, rare but serious adverse events such as stroke or serious neurological deficits were not reported in any of the trials. Serious but rare adverse events for manipulation are known to occur.[23] Graham et al[68] reported mild adverse events equal in treatment and placebo groups, including tiredness, nausea, headache, and increased pain following laser treatment.

V The following are expert opinions of the CPG development group:

• Clinicians should integrate the recommendations below with consideration of the results of the patient evaluation (eg, physical impairments most related to the patient's reported activity limitation or concerns, severity and irritability of the condition, patient values and motivating factors).

TABLE 7

Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison

		Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
Acute		
III	Brown et al[21] Cross et al[41] Furlan et al[64] Gross et al[72] Huisman et al[92] Hurwitz et al[93] Scholten-Peeters et al[182]	For patients with acute neck pain with mobility deficits, there was a **benefit** compared to control for using multiple sessions of thoracic manipulation for reducing pain over the immediate and short term.[21,41,64,72,92,93,182] This finding was consistent over the intermediate term but the magnitude of effect was small for pain, function, and quality of life.[72]
IV	Coronado et al[36] Gross et al[73] Gross et al[72]	For patients with acute neck pain with mobility deficits, there was a **benefit** compared to control for using 1 to 4 sessions of a single cervical manipulation for reducing pain over the immediate term but not short term.[36,72,73]
IV	Gross et al[72]	For patients with acute and chronic neck pain with mobility deficits, there is **conflicting evidence** supporting the use of multiple sessions of cervical manipulation as a stand-alone therapy.[72]
II	Clar et al[30] Furlan et al[64] Gross et al[72] Hurwitz et al[93] Vincent et al[229]	For patients with acute and chronic neck pain with mobility deficits, there was **no benefit** compared to cervical mobilization, in using multiple sessions of cervical manipulation for reducing pain and improving function, quality of life, global perceived effect, and patient satisfaction over the immediate, short, and intermediate term.[30,64,72,93,229]
III	Leaver et al[119]	For patients with acute to subacute neck pain with mobility deficits, there was a **benefit** compared to only using cervical manipulation or only using cervical mobilization, in using combinations of manual therapies for providing analgesic benefits over the short term.[119]
III	Gross et al[72] Vincent et al[229]	For patients with acute to subacute neck pain with mobility deficits, there was a **benefit** compared to varied oral medication combinations (oral analgesic, opioid analgesic, NSAID, muscle relaxant), in using multiple sessions of cervical manipulation for reducing pain and improving function over the long term.[72,229]
IV	Furlan et al[64] Vernon et al[226]	For patients with acute to subacute neck pain with mobility deficits, there was a **benefit** when compared to control, in using cervical mobilization and ipsilateral, but not contralateral, cervical manipulation for reducing pain over the immediate term. [64,226]
Subacute		
IV	Furlan et al[64] Huisman et al[92] Young et al[244]	For patients with subacute neck pain with mobility deficits, there was a **benefit** when compared to control, in using: • A single session of thoracic manipulation for reducing pain and improving ROM over the short term[92,244] • A single session of thoracic manipulation for reducing disability over the immediate term[64]
III	Cross et al[41]	For patients with subacute to chronic neck pain with mobility deficits, there was **no benefit**, when compared to a control, in using a single session of thoracic manipulation for reducing pain over the immediate term.[41]
IV	Coronado et al[36]	For patients with subacute to chronic neck pain with mobility deficits, there was **no benefit**, when compared to a control, in using a single session of cervical manipulation for reducing pain over the immediate term.[36]
III	Leaver et al[119]	For patients with subacute to chronic neck pain with mobility deficits, there was **no benefit** in using 2 weeks of cervical manipulation compared to 2 weeks of cervical mobilization (low velocity, oscillating passive movements) on improving function or reducing pain, disability, or days to perceived recovery.[119]
III	Hurwitz et al[93]	For patients with subacute to chronic neck pain with mobility deficits, there was **no benefit** in using cervical manipulation alone or with advice and home exercises, compared to cervical mobilization and strengthening exercises, or instrumented manipulation, for reducing pain and disability over the short or long term.[93]
IV	Furlan et al[64]	For patients with subacute to chronic neck pain with mobility deficits, there was **no benefit** in using cervical mobilization, when compared to usual care, for reducing pain over the intermediate term.[64]

Table continues on page A27.

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

		Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
Chronic		
III	Furlan et al[64] Gross et al[73] Hurwitz et al[93]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using a single session of thoracic manipulation on pain over the immediate term.[64,73,93]
IV	Cross et al[41] Damgaard et al [44] Furlan et al[64] Gross et al[73] Huisman et al[92] Hurwitz et al[93] Leaver et al[119] Scholten-Peeters et al[182] Vincent et al[229] Walser et al[231]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control in using • A single session of supine thoracic manipulation on pain over the immediate term[41,64,73,92,93,119,182,231] • 8 sessions of thoracic manipulation, for reducing pain and disability over the immediate and intermediate term[44,92,229]
IV	Gross et al[72] Young et al[244]	For patients with chronic neck pain with mobility deficits, there was a **benefit** in using the following techniques: • Upper thoracic manipulation, when compared to cervical manipulation, for reducing pain over the immediate term[244] • 12 sessions over 4 wk of anterior-posterior unilateral accessory movement procedures, when compared to a rotational or transverse accessory movement procedures, for reducing pain over the immediate term[72]
III	Furlan et al[64] Gross et al[72]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using cervical manipulation, when compared to medication (NSAIDs, Celebrex, Paracetamol) for reducing pain or improving function over the short term.[64,72]
IV	Gross et al[72]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using cervical mobilization, when compared to exercise, laser, pulsed ultrasound, acupuncture, and massage for reducing pain, improving function, and improving quality of life over the immediate to intermediate term.[72]
IV	Gross et al[72]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using the following mobilization techniques: • Mobilization at the most symptomatic segment when compared to mobilization at a randomly chosen segment • Central PA passive accessory movement mobilization technique when compared to random PAs at the same segment • Ipsilateral PAs when compared to a randomly selected PAs at the same segment • Mobilization perpendicular to the facet plane at most symptomatic segment when compared to the same mobilization 3 levels above, for reducing pain over the immediate term[72]
		Exercise
Stage/Level	**Study**	**Evidence Statement**
Acute		
III	Bertozzi et al[10] Gross et al[71] Kay et al[109]	For patients with acute to chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using scapulothoracic and upper extremity strengthening for reducing pain over the short term.[10,71,109]
III	Gross et al[71] Kay et al[109] O'Riordan et al[157] Southerst et al[190] Zronek et al[247]	For patients with acute to chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using the following: • Scapulothoracic and upper extremity endurance training for reducing pain over the immediate term[71,109,157,247] • Stretching exercises plus education for reducing pain and disability and improving quality of life over the short term[190]

Table continues on page A28.

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

		Exercise
Stage/Level	**Study**	**Evidence Statement**
IV	Bertozzi et al[10] Kay et al[109] Gross et al[71]	For patients with acute to chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using: • General fitness training for reducing pain over the immediate and short term.[10,71,109] • Deep neck flexor recruitment combined with upper extremity strengthening/endurance exercises for reducing pain over the immediate term.[71]
III	Southerst et al[190] Zronek et al[247]	For patients with acute to subacute neck pain with mobility deficits, there was a **benefit** in using a home exercise program of daily cervical ROM exercises, education, and advice, when compared to medication, for reducing pain and disability for the intermediate term.[190,247]
III	Schroeder et al[184]	For patients with acute neck pain with mobility deficits, there was a **benefit** in using stretching, strengthening, ROM /flexibility, and relaxation exercise, when compared to soft tissue and cervical joint mobilization plus coordination, stabilization, and postural exercise.[184]
IV	Schroeder et al[184] Southerst et al[190] Zronek et al[247]	For patients with acute to subacute neck pain with mobility deficits, there was **no benefit** in using a home exercise program of daily cervical ROM exercises, education, and advice, when compared to cervical and thoracic manipulation, for reducing pain or improving function over the immediate and long term.[184,190,247]
Subacute		
III	Hurwitz et al[93]	For patients with subacute to chronic neck pain with mobility deficits, there was **no benefit** in using neck and shoulder endurance exercises, when compared to neck and shoulder strengthening exercises, for reducing pain or improving function or global perceived effect over the short and long term.[93]
Chronic		
III	Bertozzi et al[10] Gross et al[71] Kay et al[109] Leaver et al[119] Monticone et al[141] Nunes and Moita[152] Southerst et al[190] Verhagen et al[221]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using the following: • Neuromuscular exercise (eg, proprioception, eye-head-neck coordination) for reducing pain and improving function over the short term, but not intermediate or long term, and for improving global perceived effect over the intermediate term[109,119,141] • Cervical stretching and strengthening for reducing pain and improving function over the immediate and intermediate term[109,190] • Combined cervical and scapulothoracic stretching and strengthening for reducing pain and improving function over the intermediate and long term.[71,109] However, there is conflicting evidence when these exercises are combined with other elements of exercise[152,221] • Deep neck flexor isometric strengthening for reducing pain and disability over the immediate and short term[10]
IV	Gross et al[71] Kay et al[109] Lee et al[120] O'Riordan et al[157] Southerst et al[190]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using the following: • A combination of stretching, strengthening, endurance training, and balance/coordination exercises and aerobic conditioning, with a cognitive/affective component (Qigong) exercise for reducing pain and improving function over the immediate, short, and intermediate terms.[71,109,120,190] Conflicting results reported by Lee et al[120] are due to a combination of different primary sources • Postural and isometric exercise added to the use of a cervical pillow for reducing pain and improving function over the immediate and short term[71,109] • Isometric neck flexion exercise, plus upper extremity strengthening and stretching for reducing pain and improving function over the immediate term[157] • Whole body group exercise of cardiovascular training with coordination and extensibility exercise for reducing pain over the immediate term[109]
III	Hurwitz et al[93]	For patients with chronic neck pain with mobility deficits, there was a **benefit** in using strengthening exercises alone or in combination with manipulation, when compared to manipulation alone, for reducing pain and disability over the long term[93]

Table continues on page A29.

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

		Exercise
Stage/Level	**Study**	**Evidence Statement**
IV	Damgaard et al[44] Haines et al[79] Kay et al[108] Macaulay et al[125] Monticone et al[141] Nunes and Moita[152] O'Riordan et al[157] Schroeder et al[184] Southerst et al[190] Verhagen et al[221] Vincent et al[229] Zronek et al[247]	For patients with chronic neck pain with mobility deficits, there was a **benefit** in using the following: • Stretching combined with upper body and neck strengthening on pain, when compared to a program of manipulation, massage, and sham micro-current, over the long term[125,184,229] • Cervical stretching and strengthening, when compared to Qigong exercise, for improving function over the intermediate term[190] • A 1-year home exercise program of 3 times per week neck flexion endurance exercise, plus upper extremity strengthening and stretching, when compared to aerobic exercise, for reducing pain and improving function and health related quality of life over the immediate term[44,157,247] • Cervical stretching or strengthening or endurance, when compared to a stress management program, for reducing pain over the immediate, but not long term[152] • Supervised exercise programs of neck and upper body strengthening and stretching, when compared to an individualized home exercise program of neck and shoulder mobilization, advice, and education, for reducing pain and improving global perceived effect over the short and long term[44,157,190] • Methods to increase physical activity at work and leisure (eg, bike to work, take stairs, general strengthening and conditioning exercise, and advice), when compared to specific exercise (eg, postural exercise, strengthening exercise for neck and shoulder, body awareness training), for reducing pain over the short term.[221] There was no difference for function, or on pain and function over the long term[221] • Deep neck flexor recruitment and strengthening, when compared to infrared radiation and advice, for reducing pain over the immediate term. There was no effect on function over the immediate term, or on pain or function over the intermediate term[157] • Individualized home exercise programs of stabilization, relaxation, and postural control, compared to written advice to stay active, for reducing pain and improving function over the intermediate term, but not over the long term[79,108,141,157] • Supervised group yoga, when compared to unsupervised home exercise program of postural exercise and neck and shoulder stretching and strengthening, for reducing pain and disability over the short term[190]
III	Bertozzi et al[10] Gross et al[71] Leaver et al[119] O'Riordan et al[157]	For patients with chronic neck pain with mobility deficits, there was **no benefit**, when compared to a control, in using upper extremity and trunk strengthening exercise,[10,71,157] and upper extremity stretching and endurance training,[71] and aerobic conditioning,[119] for reducing pain and improving function over the immediate, short, and long term.
IV	Bertozzi et al[10] Gross et al[71] Kay et al[109] Leaver et al[119] O'Riordan et al[157]	For patients with chronic neck pain with mobility deficits, there was **no benefit**, when compared to a control, in using the following: • A strengthening component added to a home based stretching program for reducing pain and disability, over the long term[157] • Breathing exercises for reducing pain and improving function and quality of life, over the immediate term[71] • McKenzie stretch/ROM plus dynamic stabilization exercises for reducing pain and disability over the immediate through long term[71,109,119] • Stretching exercise either before or after a manipulation for reducing pain and improving function over the immediate term[71,109] • General endurance, flexibility, coordination, and postural awareness training (Feldenkrais) for reducing pain over the short and long term[10,109] • Combination of strengthening, stretching, endurance, postural, and coordination exercise not specific to the neck, for reducing pain over the short term[10,109] • General strengthening for reducing pain and improving function or quality of life over the long term[157]

Table continues on page A30.

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

Stage/Level	Study	Evidence Statement
		Exercise
IV	Gross et al[71] McCaskey et al[134] O'Riordan et al[157] Southerst et al[190]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using: • Active ROM, stabilization, and postural exercises specific to the neck, when compared to generalized exercises to the body, for reducing disability over the short term[190] • Neck and upper extremity endurance training plus stretching, when compared to aerobic conditioning plus stretching, for reducing pain and improving function over the immediate term, and for improving global perceived effect over the long term[157] • General endurance, flexibility, coordination, and postural awareness training (Feldenkrais), when compared to physiotherapy intervention (lumbopelvic stabilization, whole body strengthening, coordination, endurance and flexibility exercise, advice and home exercise program), for reducing pain over the long term[71] • Proprioceptive training, compared to stretching and strengthening exercise on pain and function over the short term[134] • Deep neck flexor training with pressure biofeedback, when compared to strength training of the neck flexor muscles with weights, for reducing pain and disability over the immediate term[157]
		Multimodal: Exercise and Manual Therapy
Acute		No update evidence identified
Subacute		No update evidence identified
Chronic		
III	Gross et al[75]	For patients with chronic neck pain with mobility deficits, with or without radiating pain, and with or without headache there was a **benefit**, compared to control, in using mobilization or manipulation combined with stretching and strengthening for reducing pain over the short and long term, and function over the long term.[75]
III	Miller et al[140]	For patients with chronic neck pain with mobility deficits, there was a **benefit** in using a combination of exercise plus manipulation or mobilization, compared to manipulation or mobilization alone, for reducing pain and improving quality of life over the long term.[140]
III	McCaskey et al[134]	For patients with chronic neck pain with mobility deficits, there was a **benefit** in using a multimodal intervention including proprioceptive elements, compared to no intervention, on reducing pain over the immediate term.[134]
		Education
Acute		No update evidence identified
Subacute		
IV	Monticone et al[141]	For patients with subacute neck pain with mobility deficits, there was a **benefit** in cognitive behavioral therapy in reducing pain and improving disability, compared to manipulation and mobilization plus exercise plus advice over the long term, but the difference was not clinically meaningful.[141]
Chronic		No update evidence identified
		Physical Agents
Acute		No update evidence identified
Subacute		No update evidence identified

Table continues on page A31.

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

		Physical Agents
Stage/Level	**Study**	**Evidence Statement**
Chronic		
III	Cagnie et al[22] Damgaard et al[44] Graham et al[68] Gross et al[74] Kadhim-Saleh et al[104] Kietrys et al[113] Liu et al[124]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using the following: • Dry needling for reducing pain over the immediate[113,124] and short[22,124] term • 830-nm laser for reducing pain and improving function, global perceived effect, and quality of life over the immediate, short, and intermediate terms[44,68,74,104] • Pulsed ultrasound for reducing pain, but was inferior to mobilization over the immediate term[68] • Mechanical traction of the intermittent type, but not the continuous type, for reducing pain over the short term[68] • A variety of noninjection inserted needle treatment approaches for reducing pain over the immediate or short term[68]
III	Graham et al[68] Gross et al[74] Nunes and Moita[152]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, when compared to a control, in using the following: • Laser for reducing pain over the immediate[74] and short term,[74,152], but not over the intermediate term.[152] Gross et al[74] reported that the super-pulse type of laser drive technology may improve outcomes in patients with chronic myofascial pain syndrome • TENS and repetitive magnetic stimulation for reducing pain over the immediate and short term.[68] • TENS combined with infrared, hot pack/exercise, and collar/exercise/analgesic interventions for reducing pain and disability, and improving function over the immediate and short term[68] • Electric muscle stimulation for reducing pain over the intermediate term[68]
IV	Cagnie et al[22]	For patients with chronic neck pain with mobility deficits, there was a **benefit**, in using dry needling when compared to another treatment, over the short term: • Non–trigger point dry needling on reducing pain and improving function[22] • Standard acupuncture on reducing pain and improving function[22]
III	Liu et al[124]	For patients with chronic neck pain with mobility deficits, there was **no benefit**, in using dry needling when compared to wet needling for reducing pain over the immediate or intermediate term. However, wet needling showed a benefit over dry needling in the short term.[124]
IV	Graham et al[68] Kroeling et al[118]	For patients with chronic neck pain with mobility deficits, there was **no benefit**, when compared to a control, in using a static magnetic necklace for reducing pain over the immediate term[68,118]
IV	Cagnie et al[22]	For patients with chronic neck pain with mobility deficits, there was **no benefit**, in using dry needling when compared to another treatment, over the short term: • Miniscalpel needling on reducing pain[22] • Lidocaine injection on reducing pain[22] • Lidocaine on reducing pain, but equal in terms of improving quality of life[22] • Nonsteroidal anti-inflammatory drugs (NSAID) for quality of life[22]
IV	Liu et al[124]	For patients with chronic neck pain with mobility deficits, there was **no benefit**, in using dry needling when compared to wet needling for reducing pain over the intermediate term[124]
IV	Graham et al[68]	For patients with chronic neck pain with mobility deficits associated with osteoarthritis, there was **conflicting evidence** of benefit, when compared to a control, for using pulsed electromagnetic field for reducing pain over the immediate term.[68]
III	Ong and Claydon[156]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using dry needling on myofascial trigger points when compared to lidocaine injections, for reducing pain over the immediate through intermediate terms, and for improving function over the immediate term.[156]

Table continues on page A32.

TABLE 7 Intervention Evidence for Neck Pain With Mobility Deficits by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

		Physical Agents
Stage/Level	**Study**	**Evidence Statement**
III	Graham et al[68] Kietrys et al[113]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using the following: • Dry needling (as long as it elicited a localized twitch response), when compared to lidocaine injection for reducing pain in the immediate term. However, lidocaine injections were more effective than dry needling for reducing pain over the short term[113] • A hot pack, when compared to mobilization, manipulation, or electric muscle stimulation, for reducing pain and improving function over the intermediate term[68] • Infrared light, when compared to sham TENS, for reducing pain and improving function over the short term[68]
IV	Graham et al[68] Parreira et al[161]	For patients with chronic neck pain with mobility deficits, there was **no benefit** in using the following: • Electric muscle stimulation, when compared to manual therapy, TENS, or heat for reducing pain over the intermediate term[68] • Evaporative cooling spray and stretch, when compared to active control, placebo, or active treatment (heat, education, or exercise), for pain over the immediate term[68] • TENS, when compared to manual therapy or ultrasound, for reducing pain over the immediate and short term[68] • Kinesio Tape when compared to cervical manipulation on pain over the immediate term[161]

Abbreviations: NSAID, nonsteroidal anti-inflammatory drug; PA, posterior to anterior; ROM, range of motion; TENS, transcutaneous electrical nerve stimulation.

- Clinicians should utilize a multimodal approach in managing patients with neck pain with mobility deficits.
- In the subacute to chronic stage, the benefit of manual therapy appears to decrease. Manipulation may not offer any benefit over mobilization, and may be associated with transient discomfort.
- Exercise targeting cervical and scapulothoracic regions is a necessary component of managing patients with subacute and chronic neck pain with mobility deficits.
- Available adherence strategies (eg, McLean et al[136]) for adoption and maintenance of home exercise should be integrated to maximize clinical benefit over the long term.

2017 Recommendations

Acute

B For patients with acute neck pain with mobility deficits, clinicians should provide thoracic manipulation, a program of neck ROM exercises, and scapulothoracic and upper extremity stretching and strengthening exercises to enhance program adherence.

C For patients with acute neck pain with mobility deficits, clinicians may provide cervical manipulation and/or mobilization.

Subacute

B For patients with subacute neck pain with mobility deficits, clinicians should provide neck and shoulder girdle endurance exercises.

C For patients with subacute neck pain with mobility deficits, clinicians may provide thoracic manipulation and cervical manipulation and/or mobilization.

Chronic

B For patients with chronic neck pain with mobility deficits, clinicians should provide a multimodal approach of:

- Thoracic manipulation and cervical manipulation or mobilization
- Mixed exercise for cervical/scapulothoracic regions: neuromuscular exercise (eg, coordination, proprioception, and postural training), stretching, strengthening, endurance training, aerobic conditioning, and cognitive affective elements
- Dry needling, laser, or intermittent traction

C For patients with chronic neck pain with mobility deficits, clinicians may provide neck, shoulder girdle, and trunk endurance exercise approaches and patient education and counseling strategies that promote an active lifestyle and address cognitive and affective factors.

NECK PAIN WITH MOVEMENT COORDINATION IMPAIRMENTS

2008 Recommendation

The 2008 neck pain CPG intervention literature analyses were not specifically aligned to the neck pain categories or

staging, but the recommendations were made for coordination, strengthening, and endurance exercises, stretching exercises, and patient education and counseling that (1) promotes early return to normal, nonprovocative preinjury activities, and (2) provides reassurance to the patient that good prognosis and full recovery commonly occur.

Evidence Update

Identified were 27 systematic reviews investigating physical therapy interventions on patients who could be classified as having neck pain with movement coordination impairments. All of the studies in this section were on WAD. Levels of evidence assigned to systematic reviews in this section were assessed according to **TABLE 1.** Primary sources were generally of high or moderate methodological quality with low risk of bias, but had numbers of participants that were considered small. This resulted in downgrading the strength of the evidence by 1 or 2 levels due to imprecision and limited directness (**TABLE 1**).[63] **TABLE 8** details the levels of evidence of included studies with underpinning evidence statements. Consideration was made for the trade-offs between desirable and undesirable consequences (important adverse events). Adverse events or side effects were rarely reported in the studies, and when reported were minor, transient, and of short duration.

III In a 2015 systematic review of CPGs, Wong et al[240] found all guidelines to recommend education and exercise in the management of acute WAD, with most guidelines recommending education and exercise for the subacute and chronic stages as well. The components of education were: emphasis on remaining active, advice on management and coping, reassurance about the prognosis, and functional improvement goals. Further, this review found recommendations for mobilization or manipulation, a multimodal approach, and recommendations against the use of a cervical collar.[240]

V The following are expert opinions of the CPG development group:

- Clinicians should integrate the recommendations below with consideration of the results of the patient evaluation (eg, physical impairments most related to the patient's reported activity limitation or concerns, severity and irritability of the condition, patient values, and motivating factors).
- Existing evidence indicates that recovery from neck pain with movement coordination impairments is most likely to follow 1 of 3 trajectories: quick and early recovery, moderate to slow recovery with lingering impairments, and poor recovery with severe disability.[172] A patient's course of recovery within and between trajectories may not be fixed, as there are many factors that can influence the course of recovery. Appropriate evaluation of the acutely injured patient should focus on identifying risk factors for chronicity and predicting the most likely course of recovery for that patient. This prognostic subgrouping is conspicuously absent from many RCTs evaluated for these guidelines, but makes clinical sense. While early intervention may impede recovery in the quick and early recovery group, it is likely more appropriate for the severe and nonrecovered group. The available evidence provides little guidance for treatment recommendations based on anticipated trajectories. In light of this gap in knowledge, we endorse early, informed risk-based assessment and prognosis from which treatment recommendations should flow naturally. An aggressive search for the pain-generating "tissue at fault" is currently unlikely to be productive in the acute stage of injury.

Low Risk for Chronicity/Quick and Early Recovery Expected

As mentioned in the Clinical Course section in these guidelines, a significant portion of clients with acute neck pain with movement coordination impairments should expect to recover significantly within the first 2 to 3 months. For those clients whose condition is perceived to be at low risk of progressing into chronicity, clinicians should provide early advice, education, and counseling that includes reassurance of the expected course of recovery, encouragement to remain active at a level similar to prior to the current episode, and training in home exercises to maintain/improve movement of the neck within a comfortable range. Helpful information can be found at an Australian government-sponsored website.[193]

A supervised exercise program (minimum 1 session, and 1 follow-up session) is preferable over an unsupervised program (verbal instruction or pamphlet). Intensive exercise or work-hardening programs are not recommended in the early acute or subacute phases.

Unclear Risk for Chronicity/Moderate to Slow Recovery, With Lingering Impairments Expected

Repeated or ongoing examination may be required to make an informed assessment, which should be utilized to guide management decisions. Impairment-based treatment should flow naturally from evaluation findings. This group is more suitable for responding to a more intensive nonsurgical program combined with low-level pharmaceuticals. Clients should be monitored closely. The timing and achievement of defined favorable outcomes are often undetermined and unpredictable.

High Risk for Chronicity/Poor Recovery, With Severe Disability Expected

In consideration of the factors discussed in "Risk, Prognosis, and Clinical Course" and in "Imaging," some patients may be perceived to be at a higher risk of developing chronic problems and poor functional recovery. For those patients, a more

TABLE 8

Intervention Evidence for Neck Pain With Movement Coordination Impairments by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison

		Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
Acute		No update evidence identified
Subacute		No update evidence identified
Chronic		No update evidence identified

		Exercise
Stage/Level	**Study**	**Evidence Statement**
Acute		
III	Drescher et al[49]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using neck postural/stabilization exercise, when compared to use of a cervical collar, for reducing pain over the short through long term.[49]
IV	Teasell et al[204] Verhagen et al[223]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using supervised exercise (endurance, stretch, stabilization, coordination), when compared to unsupervised exercise, for reducing pain and disability, and improving self-efficacy over the short but not intermediate term.[204,223]
IV	Conlin et al[33] Drescher et al[49]	For patients with acute neck pain with movement coordination impairments, there was **no benefit** in using neck kinesthetic and coordination exercise, when compared to advice to stay active, for reducing pain over the short and intermediate term.[33,49]
Subacute		
IV	Teasell et al[204] Verhagen et al[223]	For patients with subacute neck pain with movement coordination impairments, there was **no benefit** in using strengthening of the cervical and shoulder muscles, or balance and postural exercises, when compared to a control, for reducing pain or improving the ability to perform work activities, over the short and long term.[204,223]
Chronic		
IV	Damgaard et al[44] Gross et al[71] Kabisch[103] Kay et al[109] O'Riordan et al[157] Southerst et al[190] Teasell et al[205]	For patients with chronic neck pain with movement coordination impairments, when compared to a control, there was a **benefit** in using the following: • An individualized, progressive submaximal exercise program and pain education including strengthening, endurance, flexibility, coordination, aerobic, and functional exercise using cognitive behavioral therapy principles, for reducing pain and improving function over the immediate, but not long term[44,71,103,109,157,190,205] • Vestibular rehabilitation for improving Dizziness Handicap Inventory scores, but not for reducing pain, over the short term[71,205] • Eye-head-neck coordination exercise for improving head repositioning accuracy over the short term. An improvement in pain was realized, but the magnitude of the effect is questionable given the group differences in initial pain scores[71,205]
IV	Teasell et al[205]	For patients with chronic neck pain with movement coordination impairments, there was **no benefit** in using cervical rotation strength training, when compared to endurance training, for reducing pain, improving muscle strength, and improving SF-36 physical function scores, over the short term.[205]

		Multimodal: Exercise and Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
Acute		
IV	Kay et al[108]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using a home program consisting of cervical ROM exercise, advice, physical agents, and limited collar use, when compared to a control, for reducing pain over the short term.[108]

Table continues on page A35.

TABLE 8 Intervention Evidence for Neck Pain With Movement Coordination Impairments by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

		Multimodal: Exercise and Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
III	Conlin et al[33] Drescher et al[49] Hurwitz et al[93] Kay et al[109] Miller et al[140] Shaw et al[186] Sutton et al[200] Teasell et al[203] Verhagen et al[223] Yu et al[245]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using the following: • Intensive physical therapy program (including, manual therapy, cervical ROM and isometric strengthening exercise, advice, and physical agents), when compared to 1 session of physical therapy consisting of home exercise instruction and advice, for reducing pain and work days lost, and improving self-perceived benefit, over the intermediate term. These differences were statistically significant but of small magnitude, and thus, possibly not clinically relevant[200,245] • Cervical mobilization or manipulation combined with active cervical ROM exercise when compared to rest, use of a collar and/or analgesic medications and/or advice, for reducing pain,[140] but there was no difference in function, over the short term[33,49,93,109,140,186,203,223]
IV	Kabisch[103] Teasell et al[203]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using the following: • Massage, active and resisted exercise of the neck and shoulder, and heat, when compared to collar use, for reducing pain and disability over the intermediate term[203] • Cervical mobilization plus low intensity active kinesthetic, postural and ROM exercise, when compared to a self-managed exercise and education program, for reducing pain and disability, over the immediate term[103,205]
IV	Haines et al[79] Hurwitz et al[93] Teasell et al[203]	For patients with acute neck pain with movement coordination impairments, there was **no benefit** in using massage plus mobilization plus active ROM exercises, when compared to collar use or advice to stay active, for affecting pain disability, work capacity, and quality of life, over the long term.[79,93,203]
IV	Kay et al[108] Verhagen et al[223]	For patients with acute neck pain with movement coordination impairments who received intensive multimodal physical therapy, a higher percentage reported symptoms after 2 years, as compared with those who received a single session of physical therapy consisting of home active cervical ROM exercise and advice.[108,223]
Subacute		No update evidence identified
Chronic		
IV	Kabisch[103]	For patients with chronic neck pain with movement coordination impairments, there was a **benefit** in using cervical mobilization combined with low load cervical and scapular muscle activation and kinesthetic training, when compared to a booklet on education and exercise, for reducing pain and improving function over the immediate term.[103]

		Education
Stage/Level	**Study**	**Evidence Statement**
Acute		
III	Gross et al[76] Gross et al[70]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using an educational video, when compared to the following: • No treatment, for reducing pain over the short, intermediate, and long term[76] • Control, for improving muscular activation over the intermediate term but not the long term[70]
III	Meeus et al[138] Teasell et al[203]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using the following: • Instructions to decrease the use of a cervical collar, improve posture, and perform mobilizing exercises, when compared to only receiving rest and analgesics, to increase ROM and decrease pain, over the intermediate term[138] • Advice to act as usual, when compared to use of a soft collar, for reducing pain over the intermediate and long term[203]

Table continues on page A36.

TABLE 8 Intervention Evidence for Neck Pain With Movement Coordination Impairments by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

Stage/Level	Study	Evidence Statement
		Education
IV	Meeus et al[138] Gross et al[76]	For patients with acute neck pain with movement coordination impairments, there was **no benefit** in using the following: • Verbal education on the mechanism of injury to reduce fear and uncertainty, and advice to remain active, when compared to the use of a semi-rigid collar or active mobilization, for reducing neck pain, headache disability, and improving work ability over the long term[138] • Instructions to decrease the use of a cervical collar, improve posture and perform mobilizing exercise, when compared to active physiotherapy, for improving cervical ROM and reducing pain intensity over the intermediate term[138] • Advice to act as usual, when compared to use of a Philadelphia collar plus manual therapy plus exercise, on improving pain, function, or quality of life over the long term[76] • Whiplash pamphlet focusing on activity, when compared to a generic information sheet, on reducing pain or improving function over the short term[76]
IV	Gross et al[70]	For patients with acute neck pain with movement coordination impairments, there was **no benefit** in using a pamphlet focusing on activity, when compared to generic information provided in the emergency department, for reducing pain or improving function over the short term.[70]
Subacute		No update evidence identified
Chronic		
IV	Meeus et al[138]	For patients with chronic neck pain with movement coordination impairments, there was a **benefit** in using verbal education focusing on prognosis, encouragement, assurance, and activity integrated with exercise, when compared to a control, for reducing pain and disability over the short term.[138]
IV	Gross et al[76]	For patients with chronic neck pain with movement coordination impairments, there was **no benefit** in adding cognitive behavioral training to a physical therapy program, on reducing pain or improving disability over the short term.[76]
		Physical Agents
Stage/Level	**Study**	**Evidence Statement**
Acute		
IV	Gross et al[76] Parreira et al[161] Vanti et al[216]	For patients with acute neck pain with movement coordination impairments, there was a **benefit** in using Kinesiotape when compared to sham Kinesio Tape on reducing pain over the immediate term. The difference was small and possibly not clinically meaningful.[76,161,216]
IV	Graham et al[68]	For patients with acute neck pain with movement coordination impairments, there was **no benefit**, when compared to a control, in using the following: • Laser for reducing pain over the immediate or intermediate term[68] • Pulsed ultrasound on function or global perceived effect over the immediate term[68] • Iontophoresis for reducing pain over the immediate term[68]
IV	Graham et al[68]	For patients with acute neck pain with movement coordination impairments, there was **no benefit** in using iontophoresis, when compared to interferential current, and was inferior to a multimodal treatment of traction, exercise, and massage, for reducing pain over the immediate term.[68]
Subacute		No update evidence identified
Chronic		
IV	Graham et al[68]	For patients with an unspecified duration of neck pain with movement coordination impairments, there was a **benefit**, when compared to a control, in using transcutaneous electrical nerve stimulation for reducing pain over the immediate term.[68]

Abbreviations: ROM, range of motion; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey.

concerted multimodal treatment program that could include medical and psychological consultation would be indicated.

- Available adherence strategies (eg, McLean et al[136]) for adoption and maintenance of home exercise should be integrated to maximize clinical benefit over the long term

2017 Recommendation

Acute

For patients with **acute** neck pain with movement coordination impairments (including WAD):

B Clinicians should provide the following:

1. Education of the patient to
   - Return to normal, nonprovocative preaccident activities as soon as possible
   - Minimize use of a cervical collar
   - Perform postural and mobility exercises to decrease pain and increase ROM
2. Reassurance to the patient that recovery is expected to occur within the first 2 to 3 months.

B Clinicians should use a multimodal intervention approach including manual mobilization techniques plus exercise (eg, strengthening, endurance, flexibility, postural, coordination, aerobic, and functional exercises) for those patients expected to experience a moderate to slow recovery with persistent impairments.

C Clinicians may provide to patients whose condition is perceived to be at low risk of progressing toward chronicity:

- A single session consisting of early advice, exercise instruction, and education
- A comprehensive exercise program (including strength and/or endurance with/without coordination exercises)
- TENS

F Clinicians should monitor recovery status in an attempt to identify those patients experiencing delayed recovery and who may need more intensive rehabilitation and an early pain education program.

Chronic

For patients with **chronic** neck pain with movement coordination impairments (including WAD):

C Clinicians may provide the following:

- Patient education and advice focusing on reassurance, encouragement, prognosis, and pain management
- Mobilization combined with an individualized, progressive submaximal exercise program including cervicothoracic strengthening, endurance, flexibility, and coordination, using principles of cognitive behavioral therapy
- TENS

NECK PAIN WITH HEADACHE

2008 Recommendation

The intervention literature analyses were not specifically aligned to the neck pain categories or staging, but recommendations were made for coordination, strengthening, and endurance exercises to reduce neck pain and headache.

Evidence Update

Identified were 17 systematic reviews investigating physical therapy interventions for neck pain with cervicogenic headache. Levels of evidence assigned to systematic reviews in this section were assessed according to **TABLE 1**. Primary sources were generally of high or moderate methodological quality, that is, with low risk of bias, but had numbers of participants that were considered small. This resulted in downgrading the strength of the evidence by 1 or 2 levels due to imprecision and limited directness (**TABLE 1**).[63] **TABLE 9** details the levels of evidence of included studies with underpinning evidence statements. Considerations were made of the trade-offs between desirable and undesirable consequences (important adverse events). Adverse events or side effects were poorly reported in the studies, and when reported were minor, transient, and of short duration. For manual therapy or exercise, the only consistently reported problem was local discomfort or dizziness. For manipulation, rare but serious adverse events such as stroke or serious neurological deficits were not reported in any of the trials. Serious but rare adverse events for manipulation are known to occur.[23]

V The following are expert opinions of the CPG development group:

- Clinicians should integrate the recommendations below with consideration of the results of the patient evaluation (eg, physical impairments most related to the patient's reported activity limitation or concerns, severity and irritability of the condition, patient values, and motivating factors).
- With patients in this category, clinicians should follow the screening and assessment procedures outlined in the IFOMPT framework before implementing interventions.
- Treatments for subgroups of patients having neck pain with headache need further research, including patients post-concussion and patients experiencing symptoms related to the temporomandibular joint.
- Craniocervical strength training may be of particular benefit.
- Available adherence strategies (eg, McLean et al[136]) for adoption and maintenance of home exercise should be integrated to maximize clinical benefit over the long term.

TABLE 9

Intervention Evidence for Neck Pain With Headache by Intervention Type, Stage, Levels of Evidence, Evidence of Benefit or No Benefit, and Comparison

Stage/Level	Study	Evidence Statement
		Manual Therapy
Acute		No update evidence identified
Subacute		
III	Chaibi and Russell[28] Fernández-de-las-Peñas et al[59] Hurwitz et al[93] Racicki et al[163]	For patients with subacute to chronic neck pain with headache, there was a **benefit**, when compared to a control, in using cervical manipulation and mobilization for reducing neck pain, headache intensity, and headache frequency over the immediate through long term.[28,59,93,163]
Chronic		
III	Brønfort et al[20] Chaibi and Russell[28] Fernández-de-las-Peñas et al[59] Gross et al[72] Racicki et al[163]	For patients with chronic neck pain with headache, there was a **benefit** in using the following: • Cervical manipulation done 3 or 4 times per week for 12 to 18 sessions, when compared to cervical manipulations done 1 time per week for 3 to 8 sessions, for reducing headache pain and frequency over the short term.[21,57] This benefit was not maintained over the intermediate term[28,72] • Multiple sessions of cervical or cervicothoracic manipulation, when compared to multiple sessions of massage or placebo treatments, for reducing pain and improving function over the short and intermediate term[28,59,163] • Cervical manipulation, when compared to cervical mobilization, for reducing pain, over the immediate, but not the short term[20]
III	Brønfort et al[20] Chaibi and Russell[28] Gross et al[72] Hurwitz et al[93] Macaulay et al[125] Racicki et al[163] Varatharajan et al[220]	For patients with chronic neck pain with headache, there was **no benefit** in using the following: • Cervical manipulation and mobilization, when compared to exercise alone or manipulation plus exercise, affecting neck pain and headache intensity, frequency, and duration, over the long term.[20,93,220] However 2 other reviews reported a small advantage in using manual therapy and exercise, when compared to manipulation alone, for reducing pain and improving function, with a 69% advantage in global perceived effect, over the long term[71,125] • Cervical manipulation alone, when compared to laser and massage, for reducing headache intensity or duration, over the immediate term[28,163]
		Exercise
Acute		
III	Gross et al[76]	For patients with acute whiplash with neck pain with headache, there was a **benefit** for active mobility exercise (physical therapist provided instruction, then home exercise), when compared to collar use, in reducing pain and disability over the short term, and pain over the intermediate term.[76]
IV	Gross et al[71] Kay et al[109] Racicki et al[163] Zronek et al[247]	For patients with acute to subacute neck pain with headache, there was a **benefit**, when compared to a control, in C1-2 self-SNAG for reducing pain and headache intensity[163] over the short and long term.[71,109,163,247]
Subacute		No update evidence identified
Chronic		
III	Gross et al[75] Gross et al[71] Kay et al[109] Racicki et al[163] Varatharajan et al[220]	For patients with chronic neck pain with headache, there was a **benefit**, when compared to a control, in using cervicoscapular strengthening and endurance exercise including craniocervical flexion training with pressure biofeedback for reducing pain and function, and improving global perceived effect, over the long term.[71,75,109,163,220]
III	Bronfort et al[19] Gross et al[71] Kay et al[109]	For patients with chronic neck pain with headache, there was **no benefit** in using endurance, isometric, and stretching exercise, when compared to manipulation, for reducing pain, headache frequency, or headache duration, over the short and long term.[19,71,109]

Table continues on page A39.

TABLE 9 Intervention Evidence for Neck Pain With Headache by Intervention Type, Stage, Levels of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

	Multimodal: Exercise and Manual Therapy	
Stage/Level	**Study**	**Evidence Statement**
Acute		No update evidence identified
Subacute		No update evidence identified
Chronic		
III	Brønfort et al[20] Chaibi and Russell[28] Fernández-de-las-Peñas et al[59] Gross et al[75] Hurwitz et al[93] Miller et al[140] Racicki et al[163] Reid and Rivett[167]	For patients with chronic neck pain with headache, there was a **benefit**, when compared to a control, in using mobilization, manipulation, and exercise (stretching, strengthening, and endurance), for reducing pain, headache frequency, headache intensity, and improving function and global perceived effect, over the short and long term.[20,28,59,75,93,140,163,167]
III	Gross et al[75]	For patients with mechanical neck pain, with or without radiating pain, and with or without headache there was a **benefit**, compared to control, in using mobilization or manipulation combined with stretching and strengthening to reduce pain over the short and long term, sand improve function over the long term.[75]
IV	Chaibi and Russell[28]	For patients with chronic neck pain with headache who also report at least 1 sign of temporomandibular dysfunction (eg, pain in the area of the jaw [or face, or ear], a click or pop heard when opening or closing the mouth, restrictions or deviations of jaw motion, or pain in the muscles of mastication), there was a **benefit**, when compared to manual therapy and exercise focused on the craniocervical region, in using manual therapy and exercise interventions focused on the temporomandibular joint, for reducing pain and improving function over the short and intermediate term.[28]

Abbreviations: SNAG, sustained natural apophyseal glide.

2017 Recommendation

Acute

B For patients with acute neck pain with headache, clinicians should provide supervised instruction in active mobility exercise.

C Clinicians may utilize C1-2 self-sustained natural apophyseal glide (self-SNAG) exercise.

Subacute

B For patients with subacute neck pain with headache, clinicians should provide cervical manipulation and mobilization.

C Clinicians may provide C1-2 self-SNAG exercise.

Chronic

B For patients with chronic neck pain with headache, clinicians should provide cervical or cervicothoracic manipulation or mobilizations combined with shoulder girdle and neck stretching, strengthening, and endurance exercise.

NECK PAIN WITH RADIATING PAIN

2008 Recommendation

B Clinicians should consider the use of upper-quarter and nerve mobilization procedures to reduce pain and disability in patients with neck and arm pain.

C Specific repeated movements or procedures to promote centralization are not more beneficial in reducing disability when compared to other forms of interventions.

B Clinicians should consider the use of mechanical intermittent cervical traction, combined with other interventions such as manual therapy and strengthening exercises, for reducing pain and disability in patients with neck and neck-related arm pain.

TABLE 10 Intervention Evidence for Neck Pain With Radiating Pain by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison

		Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
Acute		
IV	Boyles et al[17]	For patients with acute to chronic neck pain with radiating pain, there was **no benefit** from using the following: combined cervical lateral glides, thoracic mobilizations, and nerve mobilization procedures for the median nerve, when compared to general strengthening, for reducing pain and disability, over the immediate term[17]
Subacute		No update evidence identified
Chronic		
IV	Zhu et al[246]	For patients with chronic neck pain with radiating pain, there was a **benefit** in using cervical manipulation on pain, compared to mechanical traction over the immediate term.[246]
		Exercise
Stage/Level	**Study**	**Evidence Statement**
Acute		
IV	Southerst et al[190] Kay et al[109] Salt et al[178] Gross et al[71] Zronek et al[247]	For patients with acute neck pain with radiating pain, there was a **benefit**, when compared to a control, in using cervical mobilizing and stabilizing exercises for reducing pain but not for improving function over the immediate term. The benefit for relief of pain was not sustained over the short[190] or intermediate term.[71,109,178,247]
IV	Southerst et al[190] Salt et al[178]	For patients with acute to subacute neck pain with radiating pain, there was **no benefit** in using cervical stretching and strengthening exercises, when compared to wearing a semi-hard cervical collar, for reducing pain and improving function, over the immediate, short, and intermediate term.[178,190]
Subacute		No update evidence identified
Chronic		No update evidence identified
		Multimodal: Exercise and Manual Therapy
Stage/Level	**Study**	**Evidence Statement**
Acute		No update evidence identified
Subacute		No update evidence identified
Chronic		
III	Gross et al[75]	For patients with mechanical neck pain, with or without radiating pain, and with or without headache, there was a **benefit**, when compared to a control, in using mobilization or manipulation combined with stretching and strengthening exercises for reducing pain over the short and long term, and for improving function over the long term.[75]
III	Salt et al[178]	For patients with chronic neck pain with radiating pain, there was **no benefit** in using manual therapy plus exercise, when compared to advice plus sham ultrasound, or when compared to manual therapy, or when compared to exercise alone, for reducing pain or improving function, over the short and long term.[178]
IV	Salt et al[178] Boyles et al[17]	For patients with chronic neck pain with radiating pain, there was **no benefit** in using manual therapy plus exercise, when compared to rigid or soft collar, or when compared to surgery, for reducing pain or improving function, over the immediate and long term.[17,178]
		Education
Stage/Level	**Study**	**Evidence Statement**
Acute		No update evidence identified
Subacute		No update evidence identified
Chronic		
III	Salt et al[178]	For patients with chronic neck pain with radiating pain, there was a **benefit**, when compared to a control, for using patient education and counseling that encourage exercise and moderate to heavy physical activities related to work, for reducing pain, but not for improving function or reducing disability over the long term.[178]

Table continues on page A41.

TABLE 10 Intervention Evidence for Neck Pain With Radiating Pain by Intervention Type, Stage, Level of Evidence, Evidence of Benefit or No Benefit, and Comparison (continued)

	Education	
Stage/Level	**Study**	**Evidence Statement**
IV	Varatharajan et al[219]	For patients with chronic neck pain with radiating pain, there was **no benefit**, when compared to a control, for adding job stress education to ergonomic interventions for reducing pain, ergonomic risk, or work stress, or for improving function, over the intermediate and long term.[219]
	Physical Agents	
Stage/Level	**Study**	**Evidence Statement**
Acute		
IV	Graham et al[68] Gross et al[76] Kadhim-Saleh et al[104] Thoomes et al[208]	For patients with acute neck pain with radiating pain, there was a **benefit**, when compared to a control, in using the following: • 905-nm laser for reducing pain, improving function, global perceived effect, and quality of life over the immediate and intermediate term.[68,76,104] Graham et al[68] reported mild adverse events equal in treatment and placebo groups, including tiredness, nausea, headache, and increased pain following laser treatment • A cervical collar for reducing arm pain over the short but not intermediate term[76,208]
IV	Rhee et al[169]	For neck pain with radiating pain and a diagnosis of mild cervical myelopathy, there was a **benefit**, compared to surgery, in using multimodal nonsurgical management (intermittent use of collar or bed rest, medications, and activity modification) for improving gait speed over the long term, but no difference in neurological status or performance of daily living activities as compared to surgical management.[169] Rhee et al[169] also strongly recommended that traction, as part of nonsurgical management, should not be routinely prescribed for patients with moderate to severe cervical myelopathy.
IV	Gross et al[76]	For patients with acute neck pain with radiating pain, there was **no benefit**, when compared to a control, in using a semi-rigid collar for improving function over the short, intermediate, or long term.[76]
III	Graham et al[68] Thoomes et al[208]	For patients with acute and chronic neck pain with radiating pain, there was **no benefit**, when compared to a control, in using continuous traction for reducing pain or disability over the immediate, short, and intermediate term.[68,208]
IV	Thoomes et al[208]	For patients with acute and chronic neck pain with radiating pain, there was **no benefit** in using a collar, when compared to multimodal physical therapy, for reducing pain over the short term.[208]
Subacute		No update evidence identified
Chronic		
III	Graham et al[68]	For patients with chronic neck pain with radiating pain, there was a **benefit**, when compared to a control, in using intermittent traction for reducing pain in the short term.[68]
IV	Graham et al[68]	For patients with chronic neck pain with radiating pain, there was **no benefit**, when compared to a control, in using electric muscular stimulation, or modified galvanic current for reducing pain over the immediate term.[68]

Evidence Update

Identified were 15 systematic reviews investigating physical therapy interventions for neck pain with radiating pain. Levels of evidence assigned to systematic reviews in this section were assessed according to **TABLE 1**. Primary sources were generally of high or moderate methodological quality, that is, with low risk of bias, but had numbers of participants that were considered small. This resulted in downgrading the strength of the evidence by 1 or 2 levels due to imprecision and limited directness (**TABLE 1**).[63] **TABLE 10** details the levels of evidence of included studies with underpinning evidence statements. Consideration of the trade-offs between desirable and undesirable consequences (important adverse events) was made. Adverse events or side effects were poorly reported in the studies, and when reported were minor, transient, and of short duration.

V The following are expert opinions of the CPG development group:

- Clinicians should integrate the recommendations below with consideration of the results of the patient evaluation (eg, related impairments, severity, and irritability of the condition, and values). Clinicians have a responsibility to make appropriate referrals if signs and symptoms are not resolving or are worsening.
- Since the 2008 neck pain CPG, there has been little advancement in our knowledge of how to nonsurgically

treat neck pain with radiating pain. While 1 meta-analysis showed benefit from manual therapy and exercise in a population that included a mixture of neck pain categories, other studies that were selective to neck pain with radiating pain were not able to show similar benefits from this approach.

- Clinicians should monitor symptom irritability, and adjust treatment accordingly, when applying manual therapy and exercise approaches applied to patients with radicular pain.
- Because of the detrimental effects of prolonged use, collars should be restricted to a limited time in the acute phase only, and only in individuals who do not obtain relief from other treatments.
- Available adherence strategies (eg, McLean et al[136]) for adoption and maintenance of home exercise should be integrated to maximize clinical benefit over the long term.

2017 Recommendation

Acute

C For patients with acute neck pain with radiating pain, clinicians may utilize mobilizing and stabilizing exercises, laser, and short-term use of a cervical collar.

Chronic

B For patients with chronic neck pain with radiating pain, clinicians should provide mechanical intermittent cervical traction, combined with other interventions such as stretching and strengthening exercise plus cervical and thoracic mobilization/manipulation.

B Clinicians should provide education and counseling to encourage participation in occupational and exercise activities.

Limitations to This CPG

1. The estimates of the prevalence of neck pain vary so widely, with respect to definitions and associated estimates, that reporting the actual prevalence is likely impossible.

2. Reviews of musculoskeletal clinical research frequently draw somewhat vague conclusions that are only partially helpful to clinical practice. This makes the development of absolute or firm recommendations or guidelines difficult at this point in time.

3. Health care research does not account well for the dynamic or individualized nature of the less well-defined diagnoses, such as those afflicting patients with neck pain, the solutions to those problems, or the ongoing doubt associated with whether a solution to any given problem has been reached after the implementation of treatment.

4. The comparable sign, a highly adaptable patient response to a specific clinical test, appears to not be present in the scientific literature. This may complicate attempts to incorporate scientific findings into clinical practice.

5. Health care research attempts to classify and quantify the scientific aspects of patient care but cannot sufficiently capture the intuitive, responsive process so frequently associated with both the evaluation and management processes. This, to a certain extent, will of course limit the applicability of CPGs in certain scenarios.

6. Comparison across scientific papers is problematic when discrepencies exist in experience and mastery of the diagnostic process and intervention delivery. In addition, intervention specifics (eg, position, dosage) are frequently poorly described, further complicating comparison between and among studies. The clinician may have to return to the original articles in an attempt to determine evidence-based dosage.

7. The guideline recommends interventions predominantly for their effect on pain, and thus the reader may be under the impression that the authors have ignored other common symptoms associated with neck disorders, such as light-headedness and poor balance/dizziness (which are common symptoms in persons with whiplash and even cervicogenic headache).

8. The guideline discusses the major problem of the recurrent nature of neck pain and the transition to chronicity. Recommendations are based on higher-level evidence that considered relief of an episode of pain.

9. The guideline does not review a large body of research on neuromuscular and sensorimotor impairments in neck pain disorders. In many cases, the available evidence did not meet our threshold for inclusion.

10. The guideline positions itself within the ICF but does not consider the biopsychosocial context informing assessment, prognostic, and theranostic strategies on a patient-by-patient basis. In time and with more research, it is anticipated that this information will combine, if not refine, using strict inclusion criteria.

Competing Interests, Disclosures, and Author Contributions

The guideline development group members declared relationships and developed a conflict management plan that included submitting a Conflict of Interest form to the Orthopaedic Section, APTA, Inc. Articles that were authored by a group member were assigned to an alternate member for assessment. Partial funding was provided to the CPG development team for travel and expenses for CPG training and development; the content of this guideline was not influenced by this funding. The CPG development team maintained editorial independence.

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APPENDIX A

SEARCH STRATEGIES

Below is an example EMBASE search strategy for articles related to the Physical Agents section of Interventions.

Modalities =#1

'combined modality therapy'/de OR 'electrostimulation therapy'/exp OR 'electrostimulation'/de OR 'traction therapy'/exp OR 'phototherapy'/exp OR 'physiotherapy'/exp OR 'rehabilitation'/exp OR 'ultrasound therapy'/exp OR 'laser'/de OR 'cryotherapy'/exp OR 'cryoanesthesia'/de OR 'ice'/de OR 'acupuncture'/exp OR Modalit* OR 'electric stimulation' OR 'electrical stimulation' OR electrotherapy OR tens OR 'transcutaneous electric nerve stimulation' OR electroacupuncture OR acupuncture OR needling OR heat OR cold OR traction OR laser OR lasers OR rehabilitation OR 'physical therapy' OR ultrasound OR ultrasonic OR cryotherapy OR hyperthermia OR 'vapocoolant spray' OR cryoanesthesia OR ice OR faradic OR traction OR iontophoresis OR phonophoresis OR phototherapy OR hydrotherapy OR 'light therapy' OR diathermy OR ultraviolet OR infrared OR ((trigger* OR dry) and needl*)

neck anatomy =#2

'neck'/exp OR 'cervical plexus'/de OR 'cervical spine'/de OR 'atlantoaxial joint'/de OR 'atlantooccipital joint'/de OR 'spinal root'/de OR 'brachial plexus'/de OR 'atlas'/de OR 'axis'/de OR 'thoracic spine'/de OR (brachial NEAR/3 plexus) OR neck OR (thoracic NEAR/3 spine) OR (thoracic NEAR/3 outlet) OR (thoracic NEAR/3 vertebra*) OR trapezius OR odontoid* OR occip* OR atlant* OR ((cervical OR cervico*) NOT ('gynecologic disease'/exp OR 'uterus'/exp OR uterus OR cervix))

pain =#3

'pain'/exp OR pain* OR ache* OR sore* OR stiff* OR discomfort OR injur* OR neuropath* OR neuralgia* OR neurodynia*

neck pain =#4

'atlantoaxial dislocation'/de OR 'neck pain'/de OR 'brachial plexus neuropathy'/de OR 'neck injury'/exp OR 'thorax outlet syndrome'/de OR 'torticollis'/de OR 'cervical pain' OR neckache* OR neck ache* OR whiplash OR cervicodynia* OR cervicalgia* OR brachialgia* OR 'brachial neuritis' OR brachial neuralgia* OR 'cervicobrachial neuritis' OR cervicobrachial neuralgia* OR neck pain* OR neck injur* OR brachial plexus neuropath* OR 'brachial plexus neuritis' OR monoradicul* OR monoradicl* OR torticollis OR 'thoracic outlet syndrome' OR 'cervical dystonia' OR (headache* AND cervic*)

disc problems =#5

'vertebra dislocation'/exp OR 'intervertebral disk disease'/exp OR (('intervertebral disk'/exp OR disks OR disk OR discs OR disc) AND (herniat* OR slipped OR prolapse* OR displace* OR degenerat* OR bulge OR bulged OR bulging))

diseases =#6

'radiculopathy'/exp OR 'temporomandibular joint disorder'/de OR 'myofascial pain'/de OR 'musculoskeletal disease'/exp OR 'neuritis'/exp OR radiculopath* OR radiculitis OR temporomandibular OR (myofascial NEAR/3 pain*) OR (thoracic outlet syndrome*) OR 'spinal osteophytosis' OR neuritis OR spondylosis OR splondylitis OR spondylolisthesis OR spondylolysis OR arthritis OR osteoarthritis OR spondylarthritis OR fibromyalgia OR sprain* OR strain*

disease rehab =#7

'radiculopathy'/exp/dm_rh OR 'temporomandibular joint disorder'/dm_rh OR 'myofascial pain'/dm_rh OR 'musculoskeletal disease'/exp/dm_rh OR 'neuritis'/exp/dm_rh

neck pain rehab =#8

'atlantoaxial dislocation'/dm_rh OR 'neck pain'/dm_rh OR 'brachial plexus neuropathy'/dm_rh OR 'neck injury'/exp/dm_rh OR 'thorax outlet syndrome'/dm_rh OR 'torticollis'/dm_rh

Systematic Review Filter =#9

'meta analysis'/de OR 'meta analysis (topic)'/de OR 'systematic review'/de OR 'systematic review (topic)'/de OR Meta analy* OR metaanaly* OR meta analy* OR Systematic review* OR systematic overview* OR Cochrane OR embase OR psyclit OR psychlit OR psycinfo OR psychinfo OR cinahl OR cinhal OR science citation index OR bids OR cancerlit OR 'web of science' OR Reference list* OR bibliograph* OR hand search* OR 'relevant journals' OR manual search* OR (('selection criteria' OR data NEAR/3 extract*) AND (review OR reviews))

APPENDIX A

Embase Session Results

Number	Query	Results, n
1	'combined modality therapy'/de OR 'electrostimulation therapy'/exp OR 'electrostimulation'/de OR 'traction therapy'/exp OR 'phototherapy'/exp OR 'physiotherapy'/exp OR 'rehabilitation'/exp OR 'ultrasound therapy'/exp OR 'laser'/de OR 'cryotherapy'/exp OR 'cryoanesthesia'/de OR 'ice'/de OR 'acupuncture'/exp OR modalit* OR 'electric stimulation' OR 'electrical stimulation' OR electrotherapy OR tens OR 'transcutaneous electric nerve stimulation' OR electroacupuncture OR acupuncture OR needling OR heat OR cold OR laser OR lasers OR rehabilitation OR 'physical therapy' OR ultrasound OR ultrasonic OR cryotherapy OR hyperthermia OR 'vapocoolant spray' OR cryoanesthesia OR ice OR faradic OR traction OR iontophoresis OR phonophoresis OR phototherapy OR hydrotherapy OR 'light therapy' OR diathermy OR ultraviolet OR infrared OR (trigger* OR dry AND needl*) AND [english]/lim AND ([embase]/lim OR [embase classic]/lim)	1647419
2	'neck'/exp OR 'cervical plexus'/de OR 'cervical spine'/de OR 'atlantoaxial joint'/de OR 'atlantooccipital joint'/de OR 'spinal root'/de OR 'brachial plexus'/de OR 'atlas'/de OR 'axis'/de OR 'thoracic spine'/de OR brachial NEAR/3 plexus OR neck OR thoracic NEAR/3 spine OR thoracic NEAR/3 outlet OR thoracic NEAR/3 vertebra* OR trapezius OR odontoid* OR occip* OR atlant* OR (cervical OR cervico* NOT ('gynecologic disease'/exp OR 'uterus'/exp OR uterus OR cervix))	1467424
3	'pain'/exp OR pain* OR ache* OR sore* OR stiff* OR discomfort OR injur* OR neuropath* OR neuralgia* OR neurodynia*	3295582
4	'atlantoaxial dislocation'/de OR 'neck pain'/de OR 'brachial plexus neuropathy'/de OR 'neck injury'/exp OR 'thorax outlet syndrome'/de OR 'torticollis'/de OR 'cervical pain' OR neckache* OR neck AND ache* OR whiplash OR cervicodynia* OR cervicalgia* OR brachialgia* OR 'brachial neuritis' OR brachial AND neuralgia* OR 'cervicobrachial neuritis' OR cervicobrachial AND neuralgia* OR neck AND pain* OR neck AND injur* OR brachial AND plexus AND neuropath* OR 'brachial plexus neuritis' OR monoradicul* OR monoradicl* OR torticollis OR 'thoracic outlet syndrome' OR 'cervical dystonia' OR (headache* AND cervic*)	22970
5	'vertebra dislocation'/exp OR 'intervertebral disk disease'/exp OR ('intervertebral disk'/exp OR disks OR disk OR discs OR disc AND (herniat* OR slipped OR prolapse* OR displace* OR degenerat* OR bulge OR bulged OR bulging))	46463
6	'radiculopathy'/exp OR 'temporomandibular joint disorder'/de OR 'myofascial pain'/de OR 'musculoskeletal disease'/exp OR 'neuritis'/exp OR radiculopath* OR radiculitis OR temporomandibular OR myofascial NEAR/3 pain* OR (thoracic AND outlet AND syndrome*) OR 'spinal osteophytosis' OR neuritis OR spondylosis OR splondylitis OR spondylolisthesis OR spondylolysis OR arthritis OR osteoarthritis OR spondylarthritis OR fibromyalgia OR sprain* OR strain*	2801790
7	'radiculopathy'/exp/dm_rh OR 'temporomandibular joint disorder'/dm_rh OR 'myofascial pain'/dm_rh OR 'musculoskeletal disease'/exp/dm_rh OR 'neuritis'/exp/dm_rh	20066
8	'atlantoaxial dislocation'/dm_rh OR 'neck pain'/dm_rh OR 'brachial plexus neuropathy'/dm_rh OR 'neck injury'/exp/dm_rh OR 'thorax outlet syndrome'/dm_rh OR 'torticollis'/dm_rh	644
9	'meta analysis'/de OR 'meta analysis (topic)'/de OR 'systematic review'/de OR 'systematic review (topic)'/de OR meta AND analy* OR metaanaly* OR meta AND analy* OR systematic AND review* OR systematic AND overview* OR cochrane OR embase OR psyclit OR psychlit OR psycinfo OR psychinfo OR cinahl OR cinhal OR science AND citation AND index OR bids OR cancerlit OR 'web of science' OR reference AND list* OR bibliograph* OR hand AND search* OR 'relevant journals' OR manual AND search* OR ('selection criteria' OR data NEAR/3 extract* AND (review OR reviews))	75731
10	#1 AND #2 AND #3	71583
11	#1 AND #4	4332
12	#1 AND #2 AND #5	1956
13	#1 AND #2 AND #6	31349
14	#2 AND #7	2689
15	#8 OR #10 OR #11 OR #12 OR #13 OR #14	83564
16	#9 AND #15	979
17	#16 AND [english]/lim AND ([embase]/lim OR [embase classic]/lim)	957
18	#17 AND (2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py)	500

APPENDIX A

Below is an example Medline-OVID search for articles related to Interventions. We only used articles published between January 2007 and August 2016.

1. Neck Pain/
2. exp Brachial Plexus Neuropathies/
3. exp neck injuries/ or exp whiplash injuries/
4. cervical pain.mp.
5. neckache.mp.
6. whiplash.mp.
7. cervicodynia.mp.
8. cervicalgia.mp.
9. brachialgia.mp.
10. brachial neuritis.mp.
11. brachial neuralgia.mp.
12. neck pain.mp.
13. neck injur*.mp.
14. brachial plexus neuropath*.mp.
15. brachial plexus neuritis.mp.
16. thoracic outlet syndrome/ or cervical rib syndrome/
17. Torticollis/
18. exp brachial plexus neuropathies/ or exp brachial plexus neuritis/
19. cervico brachial neuralgia.ti,ab.
20. cervicobrachial neuralgia.ti,ab.
21. (monoradicul* or monoradicl*).tw.
22. or/1-21
23. exp headache/ and cervic*.tw.
24. exp genital diseases, female/
25. genital disease*.mp.
26. or/24-25
27. 23 not 26
28. 22 or 27
29. neck/
30. neck muscles/
31. exp cervical plexus/
32. exp cervical vertebrae/
33. atlanto-axial joint/
34. atlanto-occipital joint/
35. Cervical Atlas/
36. spinal nerve roots/
37. exp brachial plexus/
38. (odontoid* or cervical or occip* or atlant*).tw.
39. axis/ or odontoid process/
40. Thoracic Vertebrae/
41. cervical vertebrae.mp.
42. cervical plexus.mp.
43. cervical spine.mp.
44. (neck adj3 muscles).mp.
45. (brachial adj3 plexus).mp.
46. (thoracic adj3 vertebrae).mp.
47. neck.mp.
48. (thoracic adj3 spine).mp.
49. (thoracic adj3 outlet).mp.
50. trapezius.mp.
51. cervical.mp.
52. cervico*.mp.
53. 51 or 52
54. exp genital diseases, female/
55. genital disease*.mp.
56. exp *Uterus/
57. 54 or 55 or 56
58. 53 not 57
59. 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 58
60. exp pain/
61. exp injuries/
62. pain.mp.
63. ache.mp.
64. sore.mp.
65. stiff.mp.
66. discomfort.mp.
67. injur*.mp.
68. neuropath*.mp.
69. or/60-68
70. 59 and 69
71. Radiculopathy/
72. exp temporomandibular joint disorders/ or exp temporomandibular joint dysfunction syndrome/
73. myofascial pain syndromes/
74. exp "Sprains and Strains"/
75. exp Spinal Osteophytosis/
76. exp Neuritis/
77. Polyradiculopathy/
78. exp Arthritis/
79. Fibromyalgia/
80. spondylitis/ or discitis/
81. spondylosis/ or spondylolysis/ or spondylolisthesis/
82. radiculopathy.mp.
83. radiculitis.mp.
84. temporomandibular.mp.
85. myofascial pain syndrome*.mp.
86. thoracic outlet syndrome*.mp.
87. spinal osteophytosis.mp.
88. neuritis.mp.
89. spondylosis.mp.
90. spondylitis.mp.
91. spondylolisthesis.mp.
92. or/71-91

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93. 59 and 92
94. exp neck/
95. exp cervical vertebrae/
96. Thoracic Vertebrae/
97. neck.mp.
98. (thoracic adj3 vertebrae).mp.
99. cervical.mp.
100. cervico*.mp.
101. 99 or 100
102. exp genital diseases, female/
103. genital disease*.mp.
104. exp *Uterus/
105. or/102-104
106. 101 not 105
107. (thoracic adj3 spine).mp.
108. cervical spine.mp.
109. 94 or 95 or 96 or 97 or 98 or 106 or 107 or 108
110. Intervertebral Disk/
111. (disc or discs).mp.
112. (disk or disks).mp.
113. 110 or 111 or 112
114. 109 and 113
115. herniat*.mp.
116. slipped.mp.
117. prolapse*.mp.
118. displace*.mp.
119. degenerat*.mp.
120. (bulge or bulged or bulging).mp.
121. 115 or 116 or 117 or 118 or 119 or 120
122. 114 and 121
123. intervertebral disk degeneration/ or intervertebral disk displacement/
124. intervertebral disk displacement.mp.
125. intervertebral disc displacement.mp.
126. intervertebral disk degeneration.mp.
127. intervertebral disc degeneration.mp.
128. 123 or 124 or 125 or 126 or 127
129. 109 and 128
130. 28 or 70 or 93 or 122 or 129
131. animals/ not (animals/ and humans/)
132. 130 not 131
133. exp *neoplasms/
134. exp *wounds, penetrating/
135. 133 or 134
136. 132 not 135
137. Neck Pain/rh [Rehabilitation]
138. exp Brachial Plexus Neuropathies/rh
139. exp neck injuries/rh or exp whiplash injuries/rh
140. thoracic outlet syndrome/rh or cervical rib syndrome/rh
141. Torticollis/rh
142. exp brachial plexus neuropathies/rh or exp brachial plexus neuritis/rh
143. 137 or 138 or 139 or 140 or 141 or 142
144. Radiculopathy/rh
145. exp temporomandibular joint disorders/rh or exp temporomandibular joint dysfunction syndrome/rh
146. myofascial pain syndromes/rh
147. exp "Sprains and Strains"/rh
148. exp Spinal Osteophytosis/rh
149. exp Neuritis/rh
150. Polyradiculopathy/rh
151. exp Arthritis/rh
152. Fibromyalgia/rh
153. spondylitis/rh or discitis/rh
154. spondylosis/rh or spondylolysis/rh or spondylolisthesis/rh
155. or/144-154
156. 59 and 155
157. exp Combined Modality Therapy/
158. Exercise/
159. Physical Exertion/
160. exp Exercise Therapy/
161. exp Electric Stimulation Therapy/
162. Transcutaneous Electric Nerve Stimulation/
163. pulsed electro magnetic field.mp.
164. pulsed electromagnetic field.tw.
165. Electromagnetic Fields/
166. Magnetic Field Therapy/
167. Electric Stimulation/
168. exp Orthotic Devices/
169. kinesiotaping.tw.
170. taping.tw.
171. oral splints.tw.
172. Occlusal Splints/
173. pillow?.tw.
174. collar?.tw.
175. Traction/
176. traction.tw.
177. exp Laser Therapy/
178. laser therapy.tw.
179. exp Rehabilitation/
180. Ultrasonic Therapy/
181. exp Phototherapy/
182. Lasers/
183. exp Physical Therapy Modalities/
184. repetitive magnetic stimulation.tw.
185. exp Cryotherapy/
186. Hydrotherapy/
187. exp Hyperthermia, Induced/

APPENDIX A

188. vapocoolant spray.mp.
189. Cryoanesthesia/
190. Ice/
191. postur* correction.mp.
192. Feldenkrais.mp.
193. (alexander adj (technique or method)).tw.
194. Relaxation Therapy/
195. Biofeedback, Psychology/
196. faradic stimulation.mp.
197. or/157-196
198. 136 and 197
199. 143 or 156 or 198
200. animals/ not (animals/ and humans/)
201. 199 not 200
202. guidelines as topic/
203. practice guidelines as topic/
204. guideline.pt.
205. practice guideline.pt.
206. (guideline? or guidance or recommendations).ti.
207. consensus.ti.
208. or/202-207
209. 201 and 208
210. 136 and 208
211. 209 or 210
212. limit 211 to yr="2006 -Current"
213. limit 211 to yr="1902 - 2005"
214. meta-analysis/
215. exp meta-analysis as topic/
216. (meta analy* or metaanaly* or met analy* or metanaly*).tw.
217. review literature as topic/
218. (collaborative research or collaborative review* or collaborative overview*).tw.
219. (integrative research or integrative review* or intergrative overview*).tw.
220. (quantitative adj3 (research or review* or overview*)).tw.
221. (research integration or research overview*).tw.
222. (systematic* adj3 (review* or overview*)).tw.
223. (methodologic* adj3 (review* or overview*)).tw.
224. exp technology assessment biomedical/
225. (hta or thas or technology assessment*).tw.
226. ((hand adj2 search*) or (manual* adj search*)).tw.
227. ((electronic adj database*) or (bibliographic* adj database*)).tw.
228. ((data adj2 abstract*) or (data adj2 extract*)).tw.
229. (analys* adj3 (pool or pooled or pooling)).tw.
230. mantel haenszel.tw.
231. (cohrane or pubmed or pub med or medline or embase or psycinfo or psyclit or psychinfo or psychlit or cinahl or science citation indes).ab.
232. or/214-231
233. 201 and 232
234. limit 233 to yr="2006 -Current"
235. limit 233 to yr="1902 - 2005"

Below is an example MEDLINE-OVID search for articles related to Manual Therapy. We only used articles published between January 2007 and August 2016. Last update: April 21, 2012.

1. Neck Pain/
2. exp Brachial Plexus Neuropathies/
3. exp neck injuries/ or exp whiplash injuries/
4. cervical pain.mp.
5. neckache.mp.
6. whiplash.mp.
7. cervicodynia.mp.
8. cervicalgia.mp.
9. brachialgia.mp.
10. brachial neuritis.mp.
11. brachial neuralgia.mp.
12. neck pain.mp.
13. neck injur*.mp.
14. brachial plexus neuropath*.mp.
15. brachial plexus neuritis.mp.
16. thoracic outlet syndrome/ or cervical rib syndrome/
17. Torticollis/
18. exp brachial plexus neuropathies/ or exp brachial plexus neuritis/
19. cervico brachial neuralgia.ti,ab.
20. cervicobrachial neuralgia.ti,ab.
21. (monoradicul* or monoradicl*).tw.
22. or/1-21
23. exp headache/ and cervic*.tw.
24. exp genital diseases, female/
25. genital disease*.mp.
26. or/24-25
27. 23 not 26
28. 22 or 27
29. neck/
30. neck muscles/
31. exp cervical plexus/
32. exp cervical vertebrae/
33. atlanto-axial joint/
34. atlanto-occipital joint/

APPENDIX A

35. Cervical Atlas/
36. spinal nerve roots/
37. exp brachial plexus/
38. (odontoid* or cervical or occip* or atlant*).tw.
39. axis/ or odontoid process/
40. Thoracic Vertebrae/
41. cervical vertebrae.mp.
42. cervical plexus.mp.
43. cervical spine.mp.
44. (neck adj3 muscles).mp.
45. (brachial adj3 plexus).mp.
46. (thoracic adj3 vertebrae).mp.
47. neck.mp.
48. (thoracic adj3 spine).mp.
49. (thoracic adj3 outlet).mp.
50. trapezius.mp.
51. cervical.mp.
52. cervico*.mp.
53. 51 or 52
54. exp genital diseases, female/
55. genital disease*.mp.
56. exp *Uterus/
57. 54 or 55 or 56
58. 53 not 57
59. 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 58
60. exp pain/
61. exp injuries/
62. pain.mp.
63. ache.mp.
64. sore.mp.
65. stiff.mp.
66. discomfort.mp.
67. injur*.mp.
68. neuropath*.mp.
69. or/60-68
70. 59 and 69
71. Radiculopathy/
72. exp temporomandibular joint disorders/ or exp temporomandibular joint dysfunction syndrome/
73. myofascial pain syndromes/
74. exp "Sprains and Strains"/
75. exp Spinal Osteophytosis/
76. exp Neuritis/
77. Polyradiculopathy/
78. exp Arthritis/
79. Fibromyalgia/
80. spondylitis/ or discitis/
81. spondylosis/ or spondylolysis/ or spondylolisthesis/
82. radiculopathy.mp.
83. radiculitis.mp.
84. temporomandibular.mp.
85. myofascial pain syndrome*.mp.
86. thoracic outlet syndrome*.mp.
87. spinal osteophytosis.mp.
88. neuritis.mp.
89. spondylosis.mp.
90. spondylitis.mp.
91. spondylolisthesis.mp.
92. or/71-91
93. 59 and 92
94. exp neck/
95. exp cervical vertebrae/
96. Thoracic Vertebrae/
97. neck.mp.
98. (thoracic adj3 vertebrae).mp.
99. cervical.mp.
100. cervico*.mp.
101. 99 or 100
102. exp genital diseases, female/
103. genital disease*.mp.
104. exp *Uterus/
105. or/102-104
106. 101 not 105
107. (thoracic adj3 spine).mp.
108. cervical spine.mp.
109. 94 or 95 or 96 or 97 or 98 or 106 or 107 or 108
110. Intervertebral Disk/
111. (disc or discs).mp.
112. (disk or disks).mp.
113. 110 or 111 or 112
114. 109 and 113
115. herniat*.mp.
116. slipped.mp.
117. prolapse*.mp.
118. displace*.mp.
119. degenerat*.mp.
120. (bulge or bulged or bulging).mp.
121. 115 or 116 or 117 or 118 or 119 or 120
122. 114 and 121
123. intervertebral disk degeneration/ or intervertebral disk displacement/
124. intervertebral disk displacement.mp.
125. intervertebral disc displacement.mp.
126. intervertebral disk degeneration.mp.
127. intervertebral disc degeneration.mp.
128. 123 or 124 or 125 or 126 or 127
129. 109 and 128
130. 28 or 70 or 93 or 122 or 129

APPENDIX A

131. animals/ not (animals/ and humans/)
132. 130 not 131
133. exp *neoplasms/
134. exp *wounds, penetrating/
135. 133 or 134
136. 132 not 135
137. Neck Pain/rh, th [Rehabilitation, Therapy]
138. exp Brachial Plexus Neuropathies/rh, th
139. exp neck injuries/rh, th or exp whiplash injuries/rh, th
140. thoracic outlet syndrome/rh, th or cervical rib syndrome/rh, th
141. Torticollis/rh, th
142. exp brachial plexus neuropathies/rh, th or exp brachial plexus neuritis/rh, th
143. or/137-142
144. Radiculopathy/rh, th
145. exp temporomandibular joint disorders/rh, th or exp temporomandibular joint dysfunction syndrome/rh, th
146. myofascial pain syndromes/rh, th
147. exp "Sprains and Strains"/rh, th
148. exp Spinal Osteophytosis/rh, th
149. exp Neuritis/rh, th
150. Polyradiculopathy/rh, th
151. exp Arthritis/rh, th
152. Fibromyalgia/rh, th
153. spondylitis/rh, th or discitis/rh, th
154. spondylosis/rh, th or spondylolysis/rh, th or spondylolisthesis/rh, th
155. or/144-154
156. 59 and 155
157. acupuncture/ or chiropractic/
158. exp Musculoskeletal Manipulations/
159. massage.tw.
160. mobili?ation.tw.
161. Acupuncture Therapy/
162. (acupuncture or acu-puncture or needling or acupressure or mox?bustion).tw.
163. ((neck or spine or spinal or cervical or chiropractic* or musculoskeletal* or musculo-skeletal*) adj3 (adjust* or manipulat* or mobiliz* or mobilis*)).tw.
164. (manual adj therap*).tw.
165. (manipulati* adj (therap* or medicine)).tw.
166. (massag* or reflexolog* or rolfing or zone therap*).tw.
167. Nimmo.mp.
168. exp Vibration/tu [Therapeutic Use]
169. (vibration adj5 (therap* or treatment*)).tw.
170. (Chih Ya or Shiatsu or Shiatzu or Zhi Ya).tw.
171. (flexion adj2 distraction*).tw.
172. (myofascial adj3 (release or therap*)).tw.
173. muscle energy technique*.tw.
174. trigger point.tw.
175. proprioceptive Neuromuscular Facilitation*.tw.
176. cyriax friction.tw.
177. (lomilomi or lomi-lomi or trager).tw.
178. aston patterning.tw.
179. (strain adj counterstrain).tw.
180. (craniosacral therap* or cranio-sacral therap*).tw.
181. (amma or ammo or effleuurage or petrissage or hacking or tapotment).tw.
182. Complementary Therapies/
183. ((complement* or alternat* or osteopthic*) adj (therap* or medicine)).tw.
184. (Tui Na or Tuina).tw.
185. or/157-184
186. 136 and 185
187. 143 or 156 or 186
188. animals/ not (animals/ and humans/)
189. 187 not 188
190. exp randomized controlled trials as topic/
191. randomized controlled trial.pt.
192. controlled clinical trial.pt.
193. (random* or sham or placebo*).tw.
194. placebos/
195. random allocation/
196. single blind method/
197. double blind method/
198. ((singl* or doubl* or trebl* or tripl*) adj25 (blind* or dumm* or mask*)).ti,ab.
199. (rct or rcts).tw.
200. (control* adj2 (study or studies or trial*)).tw.
201. or/190-200
202. 189 and 201
203. limit 202 to yr="2006 -Current"
204. limit 202 to yr="1902 -Current"
205. limit 202 to yr="1902 -2005"
206. guidelines as topic/
207. practice guidelines as topic/
208. guideline.pt.
209. practice guideline.pt.
210. (guideline? or guidance or recommendations).ti.
211. consensus.ti.
212. or/206-211
213. 189 and 212
214. limit 213 to yr="2006 -Current"
215. limit 213 to yr="1902 -2005"
216. meta-analysis/
217. exp meta-analysis as topic/
218. (meta analy* or metaanaly* or met analy* or metanaly*).tw.

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219. review literature as topic/
220. (collaborative research or collaborative review* or collaborative overview*).tw.
221. (integrative research or integrative review* or intergrative overview*).tw.
222. (quantitative adj3 (research or review* or overview*)).tw.
223. (research integration or research overview*).tw.
224. (systematic* adj3 (review* or overview*)).tw.
225. (methodologic* adj3 (review* or overview*)).tw.
226. exp technology assessment biomedical/
227. (hta or thas or technology assessment*).tw.
228. ((hand adj2 search*) or (manual* adj search*)).tw.
229. ((electronic adj database*) or (bibliographic* adj database*)).tw.
230. ((data adj2 abstract*) or (data adj2 extract*)).tw.
231. (analys* adj3 (pool or pooled or pooling)).tw.
232. mantel haenszel.tw.
233. (cohrane or pubmed or pub med or medline or embase or psycinfo or psyclit or psychinfo or psychlit or cinahl or science citation indes).ab.
234. or/216-233
235. 189 and 234
236. limit 235 to yr="2006 -Current"
237. limit 235 to yr="1902 -2005"
238. (ae or to or po or co).fs.
239. (safe or safety or unsafe).tw.
240. (side effect* or side event*).tw.
241. ((adverse or undesirable or harm* or injurious or serious or toxic) adj3 (effect* or event* or reaction* or incident* or outcome*)).tw.
242. (abnormalit* or toxicit* or complication* or consequence* or noxious or tolerabilit*).tw.
243. or/238-242
244. 189 and 243
245. limit 244 to yr="2006 -Current"
246. limit 244 to yr="1902 -2005"
247. limit 202 to ed=20100701-20120321
248. limit 213 to ed=20100701-20120321
249. limit 235 to ed=20100701-20120321
250. limit 245 to ed=20100701-20120321

APPENDIX B

SEARCH DATES AND RESULTS

August 25, 2016

Database	Platform	Years Covered	Date Conducted	Results, n
MEDLINE	OVID	2014-August 2016	8-25-16	835
CINAHL	EBSCO	2014-August 2016	8-25-16	40
Web of Science	Web of Knowledge	2014-August 2016	8-25-16	...
Cochrane	Wiley	2014-August 2016	8-25-16	27
Embase		2014-August 2016	8-25-16	161
Total				1063
With duplicates removed				177

April 25, 2014: Neck Pain Modalities

Database	Platform	Years Covered	Date Conducted	Results, n
MEDLINE	OVID	2010-2014	4-21-14	153
CINAHL	EBSCO	2010-2014	4-21-14	92
Web of Science	Web of Knowledge	2010-2014	4-21-14	235
Cochrane	Wiley	2010-2014	4-21-14	57
Embase		2010-2014	4-25-14	500
Total				1037
With duplicates removed				793

May 29, 2015: Update Through November 2014

Database	Platform	Years Covered	Date Conducted	Results, n
MEDLINE	OVID	2014	5-29-15	31
CINAHL	EBSCO	2014	5-29-15	11
Web of Science	Web of Knowledge	2014	5-29-15	52
Cochrane	Wiley	2014	5-29-15	13
Embase		2014	5-29-15	47
Total				154
With duplicates removed				114

September 29, 2014: Education*

Database	Platform	Years Covered	Date Conducted	Results, n
MEDLINE	OVID	2010-current	9-29-14	34
CINAHL	EBSCO	2010-current	9-29-14	15
Web of Science	Web of Knowledge	2010-current	9-29-14	33
Cochrane	Wiley	2010-current	9-29-14	10
Embase		2010-current	9-29-14	26
Total				118
With duplicates removed				88

**Some Overlap With ICON, Whose Search Went From 2000 to 2010.*

APPENDIX B

September 29, 2014: Cervical Orthoses*

Database	Platform	Years Covered	Date Conducted	Results, n
MEDLINE	OVID	2010-current	9-29-14	43
CINAHL	EBSCO	2010-current	9-29-14	17
Web of Science	Web of Knowledge	2010-current	9-29-14	46
Cochrane	Wiley	2010-current	9-29-14	10
Embase		2010-current	9-29-14	32
Total				148
With duplicates removed				91

**Some Overlap With ICON, Whose Search Went From 2000 to 2010.*

APPENDIX C

CRITERIA FOR INCLUSION AND EXCLUSION OF STUDIES OF INTERVENTIONS

Systematic reviews and meta-analyses published in peer-reviewed journals were reviewed.

Exclusions: experimental and quasi-experimental trials, cohort, case series, and cross-sectional studies, meeting abstracts, press releases, theses, nonsystematic review articles, case reports, and articles that could not be retrieved in English.

Inclusion Criteria

- screening / differential diagnosis

OR

- diagnosis / classification

OR

- patient reported outcome measures related to neck pain.

OR

- measurement properties of physical impairments, or of activity limitation/participation restriction using data from a sample of patients with neck pain

AND

- adults (≥18 years old)

AND

- interventions within the scope of physical therapist practice for neck pain, including:
  - manual therapy
  - exercise
  - multimodal physical therapy treatments
  - patient education
  - physical agents
    - heat and cold
    - electrotherapeutic modalities
    - laser
    - inserted needle techniques (reviews clearly identified as dry needling)
    - traction
    - ultrasound
    - orthoses (neck braces)

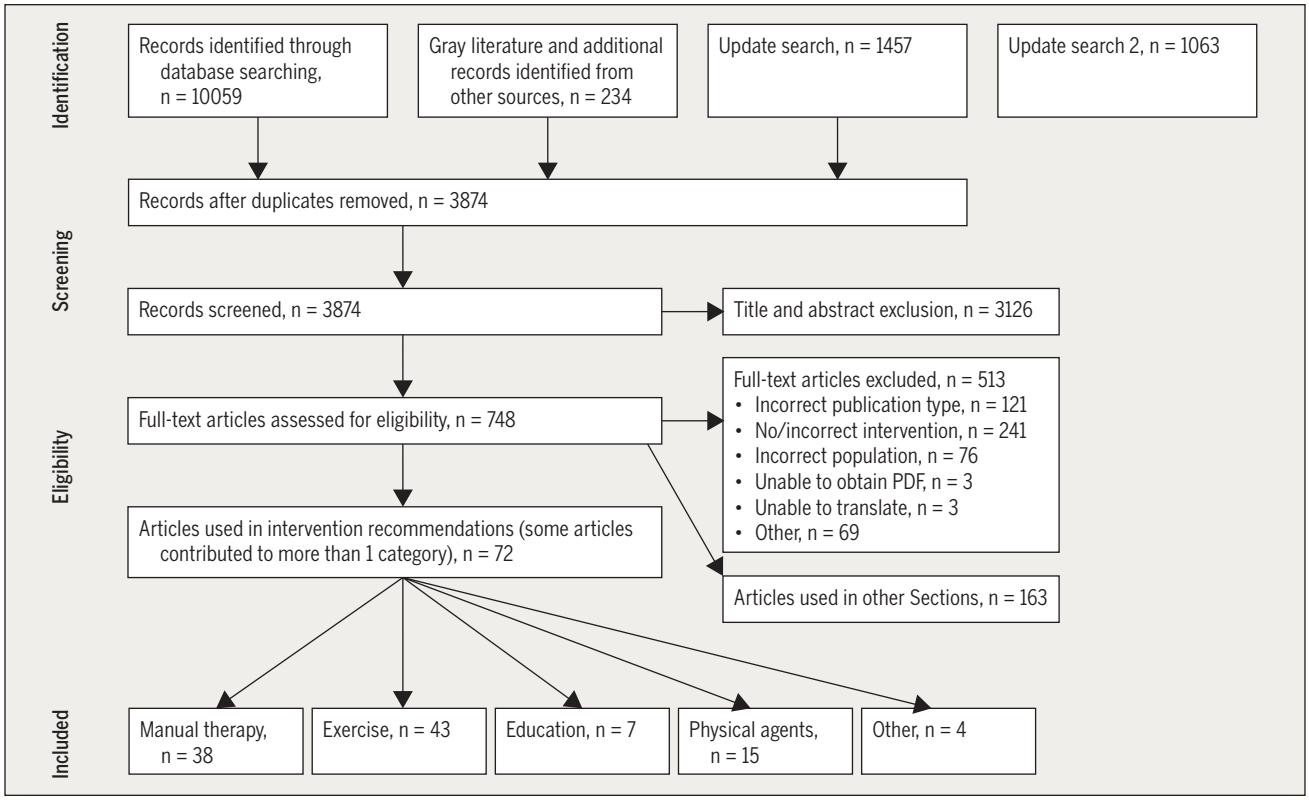
Exclusion Criteria

Articles reporting on the following were excluded:

- primarily infants, children, or adolescents (<18 years old)
- postsurgical neck pain
- cervical vertebral fracture
- nonmusculoskeletal neck pain:
  - visceral or vascular referral
  - integumentary
    - topics outside the scope of physical therapist practice (eg, surgery)
    - pharmacological interventions

APPENDIX D

FLOW DIAGRAM OF ARTICLES LEADING TO INTERVENTION RECOMMENDATIONS



APPENDIX E

ARTICLES INCLUDED IN RECOMMENDATIONS BY TOPIC

IMPAIRMENT/FUNCTION-BASED DIAGNOSIS

Prevalence

Andersson HI. The epidemiology of chronic pain in a Swedish rural area. *Qual Life Res*. 1994;3 suppl 1:S19-S26. https://doi.org/10.1007/BF00433371

Borghouts JA, Koes BW, Bouter LM. The clinical course and prognostic factors of non-specific neck pain: a systematic review. *Pain*. 1998;77:1-13. https://doi.org/10.1016/S0304-3959(98)00058-X

Borghouts JA, Koes BW, Vondeling H, Bouter LM. Cost-of-illness of neck pain in The Netherlands in 1996. *Pain*. 1999;80:629-636. https://doi.org/10.1016/S0304-3959(98)00268-1

Bot SD, van der Waal JM, Terwee CB, et al. Incidence and prevalence of complaints of the neck and upper extremity in general practice. *Ann Rheum Dis*. 2005;64:118-123. https://doi.org/10.1136/ard.2003.019349

Bovim G, Schrader H, Sand T. Neck pain in the general population. *Spine (Phila Pa 1976)*. 1994;19:1307-1309.

Brattberg G, Thorslund M, Wikman A. The prevalence of pain in a general population. The results of a postal survey in a county of Sweden. *Pain*. 1989;37:215-222. https://doi.org/10.1016/0304-3959(89)90133-4

Côté P, Cassidy JD, Carroll L. The factors associated with neck pain and its related disability in the Saskatchewan population. *Spine (Phila Pa 1976)*. 2000;25:1109-1117.

Côté P, Cassidy JD, Carroll L. The Saskatchewan Health and Back Pain Survey. The prevalence of neck pain and related disability in Saskatchewan adults. *Spine (Phila Pa 1976)*. 1998;23:1689-1698.

Côté P, Cassidy JD, Carroll LJ, Kristman V. The annual incidence and course of neck pain in the general population: a population-based cohort study. *Pain*. 2004;112:267-273. https://doi.org/10.1016/j.pain.2004.09.004

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Holmstrom EB, Lindell J, Moritz U. Low back and neck/shoulder pain in construction workers: occupational workload and psychosocial risk factors. Part 2: Relationship to neck and shoulder pain. *Spine (Phila Pa 1976)*. 1992;17:672-677.

Hoving JL, Gross AR, Gasner D, et al. A critical appraisal of review articles on the effectiveness of conservative treatment for neck pain. *Spine (Phila Pa 1976)*. 2001;26:196-205.

Hoy DG, Protani M, De R, Buchbinder R. The epidemiology of neck pain. *Best Pract Res Clin Rheumatol*. 2010;24:783-792. https://doi.org/10.1016/j.berh.2011.01.019

Jacobsson L, Lindgarde F, Manthorpe R. The commonest rheumatic complaints of over six weeks' duration in a twelve-month period in a defined Swedish population. Prevalences and relationships. *Scand J Rheumatol*. 1989;18:353-360.

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Murray CJ, Vos T, Lozano R, et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012;380:2197-2223. https://doi.org/10.1016/S0140-6736(12)61689-4

Murray CJ, Barber RM, Foreman KJ, et al. Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990-2013: quantifying the epidemiological transition. *Lancet*. 2015;386:2145-2191. https://doi.org/10.1016/S0140-6736(15)61340-X

Nygren A, Berglund A, von Koch M. Neck-and-shoulder pain, an increasing problem. Strategies for using insurance material to follow trends. *Scand J Rehabil Med Suppl*. 1995;32:107-112.

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APPENDIX F

PROCEDURES FOR ASSIGNING LEVELS OF EVIDENCE

- Levels of evidence were assigned based on the study design, the quality of the study, and the quality of the primary sources (if the study is a systematic review or meta-analysis), using the Levels of Evidence table (**TABLE 1**).
- Quality of systematic reviews (or review of reviews) was assessed using a critical appraisal tool (AMSTAR, or the closely related SIGN II), and the review was assigned 1 of 4 overall quality ratings based on the critical appraisal results:
  - High, AMSTAR or SIGN score of 8 or better
  - Acceptable, AMSTAR or SIGN score of 6 or 7
  - Low, AMSTAR or SIGN score of 4 or 5
  - Very low, AMSTAR or SIGN score of less than 4 (Reviews scored very low were not used in this revision)
- Quality of primary sources was calibrated to a 4-level scale. If the quality of the primary sources were not available in the systematic review, or if the quality appraisal tool was unique or not familiar to the guideline authors, or if the quality ratings differed between reviews, the primary source was graded by the guideline authors using the GRADE system and methods described in the text. Sources receiving a rating of very low were not used in this guideline.
  - GRADE system[77]
- Study starts with a "high" rating
- Downgrade at least 1 level for violations of
  - Risk of bias
  - Precision
  - Directness
  - publication bias
- Results in 4 levels of quality of evidence
  - High
  - moderate
  - Low
  - very low
  - PEDro system (http://abiebr.com/set/1-introduction-and-methodology/determining-levels-evidence)
    - High, score of 9 or better
    - moderate, score of 6 to 8
    - Low, score of 4 or 5
    - Very low, score of 3 or lower

APPENDIX G

AMSTAR SCORES*

Study	1	2	3	4	5	6	7	8	9	10	11	Quality†
Included articles												
Bertozzi et al[10]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	High
Boyles et al[17]	Y	Y	Y	N	Y	Y	Y	Y	NA	N	N	Acceptable
Brønfort et al[20]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N	High
Bronfort et al[19]	Y	N	Y	N	N	N	Y	Y	NA	N	N	Low
Brown et al[21]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	Y	High
Cagnie et al[22]	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	High
Chaibi and Russell[28]	Y	N	N	N	N	Y	Y	Y	NA	NA	N	Low
Clar et al[30]	Y	Y	Y	N	N	Y	Y	Y	NA	N	N	Acceptable
Conlin et al[33]	Y	N	Y	N	N	Y	Y	Y	Y	N	N	Acceptable
Coronado et al[36]	Y	N	N	N	N	Y	Y	Y	NA	N	N	Low
Cross et al[41]	Y	Y	Y	N	N	Y	Y	Y	NA	N	N	Acceptable
Damgaard et al[44]	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	High
Drescher et al[49]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Fernández-de-las-Peñas et al[59]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Ferreira et al[60]	Y	Y	Y	Y	N	N	N	NA	NA	N	N	Low
Furlan et al[64]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Graham et al[68]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Gross et al[75]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Gross et al[73]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	High
Gross et al[70]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Gross et al[74]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High
Gross et al[76]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Gross et al[71]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	High
Gross et al[72]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	High
Haines et al[79]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	High
Holly et al[87]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Horn et al[89]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Huisman et al[92]	Y	N	Y	N	Y	Y	Y	Y	NA	N	N	Acceptable
Hurwitz et al[93]	Y	N	N	Y	N	Y	Y	Y	NA	N	N	Low
Kabisch[103]	Y	N	Y	N	N	Y	Y	Y	Y	N	N	Acceptable
Kadhim-Saleh et al[104]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	High
Kay et al[108]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	High
Kay et al[109]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	High
Kelly et al[112]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Kietrys et al[113]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	High
Kroeling et al[118]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	High
Leaver et al[119]	Y	Y	Y	N	N	Y	Y	Y	Y	N	N	Acceptable
Lee et al[120]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N	High
Liu et al[124]	Y	Y	Y	Y	N	Y	y	Y	Y	Y	N	High
Macaulay et al[125]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low

Table continues on page A79.

APPENDIX G

AMSTAR SCORES* (CONTINUED)

Study	1	2	3	4	5	6	7	8	9	10	11	Quality†
MacDermid et al[127]	Y	Y	Y	N	N	Y	Y	Y	NA	N	N	Acceptable
McCaskey et al[134]	Y	N	Y	Y	N	Y	Y	Y	NA	Y	Y	High
McLean et al[136]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Meeus et al[138]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	High
Miller et al[140]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Monticone et al[141]	Y	Y	Y	Y	N	N	Y	Y	Y	N	N	Acceptable
Nunes and Moita[152]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	High
Ong and Claydon[156]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High
O'Riordan et al[157]	Y	N	Y	N	N	Y	Y	N	NA	N	N	Low
Parreira et al[161]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	High
Racicki et al[163]	Y	N	Y	N	Y	Y	Y	N	NA	N	N	Low
Reid and Rivett[167]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Rhee et al[169]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Rubio-Ochoa et al[176]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Salt et al[178]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Schellingerhout et al[180]	Y	Y	Y	N	N	Y	Y	Y	NA	N	N	Acceptable
Schellingerhout et al[181]	Y	Y	Y	N	N	Y	Y	Y	NA	N	N	Moderate
Scholten-Peeters et al[182]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	High
Shaw et al[186]	Y	Y	Y	N	N	Y	Y	Y	NA	N	N	Acceptable
Snodgrass et al[189]	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	High
Southerst et al[190]	Y	Y	Y	N	N	Y	Y	N	NA	N	N	Low
Stanton et al[192]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High
Sutton et al[200]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Takasaki and May[202]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	High
Teasell et al[203]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Teasell et al[204]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Teasell et al[205]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Thoomes et al[208]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Vanti et al[216]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	High
van Trijffel et al[217]	Y	Y	N	Y	N	Y	Y	Y	NA	N	N	Acceptable
Varatharajan et al[219]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Varatharajan et al[220]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	High
Verhagen et al[223]	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	High
Verhagen et al[221]	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	High
Vernon et al[226]	Y	N	Y	N	N	Y	Y	Y	NA	N	N	Low
Vincent et al[229]	Y	N	Nr	N	N	Y	Y	Y	NA	N	N	Low
Walser et al[231]	Y	N	Y	Y	N	Y	Y	Y	Y	N	N	Acceptable
Williams et al[238]	Y	N	Y	N	N	N	Y	Y	NA	N	Y	Low
Wong et al[240]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N	High
Young et al[244]	Y	N	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Yu et al[245]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Zhu et al[246]	Y	N	Y	Y	N	Y	Y	Y	Y	N	Y	High

Table continues on page A80.

APPENDIX G

AMSTAR SCORES* (CONTINUED)

Study	1	2	3	4	5	6	7	8	9	10	11	Quality†
Zronek et al[247]	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	High
Excluded articles												
Ainpradub et al	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	High
Ambrosio et al	Y	N	Y	Y	N	Y	Y	Y	Y	Y	N	High
Bervoets et al	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	High
Clay et al	Y	Y	Y	Y	N	y	Y	Y	Y	Y	Y	High
Ernst et al	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Acceptable
Ernst et al	Y	N	Y	N	N	Y	N	N	N	N	N	Very low
Fernández-de-las-Peñas et al	Y	N	Y	N	N	Y	Y	N	NA	N	N	Low
France et al	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	High
Franke et al	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	High
Furlan et al	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
Garcia et al	Y	N	Y	Y	N	Y	N	N	NA	N	Y	Low
Hug et al	Y	N	Y	Y	Y	Y	N	N	N	N	N	Low
Jang et al	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	High
Kim et al	Y	Y	Y	Y	N	Y	Y	N	NA	N	Y	Acceptable
Kroeling et al	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	High
Lee et al	N	N	N	Y	N	N	Y	Y	N	N	N	Very low
Lu et al	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	High
MacPherson et al	Y	N	Y	N	N	Y	N	N	Y	N	N	Low
Mao et al	N	N	N	N	N	N	N	N	N	N	N	Very low
Misailidou et al	Y	N	Y	N	N	N	N	N	NA	N	N	Very low
Moon et al	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	High
Murphy et al	Y	Y	Y	N	N	N	N	N	NA	N	N	Very low
Rodine et al	Y	N	N	N	N	Y	N	NA	NA	N	N	Very low
Ruston et al	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	High
Schroeder et al	N	N	N	N	N	Y	N	N	N	N	Y	Very low
Sihawong et al	Y	Y	N	N	Y	Y	Y	Y	NA	N	N	Acceptable
Trinh et al	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Vernon et al	Y	N	N	N	N	Y	N	N	NA	N	N	Very low
Wanderley et al	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N	Acceptable
Yuan et al	Y	N	Y	N	N	Y	Y	Y	Y	Y	N	Acceptable
Wei et al	Y	Y	Y	Y	N	Y	Y	Y	NA	N	Y	High
Wiangkham et al	Y	Y	Y	Y	N	y	y	Y	Y	N	N	High
Zarghooni et al	Y	N	N	N	N	N	N	N	NA	N	N	Very low

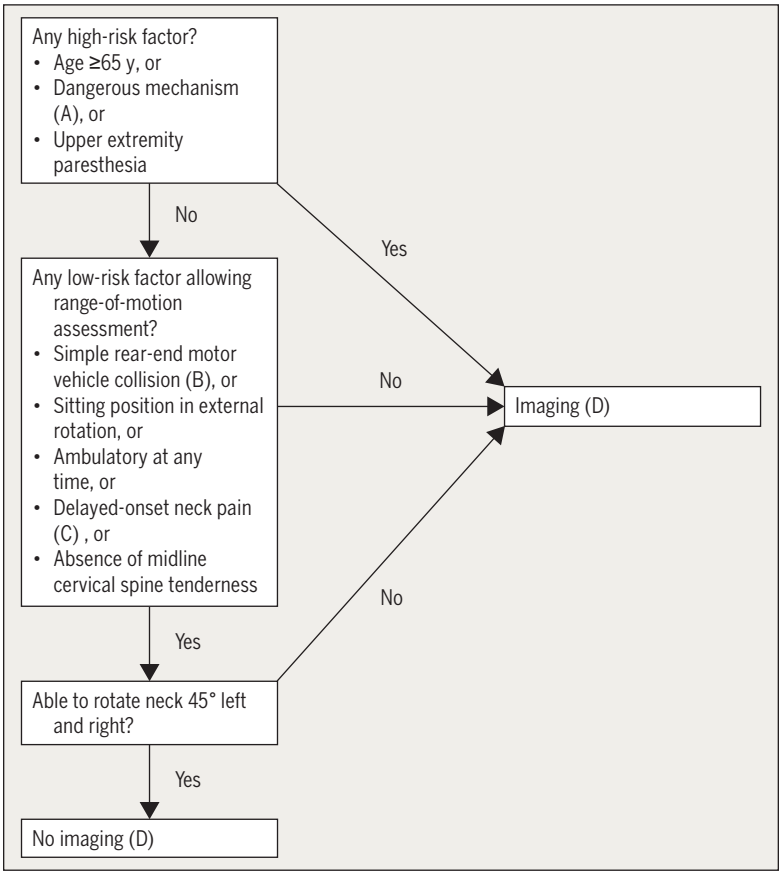
Abbreviations: N, no; NA, not applicable; Y, yes.

**Yes/no. Items: 1, the study addresses a clearly defined research question; 2, at least two people should select studies and extract data; 3, a comprehensive literature search is carried out; 4, the authors clearly state if or how they limited their review by publication type; 5, the included and excluded studies are listed; 6, the characteristics of the included studies are provided; 7, the scientific quality of the included studies is assessed and documented; 8, yhe scientific quality of the included studies was assessed appropriately; 9, appropriate methods are used to combine the individual study findings; 10, the likelihood of publication bias is assessed; 11, conflicts of interest are declared.*

†Quality rating: 8 or higher, high; 6 or 7, acceptable; 5 or 4, low; 3 or below, very low.

APPENDIX H

IMAGING CONDITIONS FOR SUSPECTED SPINE TRAUMA FROM THE AMERICAN COLLEGE OF RADIOLOGY APPROPRIATENESS CRITERIA



(A) Dangerous Mechanism = Fall from ≥3 ft/5 stairs, axial load, MVC at >60 mph or rollover or ejection, motorized recreational vehicle accident, bicycle collision.
(B) Simple Rear-End MVC excludes pushed into on-coming traffic, hit by bus or large truck, rollover, hit by high speed vehicle
(C) Delayed onset neck pain = No immediate onset after trauma
(D) At time of derivation, radiograph was chosen imaging. Now, American College of Radiology recommends computed tomography, if positive on criteria.

Reproduced from Elliott JM, Dayanidhi S, Hazle C, et al. Advancements in imaging technology: do they (or will they) equate to advancements in our knowledge of recovery in whiplash? *J Orthop Sports Phys Ther*. 2016;46:862-873. https://doi.org/10.2519/jospt.2016.6735

Sensitivity, Specificity, and Negative Predictive Values of the Canadian Cervical Spine Rules and the NEXUS Low-Risk Criteria for 162 Cases of "Clinically Important" Injury in 7438 Patients[32,85,160,196,197]

APPENDIX H

	Canadian Cervical Spine Rule		NEXUS Low-Risk Criteria	
Decision Rule	Yes	No	Yes	No
Positive	161	3995	147	4599
Negative	1	3281	15	2677
Sensitivity, %*	99.4 (96, 100)		90.7 (85, 94)	
Specificity, %*	45.1 (44, 46)		36.8 (36, 88)	
Negative predictive value, %	100.0		99.4	

Abbreivation: NEXUS, National Emergency X-Radiography Utilization Study.
**Values in parentheses are 95% confidence interval.*

Interests that were disclosed include financial interests and secondary interests (eg, personal, academic, political).

Author	Competing Interests	Disclosures
Peter Blanpied	None known	None known
Anita Gross	ICON - International Collaboration on Neck - I am a lead and reviewer within this body of work. COG - Cervical Overview Group contributing to a series of systematic reviews for Neck Pain in Cochrane Collaboration - I am the coordinator and reviewer on primary systematic reviews on this topic.	None known
James Elliott	JOSPT - Board of Directors - Advisory Member JOSPT - International Editorial Board Spine - Advisory Board Member Musculoskeletal Science and Practice (formerly Manual Therapy) - International Advisory Board NIHR01HD079076 - NICHD/NCMRR	Partial ownership/investment interest in Pain ID, LLC (a medical-consulting start-up).
Laurie Devaney	None known	None known
Derek Clewley	None known	None known
David Walton	ICON - International Consensus on Neck Pain, Prognosis section lead reviewer Journal of Musculoskeletal Science and Practice (formerly Manual Therapy) - Associate Editor JOSPT - International Editor International Association for the Study of Pain - Education Special Interest Group Secretary	Owner/Operator - David Walton Rehabilitation Education, Consulting and Research
Cheryl Sparks	None known	None known
Eric Robertson	None known	None known

Peter Blanpied coordinated the Neck Pain CPG Revision, secured limited funding, coordinated and collated searches and search results, organized retrieval of papers, screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

Anita Gross coordinated and collated searches and search results, organized retrieval of papers, screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

James Elliott screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

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Laurie Devaney screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

Derek Clewley screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

David Walton screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

Cheryl Sparks screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.

Eric Robertson screened and appraised papers, extracted data from papers, analyzed and interpreted data, provided a methodological, clinical, and end-user perspective, and wrote the revision.