Neck Pain: A Clinical Practice Guideline linked to the International Classification of Functioning, Disability, and Health from the Orthopaedic Section of the American Physical Therapy Association.


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**Recommendations**

**Pathoanatomical Features:** 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 impairments in muscle, connective, and nerve tissues associated with the identified pathological tissues when a patient presents with neck pain (recommendation based on theoretical/foundational evidence).

**Risk Factors:** Clinicians should consider age > 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).

**Diagnosis/Classification:** Neck pain, without symptoms or signs of serious medical or psychological conditions, associated with 1) motion limitations in the cervical and upper thoracic regions, 2) headaches, and 3) referred or radiating pain into an upper extremity are useful clinical findings for classifying a patient with neck pain into one of the following International Statistical Classification of Diseases and Related Health Problems (ICD) categories: cervicalgia, pain in thoracic spine, headaches, cervicocranial syndrome, sprain and strain of cervical spine, spondylosis with radiculopathy, and cervical disc disorder with radiculopathy; and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category of neck pain with the following impairments of body function:

- Neck pain with mobility impairments (b7101 Mobility of several joints)
- Neck pain with headaches (28010 Pain in head and neck)
- Neck pain with movement coordination impairments (b7601 Control of complex voluntary movements)
- Neck pain with radiating pain (b2804 Radiating pain in a segment or region)

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of **neck pain with mobility impairments** and the associated ICD category of **cervicalgia, or pain in thoracic spine** (recommendation based on moderate evidence).

- Cervical active range of motion
- Cervical and thoracic segmental mobility

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of **neck pain with headaches** and the associated ICD category of **headaches, or cervicocranial syndrome** (recommendation based on moderate evidence).

- Cervical active range of motion
- Cervical segmental mobility
- Cranial cervical flexion test

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of **neck pain with movement coordination impairments** and the associated ICD category of **sprain and strain of cervical spine** (recommendation based on moderate evidence).

- Cranial cervical flexion test
- Deep neck flexor endurance test
The following physical examination measures may be useful in classifying a patient in the ICF
impairment-based category of **neck pain with radiating pain** and the associated ICD category
of **spondylosis with radiculopathy or cervical disc disorder with radiculopathy**
(recommendation based on moderate evidence).

- Upper limb tension test
- Spurling’s test
- Distraction test

**Differential Diagnosis:** Clinicians should consider diagnostic classifications associated with
serious pathological conditions or psychosocial factors when the patient’s reported activity
limitations or impairments of body function and structure are not consistent with those presented
in the diagnosis/classification section of this guideline, or, when the patient’s symptoms are not
resolving with interventions aimed at normalization of the patient’s impairments of body
function (recommendation based on moderate evidence).

**Examination – Outcome Measures:** Clinicians should use validated self-report questionnaires,
such as the Neck Disability Index and the Patient-Specific Functional Scale 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 patient’s status throughout the course of
treatment (recommendation based on strong evidence).

**Examination – Activity Limitation and Participation Restriction Measures:** Clinicians
should utilize easily reproducible activity limitation and participation restriction measures
associated with their patient’s neck pain to assess the changes in the patient’s level of function
over the episode of care (recommendation based on expert opinion).

**Interventions – Cervical Mobilization/Manipulation:** Clinicians should consider utilizing
cervical manipulative procedures, thrust and non-thrust, to reduce neck pain and headache.
Combining cervical manipulation and exercise is more effective for reducing neck pain, headache,
and disability than manipulation alone (recommendation based on strong evidence).

**Interventions – Thoracic Mobilization/Manipulation:** Thoracic spine thrust manipulation can be
used for patients with primary complaints of neck pain. Thoracic spine thrust manipulation can
also be used for reducing pain and disability in patients with neck and arm pain (recommendation
based on weak evidence).

**Interventions – Stretching Exercises:** There is minimal evidence to suggest that flexibility
exercises improve neck symptoms. Examination and targeted flexibility exercises for the following
muscles are suggested: anterior/medial/posterior scalenes, upper trapezius, levator scapulae,
pectoralis minor and pectoralis major (recommendation based on weak evidence).

**Interventions – Coordination, Strengthening and Endurance Exercises:** Coordination,
strengthening, and endurance exercises should be used to reduce neck pain and headache
(recommendation based on strong evidence).

**Interventions – Centralization Procedures and Exercises:** Specific repeated movements or
procedures to promote centralization are not more beneficial in reducing disability when
compared to other forms of interventions (recommendation based on weak evidence).
Interventions – Upper Quarter Mobilization Procedures and Nerve Mobility Exercises: Clinicians should consider the use of neural mobilization procedures for the reduction of pain and disability in patients with neck and arm pain (recommendation based on moderate evidence).

Interventions – Traction: Mechanical intermittent traction, combined with other interventions such as manual therapy and strengthening exercises, can be used for the reducing pain and disability in patients with neck and neck-related arm pain (recommendation based on moderate evidence).

Interventions – Patient Education and Counseling: In patients with whiplash-associated disorder, recovery is improved by educating the patient that early return to normal, non-provocative pre-accident activities is important and by providing reassurance to the patient that good prognosis and full recovery commonly occurs in many (recommendation based on strong evidence).

*These recommendations and clinical practice guidelines are based on the scientific literature published prior to June 2007.*
Introduction

AIM OF THE GUIDELINE

The Orthopaedic Section of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based practice guidelines for orthopaedic physical therapy management of patients with musculoskeletal impairments described in the World Health Organization’s International Classification of Functioning, Disability, and Health (ICF).167

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 to policy makers, using internationally accepted terminology, of the practice of orthopaedic physical therapists
- Provide information for 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

This guideline is 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 in light of the clinical data presented by the patient and the diagnostic and treatment options available. However, we suggest that significant departures from accepted guidelines should be documented in the patient’s medical records at the time the relevant clinical decision is made.
Methods

Content experts were appointed by the Orthopaedic Section, APTA as developers and authors of clinical practice guidelines for musculoskeletal conditions of the cervical region that are commonly treated by physical therapists. These content experts were given the task to identify impairments of body function and structure, activity limitations, and participation restrictions, described using ICF terminology, that could 1) categorize patients into mutually exclusive impairment patterns upon which to base intervention strategies, and 2) serve as measures of changes in function over the course of an episode of care. The second task given to the content experts was to describe interventions and supporting evidence for specific subsets of patients based upon the previously chosen patient categories. It was also acknowledged by the Orthopaedic Section, APTA that a systematic search and review of the evidence related to diagnostic categories based on International Statistical Classification of Diseases and Health Related Problems (ICD) terminology would not be useful for these ICF-based clinical practice guidelines as most of the evidence associated with changes in levels of impairment or function in homogeneous populations is not readily searchable using the current terminology. This approach, although less systematic, enabled the content experts to search the scientific literature related to classification, outcome measures, and intervention strategies for musculoskeletal conditions commonly treated by physical therapists.

This guideline was issued in 2008 based upon publications in the scientific literature prior to June 2007. This guideline will be considered for review in 2012, 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

Individual clinical research articles will be graded according to criteria described by the Center for Evidence-Based Medicine, Oxford, United Kingdom. (Table 1)

<table>
<thead>
<tr>
<th></th>
<th>Evidence obtained from high quality randomized controlled trials, prospective studies, or diagnostic studies</th>
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<tr>
<td>II</td>
<td>Evidence obtained from lesser quality randomized controlled trials, prospective studies or diagnostic studies (e.g., improper randomization, no blinding, &gt; 80 % follow-up)</td>
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<tr>
<td>III</td>
<td>Case controlled studies or retrospective studies</td>
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<td>IV</td>
<td>Case series</td>
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<td>V</td>
<td>Expert opinion</td>
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Table 1. Levels of Evidence

The overall strength of the evidence supporting recommendations made in this guideline will be graded according to guidelines described by Sackett as modified by MacDermid and adopted by the coordinator and reviewers of this project. In this modified system, the typical A, B, C and D grades of evidence have been modified to include the role of consensus expert opinion and basic science research to demonstrate biological or biomechanical plausibility. (Table 2)
Grades of Recommendation | Strength of Evidence
---|---
A | Recommendation based on Strong Evidence. A preponderance of Level I and/or Level II studies support the recommendation. This must include at least 1 Level I study.
B | Recommendation based on Moderate Evidence. A single high quality randomized control trial or a preponderance of Level II studies support the recommendation.
C | Recommendation based on Weak Evidence. A single Level II study or a preponderance of Level III and IV studies including statements of consensus by content experts support the recommendation.
D | Recommendation based on Conflicting Evidence. Higher quality studies conducted on this topic disagree with respect to their conclusions. The recommendation is based on these conflicting studies.
E | Recommendation based on Theoretical/Foundational Evidence. A preponderance of evidence from animal or cadaver studies, from conceptual models/principles or from basic sciences/bench research support this conclusion.

Table 2. Grades of Evidence

The Orthopaedic Section, APTA also selected consultants from the following areas to serve as reviewers of the early drafts of this clinical practice guideline: claims review, coding, epidemiology, medical practice guidelines, orthopaedic physical therapy residency education, physical therapy academic education, and sports physical therapy residency education. Comments from these reviewers were utilized by the project coordinators to edit this clinical practice guideline prior to submitting it for publication to the Journal of Orthopaedic & Sports Physical Therapy. In addition, several physical therapists practicing in orthopaedic and sports physical therapy settings were sent initial drafts this clinical practice guideline along with feedback forms to determine its usefulness, validity and impact. All returned feedback forms from these practicing clinicians described this clinical practice guideline as 1) “extremely useful,” 2) an “accurate representation of the peer-reviewed literature,” and 3) a guideline that will have a “substantial positive impact on orthopaedic physical therapy patient care.”
CLASSIFICATION

The primary ICD-10 codes and conditions associated with neck pain are: **M54.2 Cervicalgia**, **M54.6 Pain in thoracic spine**, **R51 Headache**, **M53.0 Cervicocranial syndrome**, **S13.4 Sprain and strain of cervical spine**, **M47.2 Spondylosis with radiculopathy**, and **M50.1 Cervical disc disorder with radiculopathy**. The corresponding ICD-9 CM codes and conditions, which are used in the USA, are **723.1 Cervicalgia**, **724.1 Pain in thoracic spine**, **784.0 Headache**, **723.2 Cervicocranial syndrome**, **847.0 Sprains and strains of the neck**, and **723.4 Brachial neuritis or radiculitis NOS** (Cervical radiculitis / Radicular syndrome of upper limbs).

The primary ICF body function codes associated with the above noted ICD-10 conditions are the sensory functions related to pain, and the movement functions related to joint motion and control of voluntary movements. These body function codes are **b7101 Mobility of several joints**, **b28010 Pain in head and neck**, **b7601 Control of complex voluntary movements**, and **b2803 Radiating pain in a dermatome**.

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

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

The ICD-10 and primary and secondary ICF codes associated with neck pain are provided in Table 3.
**Table 3 (p 9-13)**

**ICD-10 and ICF codes associated with Neck Pain**

*International Statistical Classification of Diseases and Related Health Problems*

**Neck Pain with Mobility Impairments**

<table>
<thead>
<tr>
<th>ICD-10 codes:</th>
<th>M54.2</th>
<th>Cervicalgia</th>
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<tbody>
<tr>
<td></td>
<td>M54.6</td>
<td>Pain in thoracic spine</td>
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**Neck Pain with Headaches**

<table>
<thead>
<tr>
<th>ICD-10 codes:</th>
<th>R51</th>
<th>Headache</th>
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<tr>
<td></td>
<td>M53.0</td>
<td>Cervicocranial syndrome</td>
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**Neck Pain with Movement Coordination Impairments**

| ICD-10 code: | S13.4 | Sprain and strain of cervical spine |

**Neck Pain with Radiating Pain**

<table>
<thead>
<tr>
<th>ICD-10 codes:</th>
<th>M47.2</th>
<th>Spondylosis with radiculopathy</th>
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<tr>
<td></td>
<td>M50.1</td>
<td>Cervical disc disorder with radiculopathy</td>
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</table>
International Classification of Functioning, Disability and Health

**Neck Pain with Mobility Impairments**

Primary ICF Body Functions code: b7101 Mobility of several joints

Primary ICF Body Structure code: s76000 Cervical vertebral column

Primary ICF Activities and Participation codes: d4108 Changing a basic body position, specified as moving the head and neck while looking to the left or to the right

**Neck Pain with Headaches**

Primary ICF Body Functions code: 28010 Pain in head and neck

Primary ICF Body Structure codes: s7103 Joints of head and neck region

s7104 Muscles of head and neck region

Primary ICF Activities and Participation codes: d4158 Maintaining a body position, specified as maintaining the head in a flexed position, such as when reading a book; or, maintaining the head in an extended position, such as when looking up at a video monitor

**Neck Pain with Movement Coordination Impairments**

Primary ICF Body Functions code: b7601 Control of complex voluntary movements

Primary ICF Body Structure code: s7105 Ligaments and fasciae of head and neck region

Primary ICF Activities and Participation codes: d4158 Maintaining a body position, specified as maintaining alignment of the head, neck and thorax such that the cervical vertebral segments function in a neutral, or mid-range, position

**Neck Pain with Radiating Pain**

Primary ICF Body Functions code: b2804 Radiating pain in a segment or region

Primary ICF Body Structure code: s1201 Spinal nerves

Primary ICF Activities and Participation codes: d4452 Reaching
Neck Pain with Mobility Impairments

Secondary ICF Body Functions codes:
- b28010 Pain in head and neck
- b28013 Pain in back
- b28014 Pain in upper limb
- b7101 Mobility of several joints
- b7151 Stability of several joints
- b7305 Power of muscles of the trunk
- b7350 Tone of isolated muscles and muscle groups
- b7400 Endurance of isolated muscles
- b7601 Control of complex voluntary movements

Secondary ICF Body Structure codes:
- s12001 Thoracic spinal cord
- s130 Structure of meninges
- s7103 Joints of head and neck region
- s7104 Muscles of head and neck region
- s7105 Ligaments and fasciae of head and neck region
- s76000 Cervical vertebral column
- s76001 Thoracic vertebral column
- s7601 Muscles of trunk
- s7602 Ligaments and fasciae of trunk

Secondary ICF Activities and Participation codes:
- d2302 Completing the daily routine
- d2400 Handling responsibilities
- d4100 Lying down
- d4105 Bending
- d4150 Maintaining a lying position
- d4750 Driving human-powered transportation
- d4750 Driving motorized vehicles
- d4750 Driving animal-powered transportation
- d4554 Swimming
- d6409 Doing housework, unspecified
- d9109 Community life, unspecified
- d9209 Recreation and leisure, unspecified

Neck Pain with Headaches

Secondary ICF Body Functions codes:
- b2803 Radiating pain in a dermatome
- b2804 Radiating pain in a segment or region
- b7101 Mobility of several joints
- b7151 Stability of several joints
- b7305 Power of muscles of the trunk
- b7350 Tone of isolated muscles and muscle groups
- b7400 Endurance of isolated muscles
- b7601 Control of complex voluntary movements
- b2359 Vestibular functions, unspecified
- b2409 Sensations associated with hearing and vestibular function, unspecified
Secondary ICF Body Structure codes:
- s12000 Cervical spinal cord
- s12001 Thoracic spinal cord
- s1201 Spinal nerves
- s130 Structure of meninges
- s7105 Ligaments and fasciae of head and neck region
- s76001 Thoracic vertebral column
- s76000 Cervical vertebral column
- s7601 Muscles of trunk

Secondary ICF Activities and Participation codes:
- d163 Thinking
- d166 Reading
- d2302 Completing the daily routine
- d2400 Handling responsibilities
- d4150 Maintaining a lying position
- d4153 Maintaining a sitting position
- d4154 Maintaining a standing position
- d4750 Driving human-powered transportation
- d4750 Driving motorized vehicles
- d4750 Driving animal-powered transportation
- d6409 Doing housework, unspecified
- d9109 Community life, unspecified
- d9209 Recreation and leisure, unspecified

Neck Pain with Movement Coordination Impairments

Secondary ICF Body Functions codes:
- 28010 Pain in head and neck
- b28013 Pain in back
- b28014 Pain in upper limb
- b7151 Stability of several joints
- b7305 Power of muscles of the trunk
- b7400 Endurance of isolated muscles
- b7602 Coordination of voluntary movements

Secondary ICF Body Structure codes:
- s7103 Joints of head and neck region
- s7104 Muscles of head and neck region
- s76000 Cervical vertebral column
- s76001 Thoracic vertebral column
- s7601 Muscles of trunk
- s7602 Ligaments and fasciae of trunk

Secondary ICF Activities and Participation codes:
- d2302 Completing the daily routine
- d2400 Handling responsibilities
- d4105 Bending
- d4153 Maintaining a sitting position
- d4154 Maintaining a standing position
- d4750 Driving human-powered transportation
- d4750 Driving motorized vehicles
Neck Pain with Radiating Pain

Secondary ICF Body Functions code:  
b28013  Pain in back  
b28014  Pain in upper limb  
b2803  Radiating pain in a dermatome  
b7101  Mobility of several joints  
b7151  Stability of several joints  
b7305  Power of muscles of the trunk  
b7350  Tone of muscles of the trunk  
b7400  Endurance of isolated muscles  
b7601  Control of complex voluntary movements

Secondary ICF Body Structure codes:  
s12000  Cervical spinal cord  
s12001  Thoracic spinal cord  
s1201  Spinal nerves  
s130  Structure of meninges  
s7105  Ligaments and fasciae of head and neck region  
s76000  Cervical vertebral column  
s76001  Thoracic vertebral column  
s7601  Muscles of trunk  
s7602  Ligaments and fasciae of trunk

Secondary ICF Activities and Participation codes:  
d2302  Completing the daily routine  
d2400  Handling responsibilities  
d4150  Maintaining a lying position  
d4153  Maintaining a sitting position  
d4150  Maintaining a standing position  
d4300  Lifting  
d4301  Carrying in the hands  
d4302  Carrying in the arms  
d4303  Carrying on shoulders, hip and back  
d4304  Carrying on the head  
d4305  Putting down objects  
d4750  Driving human-powered transportation  
d4750  Driving motorized vehicles  
d4750  Driving animal-powered transportation  
d6409  Doing housework, unspecified  
d9109  Community life, unspecified  
d9209  Recreation and leisure, unspecified
IMPAIRMENT/FUNCTION-BASED DIAGNOSIS

PREVALENCE

Pain and impairment of the neck is common. Estimates of individuals that will have neck pain some time in their lives range from 22% to 70%\textsuperscript{16, 17, 38, 39, 48, 102, 115}. It has been suggested that the incidence of neck pain is increasing\textsuperscript{112, 170}. At any given time, 10% to 20% of the population reports neck problems\textsuperscript{16, 40, 70, 154}, with 54% of individuals having experienced neck pain within the last 6 months\textsuperscript{38}. Prevalence of neck pain increases with age and is most common in women around the fifth decade of life\textsuperscript{3, 16, 42, 103, 150}. Although the natural history of neck pain appears to be favorable\textsuperscript{44, 80}, rates of recurrence and chronicity are high\textsuperscript{12, 73}. One study reported that 30% of patients with neck pain will develop chronic symptoms, with neck pain of greater than 6 months duration affecting 14% of all individuals who experience an episode of neck pain\textsuperscript{16}. Additionally, a recent survey demonstrated that 37% of individuals who experience neck pain will continue to report persistent problems for at least 12 months\textsuperscript{40}. Five percent of the adult population with neck pain will be disabled by it, representing a serious health concern\textsuperscript{16, 77}. In a survey of workers with injuries to the neck and upper extremity, Pransky et al\textsuperscript{121} 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, to include costs of treatment, lost wages, and compensation expenditures\textsuperscript{13, 124}. Neck pain is second only to low back pain in annual workers’ compensation costs in the United States\textsuperscript{170}. In Sweden, neck and shoulder problems account for 18% of all disability payments\textsuperscript{112}. Jette et al\textsuperscript{79} reported that patients with neck pain make up approximately 25% of patients receiving outpatient physical therapy and patients with neck pain frequently are treated without surgery by primary care and physical therapy providers\textsuperscript{14, 44, 80}.

PATHOANATOMICAL FEATURES

A variety of causes of neck pain have been described and include osteoarthritis, discogenic disorders, trauma, tumors, infection, myofascial pain syndrome, torticollis, and whiplash\textsuperscript{107}. Unfortunately, clearly defined diagnostic criteria have not been established for many of these entities. Similar to low back pain, a pathoanatomical cause is not identifiable in the majority of patients who present with complaints of neck pain and neck related symptoms of the upper quarter\textsuperscript{12}. Therefore, once serious medical pathology (such as cervical fracture or myelopathy) has been ruled out, patients with neck pain are often classified as having either a nerve root compromise or a “mechanical neck disorder.”

In some conditions, particularly those that are degenerative in nature or involve abnormalities of the vertebral motion segment, abnormal findings are not always associated with clinical signs and symptoms. Fourteento 18% of people without
neck pain demonstrate a wide range of abnormalities with imaging studies, including disc protrusion, extrusion, and impingement of the thecal sac on the nerve root and spinal cord.\textsuperscript{9} However, degenerative changes are still suggested to be a possible cause of mechanical neck pain in some cases,\textsuperscript{96, 116, 117} despite the fact that these changes are present in asymptomatic individuals, are non-specific, and are highly prevalent in the elderly.\textsuperscript{155} Disorders such as cervical radiculopathy and cervical compressive myelopathy are most frequently caused by space-occupying lesions (osteophytosis or herniated cervical disc). These may be secondary to degenerative processes and can give rise to neck and/or upper quarter pain as well as neurologic signs and symptoms.\textsuperscript{122} While cervical disc herniation and spondylosis are the most commonly linked to cervical radiculopathy and myelopathy,\textsuperscript{7,122} the bony and ligamentous tissues affected by these conditions are themselves pain generators and are capable of giving rise to some of the referred symptoms observed in patients with these disorders.\textsuperscript{10, 36}

Because most patients with neck pain usually lack an identifiable pathoanatomic cause for their problem, the majority are classified as having mechanical neck disorders.\textsuperscript{74}

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 impairments in muscle, connective, and nerve tissues associated with the identified pathological tissues when a patient presents with neck pain.

**RISK FACTORS**

Bot and colleagues\textsuperscript{15} investigated the clinical course and predictors of recovery for patients with neck and shoulder pain. 443 patients who consulted their primary care physician with neck or shoulder symptoms were followed for 12 months. At 12 months, 32% of patients reported that they were recovered. Predictors of poor pain-related outcome at 12 months included less intense pain at baseline, a history of neck and shoulder symptoms, more worrying, worse perceived health, and a moderate or bad quality of life. The predictors for a poor disability-related response at 12 months included older age, less disability at baseline, longer duration of symptoms, loss of strength in hands, having multiple symptoms, more worrying, moderate or bad quality of life, and less vitality.

Hill and colleagues\textsuperscript{68} investigated the course of neck pain in an adult population over a 12 month period. Significant baseline characteristics, which predicted persistent neck pain were age (45 – 59 years), being off work at the time of the baseline survey (odds ratio [OR] = 1.6), comorbid low back pain (OR = 1.6), and bicycling as a regular activity (OR = 2.4).

In a prospective cohort study, Hoving et al\textsuperscript{72} examined the predictors of outcome in a patient population with neck pain. A total of 183 patients participated in the
study of which 63% had improved at a 12-month follow-up. In the short term, older age (≥40), concomitant low back pain, and headache were associated with poor outcome. In the long-term, in addition to age and concomitant low back pain, previous trauma, a long duration of neck pain, stable neck pain during the 2 weeks prior to baseline measurement, and previous neck pain predicted poor prognosis.

Clinicians should consider age > 40, coexisting low back pain, a long history of neck pain, bicycling 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.

**CLINICAL COURSE**

Approximately 44% of patients experiencing neck pain will go on to develop chronic symptoms,12 and many will continue to exhibit moderate disability at long-term follow-up.59 A recent systematic review examined the outcomes of non-treatment control groups in clinical trials for the conservative management of chronic mechanical neck pain - not due to whiplash.158 The outcomes of patients receiving a control or placebo intervention were analyzed and effect sizes were calculated. The changes in pain scores over the varying trial periods in these untreated subjects with chronic mechanical neck pain were consistently small and not significant.158

Conversely, there is substantial evidence that favourable outcomes are attained following treatment of patients with cervical radiculopathy.71, 122 For example, Radhakrishnan and colleagues122 reported that nearly 90% of patients with cervical radiculopathy presented with only mild symptoms at a median follow-up of 4.9 years. Honet and Puri71 found that 70% of patients with cervical radiculopathy exhibited good or excellent outcomes after a 2-year follow-up. Outcomes for the patients in the aforementioned studies71, 122 appeared favorable and suggest that 70-90% of this population can experience improvement without surgical intervention. In contrast, the clinical prognosis of patients with following whiplash-associated disorder is less favorable. A survey of 108 patients with a previous history of whiplash requiring care at an emergency department (mean 17 years) found that 55% had residual pain/disability referable to the original accident. Neck pain, radiating pain, and headache were the most common symptoms. 33% of the respondents with residual symptoms suffered from work disability, compared to 6% in the group of patients without residual disorders.22
DIAGNOSIS/CLASSIFICATION

Strategies for the classification of patients with neck pain have been recently proposed by Wang et al., Childs et al., and Fritz and Brennan. The underlying premise is that classifying patients into groups based on clinical characteristics and matching these patient subgroups to management strategies likely to benefit them will improve the outcome of physical therapy interventions. The classification system described by Wang et al. categorized patients into 1 of 4 subgroups based on the area of symptoms and the presumed source of the symptoms. The labels of these 4 categories were neck pain only, headaches, referred arm pain and neck pain, and radicular arm pain and neck pain. Distinct treatment approaches were linked to each of the 4 categories. Wang et al. reported the results of 30 patients treated using this classification strategy as well as 27 patients who were not treated. Statistically and clinically significant reductions in pain and disability were reported for the classification group only. It is difficult to draw conclusions regarding the potential usefulness of the Wang et al. classification system because patients in the control group were not treated, which is not reflective of physical therapy practice. The classification system described by Childs et al. and Fritz and Brennan uses information from the history and physical examination to place patients into 1 of 5 separate treatment subgroups. The labels of these 5 subgroups, which are mobility, centralization, exercise and conditioning, pain control, and headache, intend to capture the primary focus or goal of treatment. Fritz and Brennen, utilizing a prospective, observational study of 274 patients, reported that patients who received interventions matched with their treatment subgroup were associated with better outcomes than patients who received interventions that were not matched with their subgroups. The classification system described in this practice guideline linked to the ICF, parallels the Childs et al. and Fritz and Brennan classification with 2 noteworthy differences. The first difference is that the labels in this clinical practice guideline incorporate the following ICF impairments of body functions terminology: Neck pain with mobility impairments, neck pain with headaches, neck pain with movement coordination impairments, and neck pain with radiating pain. The second difference is that Fritz and Brennan’s “pain control” category, which was linked to mobilization and range of motion exercises following an acute cervical sprain, was collapsed into the “neck pain with movement coordination impairments,” and “neck pain with mobility impairments” categories, where the patient would receive interventions linked to the most relevant impairment(s) exhibited at a given period during the patient’s episode of care.
The ICD diagnosis of *cervicalgia*, or *pain in thoracic spine* and the associated ICF diagnosis of **neck pain with mobility impairment** is made with a reasonable level of certainty when the patient presents with the following clinical findings:29, 55, 74, 153
- Younger individual (age < 50)
- Acute neck pain (duration < 12 weeks)
- Symptoms isolated to the neck
- Restricted cervical range of motion

The ICD diagnosis of *headaches*, or *cervicocranial syndrome* and the associated ICF diagnosis of **neck pain with headaches** is made with a reasonable level of certainty when the patient presents with the following clinical findings:5, 55, 86, 174
- Unilateral headache associated with neck/suboccipital area symptoms that are aggravated by neck movements or positions
- Headache produced or aggravated with provocation of the ipsilateral posterior cervical myofascia and joints
- Restricted cervical range of motion
- Restricted cervical segmental mobility
- Abnormal/substandard performance on the cranial cervical flexion test

The ICD diagnosis of *sprain and strain of cervical spine* and the associated ICF diagnosis of **neck pain with movement coordination impairments** is made with a reasonable level of certainty when the patient presents with the following clinical findings:19, 26, 131, 149, 171, 173
- Longstanding neck pain (duration > 12 weeks)
- Abnormal/substandard performance on the cranial cervical flexion test
- Abnormal/substandard performance on the deep flexor endurance test
- Coordination, strength, and endurance deficits of neck and upper quarter muscles (longus colli, middle trapezius, lower trapezius, serratus anterior)
- Flexibility deficits of upper quarter muscles (anterior/medial/posterior scalenes, upper trapezius, levator scapulae, pectoralis minor, pectoralis major)
- Ergonomic inefficiencies with performing repetitive activities

The ICD diagnosis of *spondylosis with radiculopathy* or *cervical disc disorder with radiculopathy* and the associated ICF diagnosis of **neck pain with radiating pain** is made with a reasonable level of certainty when the patient presents with the following clinical findings:162
- Upper extremity symptoms, usually radicular or referred pain, that are produced or aggravated with Spurling’s maneuver and upper limb tension tests, and reduced with the neck distraction test
- Decreased cervical rotation (<60 degrees) toward the involved side
- Signs of nerve root compression
- Success with reducing upper extremity symptoms with initial examination and intervention procedures
Neck pain, without symptoms or signs of serious medical or psychological conditions, associated with 1) motion limitations in the cervical and upper thoracic regions, 2) headaches, and 3) referred or radiating pain into an upper extremity are useful clinical findings for classifying a patient with neck pain into the following International Statistical Classification of Diseases and Related Health Problems (ICD) categories: cervicalgia, pain in thoracic spine, headaches, cervicocranial syndrome, sprain and strain of cervical spine, spondylosis with radiculopathy, and cervical disc disorder with radiculopathy; and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category of neck pain with the following impairments of body function:

- Neck pain with mobility impairments (b7101 Mobility of several joints)
- Neck pain with headaches (28010 Pain in head and neck)
- Neck pain with movement coordination impairments (b7601 Control of complex voluntary movements)
- Neck pain with radiating pain (b2804 Radiating pain in a segment or region)

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of **neck pain with mobility impairments** and the associated ICD category of *cervicalgia*, or *pain in thoracic spine* (recommendation based on moderate evidence).

- Cervical active range of motion
- Cervical and thoracic segmental mobility

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of **neck pain with headaches** and the associated ICD category of *headaches*, or *cervicocranial syndrome* (recommendation based on moderate evidence).

- Cervical active range of motion
- Cervical segmental mobility
- Cranial cervical flexion test

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of **neck pain with movement coordination impairments** and the associated ICD category of *sprain and strain of cervical spine* (recommendation based on moderate evidence).

- Cranial cervical flexion test
- Deep neck flexor endurance

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of **neck pain with radiating pain** and the associated ICD category of *spondylosis with radiculopathy* or *cervical disc disorder with radiculopathy* (recommendation based on moderate evidence).

- Upper limb tension test
- Spurling’s test
- Distraction test
DIFFERENTIAL DIAGNOSIS

A primary goal of diagnosis is to match the patient’s clinical presentation with the most efficacious treatment approach. A component of this decision is determining whether the patient is, in fact, appropriate for physical therapy management. The vast majority of symptoms of patients with neck pain can be attributed to mechanical factors. However, in a much smaller percentage, the cause of a patient’s neck pain may be something more serious, such as cervical myelopathy, ligamentous instability, fracture, neoplastic conditions, vascular comprise, or systemic disease. Clinicians must be aware of the key signs and symptoms associated with serious pathological neck conditions, continually screen for the presence of these conditions, and initiate referral to the appropriate medical practitioner when a potentially serious medical condition is suspected.

When a patient with neck pain reports a history of trauma, the therapist needs to be particularly alert for the presence of cervical instability, spinal fracture, and the presence of or potential for spinal cord or brain stem injury. Recently, a clinical prediction rule was developed to assist clinicians in determining when to order radiographs in individuals who have experienced trauma.

In addition to medical conditions, clinicians should be aware of psychosocial factors that may be contributing to a patient’s persistent pain and disability, or that may contribute to the transition of an acute condition to a chronic, disabling condition. Recent research has shown that psychosocial factors are an important prognostic indicator of prolonged disability. And, if relevant psychosocial factors are identified, the rehabilitation approach may need to be modified to emphasize active rehabilitation, graded exercise programs, positive reinforcement of functional accomplishments, and/or graduated exposure to specific activities that a patient fears as potentially painful or difficult to perform.

Clinicians should consider diagnostic classifications associated with serious pathological conditions or psychosocial factors when the patient’s reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline, or, when the patient’s symptoms are not resolving with interventions aimed at normalization of the patient’s impairments of body function.
IMAGING STUDIES

Routine investigation of patients with neck pain with radiological imaging (e.g. x-ray, ultrasonography and magnetic resonance imaging (MRI)) has not been justified in view of the infrequency of abnormalities detected, the lack of prognostic value, inaccessibility and the high cost of the procedures. A major limitation is the paucity of specific findings in patients with neck disorder and no definite correlation between the patient’s subjective symptoms and clinical signs. As a result, debate continues as to whether persistent pain is attributable to structural pathology or to other underlying causes.

Recently, Kristjansson compared sagittal plane, rotational, and translational cervical segmental motion and in women with 1) persistent whiplash-associated disorder (WAD) (grades I and II), 2) persistent non-traumatic, insidious onset of neck pain, and 3) normal values of rotational and translational motion. Lateral radiographic analysis revealed significantly increased rotational motion at C3-4 and C4-5 (WAD and insidious groups), significantly excessive translational motion at C3-4 (WAD and insidious groups), and significantly excessive translational motion at C5-6 (WAD group) when compared to normal subjects.

Ultrasonography has been used to accurately measure the size of the cervical multifidus muscle at the C4 level in asymptomatic female subjects. For those with chronic WAD, ultrasonography did not accurately measure the cervical multifidus because the fascial borders of the multifidus were largely indistinguishable, indicating possible pathological conditions.

High resolution proton density-weighted MRI has recently demonstrated abnormal signal intensity (indicative of tissue damage) in both the alar and transverse ligaments in some subjects with chronic WAD. Later follow-up studies indicated a strong relationship between alar ligament damage, head position (turned at time of impact) and disability levels (as measured with the Neck Disability Index.).

Elliott et al have demonstrated that female patients (18-45 years) with persistent WAD (II) show MRI changes in the fat content of the cervical extensor musculature that were not present in subjects with chronic insidious onset neck pain or healthy controls. It is currently unclear whether the patterns of fatty infiltration are the result of local structural trauma causing a general inflammatory response, a specific nerve injury or insult or a generalized disuse phenomenon. Further, as the muscular changes were observed in the chronic state, it is not yet known whether they occur uniformly in all people who have sustained whiplash injury irrespective of recovery or are unique to only those who develop chronic symptoms.

In addition to fatty infiltration, Elliott et al have identified changes in the relative cross-sectional area (rCSA) of the cervical paraspinal musculature in
patients with chronic WAD relative to control subjects with no history of neck pain. Specifically, the WAD group demonstrated a consistent pattern of larger rCSA in the multifidii muscles at each segment (C3-C7). Inference can be drawn that the larger rCSAs recorded in the WAD multifidii muscles are the result of larger amounts of fatty infiltrate.

In summary, imaging studies often fail to identify any structural pathology related to symptoms in patients with neck disorder and in particular, whiplash injury. However, emerging evidence into upper cervical ligamentous disruption, altered segmental motion and muscular degeneration has been demonstrated with x-ray, ultrasonography and MRI studies. It remains unknown if 1) these findings are unique to chronic WAD; 2) whether they relate to patients’ physical signs and symptoms and 3) whether specific physical therapy intervention can alter such degeneration. Such knowledge may offer prognostic information and provide the foundation for interventional based studies.
EXAMINATION – OUTCOME MEASURES

The Neck Disability Index (NDI) is a commonly utilized outcome measure to capture perceived disability in patients with neck pain. The NDI contains 10 items, 7 related to activities of daily living, 2 related to pain, and 1 item related to concentration. Each item is scored from 0-5 and the total score is expressed as a percentage, with higher scores corresponding to greater disability. Riddle and Stratford identified a significant correlation between the NDI and both the physical and mental health components of the SF-36. The authors also identified that the NDI possesses adequate sensitivity as compared to the magnitude of change that occurred for patients reaching their functional goals, work status and if the patient was currently in litigation. Jette and Jette further substantiated the sensitivity to change by calculating the effect sizes for change scores of both the NDI and SF-36.

Two studies with small sample sizes have identified the minimal detectable change, or the amount of change that must be observed before the change can be considered to exceed the measurement error, for the NDI. Westaway identified the minimal detectable change as 5 (10 percentage points) in a group of 31 patients with neck pain. Stratford and colleagues identified the minimal detectable change also to be 5 (10 percentage points) points in a group of 48 patients with neck pain. Cleland and colleagues, however, recently described the minimum clinically important difference for the NDI to be 9.5 (19 percentage points) for patients with mechanical neck disorders.

The NDI has demonstrated moderate test re-test reliability and has been shown to be a valid health outcome measure in a patient population with cervical radiculopathy. The ICC values for test retest reliability was 0.68 for the NDI and the minimum clinically important difference was 7 points (14 percentage points).

The Patient-Specific Functional Scale (PSFS) is a practical alternative or supplement to generic and condition-specific measures. The PSFS asks patients to list three activities that are difficult as a result of their symptoms, injury, or disorder. The patient rates each activity on a 0-10 scale, with 0 representing the inability to perform the activity, and 10 representing the ability to perform the activity as well as they could prior to the onset of symptoms. The final PSFS score is the average of the three activity scores. The PSFS was developed by Stratford et al. in an attempt to present a standardized measure for recording a patient’s perceived level of disability across a variety of conditions. The PSFS has been shown to exhibit reliability and validity in patients with neck pain. The ICC values for test retest reliability in a patient population with neck pain was 0.82. The minimal detectable change was identified to be 2.0 points.

Clinicians should use validated self-report questionnaires, such as the Neck Disability Index and the Patient-Specific Functional Scale 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 patient’s status throughout the course of treatment.
EXAMINATION – ACTIVITY LIMITATION AND PARTICIPATION RESTRICTION MEASURES

There are no activity limitation and participation restriction measures specifically reported in the literature associated with neck pain - other than those that are part of the self-report questionnaire noted in this guideline’s section on Outcome Measures. However, the following measures are options that a clinician may use to assess changes in a patient’s level of function over an episode of care.

- Pain level at end ranges of looking over shoulder
- Pain level at end ranges of looking down
- Pain level at end ranges of looking up
- Pain level after sitting for two hours
- Number of times per night that pain disrupts sleep
- Deskwork tolerance (in number of minutes or hours)
- Percent of time experiencing neck pain over the past 24 hours
- Percent of time experiencing headache(s) over past month

In addition, the Patient-Specific Functional Scale is a questionnaire that can be used to quantify changes in activity limitations and level of participation for patients with neck pain. This scale enables the clinician to collect measures related to function that may be different then the measures that are components of the region-specific outcome measures section such as the Neck Disability Index.

Clinicians should utilize easily reproducible activity limitation and participation restriction measures associated with their patient’s neck pain to assess the changes in the patient’s level of function over the episode of care.
EXAMINATION – PHYSICAL IMPAIRMENT MEASURES

CERVICAL ACTIVE RANGE OF MOTION

ICF category: Measurement of impairment of body function – mobility of several joints

Description: The amount of active neck flexion, extension, rotation and sidebending motion measured using an inclinometer

Measurement method: All cervical ROM measures are performed in the upright sitting position. Care should be taken to ensure the patient maintains an upright sitting position throughout the examination and during subsequent follow-up examinations. The following procedures are used to measure the range of motion for the cervical spine.

Neck Flexion/Extension - For neck flexion, the inclinometer is placed on the top of the patient’s head aligned with the external auditory meatus and then zeroed. The patient is asked to flex the head forward as far as possible, bringing the chin to the chest. The amount of neck flexion is recorded from the inclinometer. For extension ROM, the inclinometer is positioned in the same manner, and the patient is asked to extend the neck backwards as far as possible. The amount of neck extension is recorded with the inclinometer.

Neck Sidebending - The inclinometer is positioned in the frontal plane on the top of the patient’s head in alignment with the external auditory meatus. To measure right sidebending, the patient is asked to move the right ear to the right shoulder. The amount of sidebending is recorded with the inclinometer. The opposite is performed to measure left sidebending. Care should be taken to avoid concomitant rotation or flexion with the sidebending movement.

Neck Rotation - Rotation can be measured with a universal / standard goniometer. The patient is seated, looking directly forward with the neck in a neutral position. The fulcrum of the goniometer is placed over the top of the head with the stationary arm aligned with the acromion process, and the moveable arm bisecting the patient’s nose. The patient is asked to rotate in each direction as far as possible.

Nature of variable: Continuous

Units of measurement: Degrees

Measurement properties: Cervical range of motion measurements for flexion, extension and lateral flexion using a bubble inclinometer have exhibited reliability coefficients ranging from 0.66 to 0.84 (ICC 2,1).\(^{28, 162}\)

Instrument Variations: ROM can also be measured for clinical purposes using a CROM\(^{100, 152}\) or inclinometry\(^{4, 75, 114, 165}\) or using a tape measure. All methods are moderately correlated with more definitive radiographic and 3D kinematic measurement.\(^{4, 5}\)
CERVICAL AND THORACIC SEGMENTAL MOBILITY

ICF category: Measurement of impairment of body function – mobility of single joints

Description: With the patient prone, a measurement of cervical and thoracic spine segmental movement and pain response.

Measurement method

The patient is prone. The examiner contacts each cervical spinous process with the thumbs. The lateral neck musculature is gently pulled slightly posterior with the fingers. The examiner should be directly over the contact area keeping elbows extended, then he/she uses the upper trunk to impart a posterior to anterior force in a progressive oscillatory fashion over the spinous process. This is repeated for remaining cervical segments. The examiner then changes his/her contact position and places the hypothenar eminence (just distal to the pisiform) over the spinous process of each thoracic spine spinous process and repeats the same posterior to anterior forces in a progressive oscillatory fashion. The test result is considered to be positive if the patient reports reproduction of pain. The mobility of the segment is judged to be normal, hypermobile, or hypomobile. Interpretation of mobility is based on the examiner’s perception of the mobility at each spinal segment relative to those above and below the tested segment, and based on the examiner’s experience and perception of normal mobility.

Nature of variable
Nominal (pain response) & Ordinal (mobility judgment)

Units of measurement
None

Diagnostic accuracy and measurement properties

**Diagnostic Accuracy:**

- Pain during segmental testing associated with reports of neck pain.
  - Sensitivity = 0.82 - LR = 0.23
  - Specificity = 0.79 + LR = 3.9

**Reliability for cervical spine assessment:**

- Kappa = 0.14 to 0.37 (pain)\(^{156}\)
- ICC = 0.42 to 0.79 (pain)\(^8\)
- ICC = 0.78 to 1.0 (mobility on a 7-point scale for the upper 4 cervical spine segments)\(^{87}\)
- Weighted kappa: -0.26 to 0.74 (mobility), -0.52 to 0.90 (pain)\(^{28}\)

**Reliability for thoracic spine assessment:**

- Weighted kappa: 0.13 to 0.82 (mobility), -0.11 to 0.90 (pain)\(^{28}\)
CRANIAL CERVICAL FLEXION TEST

ICF category: Measurement of impairment of body function – control of simple voluntary movements and endurance of isolated muscles

Description: In supine, the ability to initiate and maintain isolated cranial and cervical flexion.

Measurement method

Patient is positioned supine in the hook-lying and the head and neck in mid-range neutral (imaginary line between forehead and chin and imaginary line between the tragus of the ear and the neck longitudinally should be parallel to each other and the treatment table). Towels may be needed under the occiput to achieve this neutral position. A pneumatic pressure device, such as a pressure biofeedback unit, is inflated to 20 mm Hg to fill the space between the cervical lordotic curve and the surface of the table (behind the suboccipital region, not below the lower cervical area).

While keeping the posterior head/occiput stationary (do not lift, do not push down), the patient performs cranial cervical flexion (CCF) in a graded fashion in five increments (22, 24, 26, 28, and 30 mm Hg) and aims to hold each position for 10 seconds. Ten seconds rest is provided between stages. To perform CCF, the patient is instructed to “gently nod the head as though they were saying “yes” with the upper neck. This motion will flatten the cervical lordosis, thus changing the pressure in the pneumatic pressure device. While the patient is performing the test movement, the therapist palpates the neck to monitor for unwanted activation of the superficial cervical muscles, such as the sternocleidomastoid. The patient can place his/her tongue on the roof of the mouth, with lips together but the teeth slightly separated, to help decrease platysma and/or hyoid activation. The test is graded according to the pressure level the patient can achieve with concentric contractions and accurately sustain isometrically. The test is terminated when the pressure is decreased by > 20% or when the patient cannot perform the proper CCF movement without substitution strategies.

A normal response is for the pressure to increase to between 26-30 mmHg and be maintained for 10 seconds without utilizing superficial cervical muscle substitution strategies.

An abnormal response is where the patient:

1. is unable to generate an increase in pressure of at least 6 mmHg
2. is unable to hold the generated pressure for 10 seconds,
3. uses superficial neck muscles to accomplish the cervical flexion motion, or
4. uses a sudden movement of the chin or pushing (extending)
the neck forcefully against the pressure device

Scoring:
- Activation Score: Pressure achieved and held for 10 second
- Performance Index: Increase in Pressure $\times$ number of repetitions

<table>
<thead>
<tr>
<th>Nature of variable</th>
<th>Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units of measurement</td>
<td>Millimeters Hg for the activation score</td>
</tr>
<tr>
<td>Measurement properties</td>
<td>Reliability assessment for 50 asymptomatic subjects, tested twice (one week apart): Activation score: ICC=0.81; Performance Index: ICC=.9383</td>
</tr>
</tbody>
</table>
NECK FLEXOR MUSCLE ENDURANCE TEST

ICF Category: Measurement of impairment of body function – endurance of isolated muscles

Description: In supine, the ability to lift the head and neck against gravity for an extended period

Measurement Method: The test is performed in a supine, hook-lying position. With the chin maximally retracted and maintained isometrically, the patient lifts the head and neck until the head is approximately 2.5 cm (1 in) above the plinth while keeping the chin retracted to the chest. The clinician focuses on the skin folds along the patient’s neck and places a hand on the table just below the occipital bone of the patient’s head. Verbal commands (ie, “Tuck your chin” or “Hold your head up”) are given when either the skin fold(s) began to separate or the patient’s head touched the clinician’s hand. The test is terminated if the skin fold(s) is separated due to loss of chin tuck or the patient’s head touches the clinician’s hand for more than 1 second.67

Nature of Variable: Continuous

Units of Measurement: Seconds

Measurement Properties: In a study by Harris et al,67 41 subjects with and without neck pain performed this test. Two raters tested all subjects at baseline, and subjects without neck pain were tested again one week later.

Reliability:
Subjects without neck pain:
  ICC (3,1) = 0.82 to 0.91, SEM 8.0 - 11.0 seconds
  ICC (2,1) = 0.67 to 0.78, SEM 12.6 - 15.3 seconds
Subjects with neck pain:
  ICC (2,1) = 0.67, SEM 11.5 seconds

Test results:
Subjects without neck pain: Mean 38.95 seconds (SD=26.4)
Subjects with neck pain: Mean 24.1 seconds (SD=12.8)
UPPER LIMB TENSION TEST

ICF category: Measurement of impairment of structure of the nervous system, other specified

Description: In non-weight bearing, the amount of mobility of the neural elements of the upper limb are assessed while determining whether the patient’s upper quarter symptoms are elicited during performance of the test.

Measurement method

Upper limb tension tests are performed with the patient supine. During performance of the upper limb tension test that places a bias toward testing the patient’s response to tension placed on the median nerve, the examiner sequentially introduces the following movements to the symptomatic upper extremity:
- scapular depression
- shoulder abduction to about 90° with the elbow flexed
- forearm supination, wrist and finger extension
- shoulder lateral rotation
- elbow extension
- contralateral then ipsilateral cervical side-bending.

A positive test occurs when any one of the following findings are present:
1. reproduction of all or part of the patient’s symptoms
2. side-to-side differences of >10° of elbow extension or wrist extension
3. on the symptomatic side, contralateral cervical side-bending increases the patient’s symptoms, or ipsilateral side-bending decreases the patient’s symptoms

<table>
<thead>
<tr>
<th>Nature of variable</th>
<th>Nominal</th>
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<tbody>
<tr>
<td>Units of measurement</td>
<td>None</td>
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</table>

Diagnostic accuracy indices for the upper limb tension test, based on the study by Wainer et al[162]

<table>
<thead>
<tr>
<th></th>
<th>95% Confidence Interval</th>
</tr>
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<tbody>
<tr>
<td>Kappa</td>
<td>0.76</td>
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<tr>
<td></td>
<td>0.51 – 1.0</td>
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<tr>
<td>Sensitivity</td>
<td>0.97</td>
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<tr>
<td></td>
<td>0.90 – 1.0</td>
</tr>
<tr>
<td>Specificity</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>0.12 – 0.33</td>
</tr>
<tr>
<td>Positive likelihood ratio</td>
<td>1.30</td>
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<tr>
<td></td>
<td>1.10 – 1.5</td>
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<tr>
<td>Negative likelihood ratio</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>0.01 – 1.9</td>
</tr>
</tbody>
</table>
SPURLING’S TEST

ICF Category: Measurement of impairment of structure of the nervous system, other specified

Description: Combination of sidebending to the symptomatic side coupled with compression in order to reduce the diameter of the neural foramen and elicit the patient’s symptoms.

Measurement method: The patient is seated and is asked to side bend and slightly rotate the head to the painful side while the examiner places a compression force of approximately 7 kg through the top of the head in an effort to further narrow the intervertebral foramen. The test is considered positive when it reproduces the patient’s symptoms. The test is not indicated if the patient has no upper extremity or scapular region symptoms.

Nature of variable: Nominal/dichotomous

Units of measurement: None

Measurement Properties:
- Kappa: .37
- Sensitivity: 0.50
- Specificity: 0.88
- Positive likelihood ratio: 4.3
- Negative likelihood ratio: 0.75

Diagnostic accuracy indices for Spurling’s test, based on the study by Wainner et al: 162

<table>
<thead>
<tr>
<th></th>
<th>Kappa</th>
<th>95% Confidence Interval</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>0.32 – 0.87</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.50</td>
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<tr>
<td>Specificity</td>
<td>0.88</td>
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<tr>
<td>Positive likelihood ratio</td>
<td>3.50</td>
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<tr>
<td>Negative likelihood ratio</td>
<td>0.58</td>
<td>0.36 – 0.94</td>
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</table>
## DISTRACTION TEST

### ICF Category:
Measurement of impairment of structure of the nervous system, other specified

### Description:
Distraction of the cervical spine in order to maximize the diameter of the neural foramen and reduce or eliminate the patient's symptoms.

### Measurement Method:
The distraction test is used to identify cervical radiculopathy and is performed with the patient supine. The examiner grasps under the chin and occiput, flexes the patient's neck to a position of comfort, and gradually applies a distraction force of up to approximately 14 kg. A positive test occurs with the diminution or elimination of the patient's symptoms. This test is not indicated if the patient has no upper extremity or scapular region symptoms.

### Nature of Variable:
Nominal

### Units of Measurement:
None

### Diagnostic accuracy indices for the distraction test, based on the study by Wainner et al.¹⁶²

<table>
<thead>
<tr>
<th>Diagnostic accuracy indices</th>
<th>Value</th>
<th>95% Confidence Interval</th>
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</thead>
<tbody>
<tr>
<td>Kappa</td>
<td>0.88</td>
<td>0.64 – 1.0</td>
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<tr>
<td>Sensitivity</td>
<td>0.44</td>
<td>0.21 – 0.67</td>
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<tr>
<td>Specificity</td>
<td>0.90</td>
<td>0.82 – 0.98</td>
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<tr>
<td>Positive likelihood ratio</td>
<td>4.40</td>
<td>1.80 – 11.1</td>
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<tr>
<td>Negative likelihood ratio</td>
<td>0.66</td>
<td>0.40 – 0.90</td>
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</table>
VALSALVA TEST

ICF category: Measurement of impairment of structure of the nervous system, other specified

Description: Maneuver in which the patient bears down without exhaling in order to increase intrathecal pressure and elicit upper quarter symptoms.

Measurement Method: The patient is seated and instructed to take a deep breath and hold it while attempting to exhale for 2-3 seconds. A positive response occurs with reproduction of symptoms.

Nature of variable: Nominal/dichotomous

Units of measurement: None

| Diagnostic accuracy indices for the valsalva test, based on the study by Wainner et al\textsuperscript{162} | Kappa | 0.69 | 0.36 – 1.0 |
| Sensitivity | 0.22 | 0.03 – 0.41 |
| Specificity | 0.94 | 0.88 – 1.0 |
| Positive likelihood ratio | 3.50 | 0.97 – 12.6 |
| Negative likelihood ratio | 0.83 | 0.64 – 1.1 |
CLINICAL GUIDELINES

INTERVENTIONS

A variety of interventions have been described for the treatment of neck pain and there is good evidence from high-quality randomized, controlled trials and systematic reviews to support the benefits of physical therapy intervention in these patients.

CERVICAL MOBILIZATION/MANIPULATION

The most recent Cochrane Collaboration Review \(^62\) of mobilization and manipulation for mechanical neck disorders included 33 randomized controlled trials of which 42\% were considered high quality. They concluded that the most beneficial manipulative interventions for patients with mechanical neck pain with or without headaches should be combined with exercise to reduce pain and improve patient satisfaction. Manipulation (thrust) and mobilization (non-thrust manipulation) intervention alone were determined to be less effective than when these were combined with exercise (combined intervention). \(^62\) A recently published clinical practice guideline concluded that the evidence for combined intervention was relatively strong, while the evidence for the effectiveness of thrust or non-thrust manipulation in isolation was weaker. \(^61\)

The recommendations of the Cochrane Review \(^62\) and the recently published clinical practice guideline \(^61\) were based on key findings that warrant further discussion. Studies cited included patients with both acute \(^74\) and chronic neck pain \(^19\) and interventions consisted of soft-tissue and stretching as well as thrust \(^17\), \(^83\) and non-thrust manipulation \(^74\) directed at spinal motion segments. Number of visits ranged from 6 over a 3 week period \(^74\) to 20 over an 11 week period \(^19\) and the duration of sessions ranged from 30 minutes \(^86\) to 60 minutes. \(^19\) Combined intervention was compared with various competing interventions that included manipulation alone, \((53, 55)\) various non-manual physical therapy interventions, \(^74\) high-tech and low-tech exercise, \(^19, 74, 86\) general practitioner care (medication, advice, education) \(^74\) and no treatment control. \(^86\)

The majority of studies report either clinically or statistically important differences in pain in favor of combined intervention when compared to competing interventions. \(^62\) Differences in muscle performance \(^19, 86\) as well as patient satisfaction have also been reported for both short-term \(^19, 74, 86\) as well long-term outcomes one \(^19\) and two years later. \(^50\) When compared to care rendered by a general practitioner and non-manual physical therapy interventions, the combination of manipulation and exercise may result in significant cost-savings of up to 68\%. \(^93\)

Although many patients experience a significant benefit when treated with manipulation, it is still unclear which patients benefit most. Tseng and Wang \(^153\) reported six predictors for patients who experienced an immediate improvement in either pain, satisfaction, or perception of condition following manipulation of
the cervical spine. These predictors included: \textsuperscript{153}

- Initial scores on Neck Disability Index < 11.5
- Having bilateral involvement pattern
- Not performing sedentary work > 5 hours per day
- Feeling better while moving the neck
- Did not feel worse while extending the neck
- The diagnosis of spondylosis without radiculopathy

The presence of four or more of these predictors increased the probability of success with manipulation to 89%. \textsuperscript{153} Predictors of which patients respond best to combined intervention has not been reported.

Nilsson et al\textsuperscript{111} conducted a randomized, clinical trial (n=53) in individuals with cervicogenic headache. Subjects were randomized to receive high velocity low amplitude spinal manipulation or low level laser and deep friction massage. The use of analgesics were reduced by 36% in the manipulation group but were unchanged in the laser/massage group. The number of headaches per hours decreased by 69% in the manipulation group and 37% in the laser/massage group. Headache intensity per episode decreased by 36% in the manipulation group and 17% in the laser/massage group.

A systematic review by Vernon et al\textsuperscript{158} which included studies published through 2005 concluded that there is moderate- to high-quality evidence that subjects with chronic neck pain and headaches show clinically important improvements from a course of spinal mobilization or manipulation at 6, 12, and up to 104 weeks post-treatment.

Despite good evidence to support the benefits of cervical mobilization/manipulation, it is important that physical therapists be apprised of the potential risks.\textsuperscript{61, 62} However, it is impossible to determine the precise risk because 1) it is extremely difficult to quantify the number of cervical spine mobilization/manipulative interventions performed each year, and 2) not all adverse events occurring after mobilization/manipulation interventions are published in the peer-reviewed literature, and there is no accepted standard for reporting these injuries. Reported risk factors include hypertension, migraines, oral contraceptive use, and smoking.\textsuperscript{64} However, the prevalence of these factors in the study by Haldeman et al is largely the same or lower than that which occurs in the general population.\textsuperscript{64}

Although the true risk for complications remains unknown, the risk for serious complications is six in ten million (0.00006%), with the risk of death being 3 in 10 million (0.000003%). Importantly, these rates are adjusted assuming that only 1 in 10 complications is actually reported in the literature.\textsuperscript{76} Gross et al recently reported in a published clinical practice guideline on the use of mobilization/manipulation in patients with mechanical neck pain that estimates for serious complication for manipulation ranged from 1 in 20 000 (0.01%) to 5 in 10 million (0.0005%).\textsuperscript{63}

The risk estimate for patients experiencing non-serious side effects such as
increased symptoms, ranges from 1% to 2%.135 The most common side effects included local discomfort (53%), local headache (12%), fatigue (11%), or radiating discomfort (10%). Patients characterized 85% of these complaints as mild or moderate, with 64% of side effects appearing within 4 hours after manipulation. Within 24 hours after manipulation, 74% of the complaints had resolved. Less than 5% of side effects were characterized as dizziness, nausea, hot skin, or other complaints. Side effects were rarely still noted on the day after manipulation, and very few patients reported the side effects as being severe.

**Recommendation:** Clinicians should consider utilizing cervical manipulative procedures, thrust and non-thrust, to reduce neck pain and headache. Combining cervical manipulation and exercise is more effective for reducing neck pain, headache, and disability than manipulation alone

**THORACIC MOBILIZATION/MANIPULATION**

A survey among clinicians that practice manual physical therapy reported that the thoracic spine is the region of the spine most often manipulated, despite the fact that more patients complain of neck pain.1 While several randomized clinical trials have examined the effectiveness of thoracic spine thrust manipulation (TSM) for patients with neck pain, patients in these studies also received cervical manipulation.2, 19, 49 The rationale to include thoracic spine mobilization/manipulation in the treatment of patients with neck pain stems from the theory that disturbances in joint mobility in the thoracic spine may be an underlying contributor to musculoskeletal disorders in the neck.81, 92

Cleland et al30 compared the effectiveness of TSM in a trial in which patients were randomized to either a single session of TSM manipulation or sham manipulation. Patients who received TSM experienced a clinically meaningful and statistically significant reduction in pain on the VAS compared to patients who received the placebo intervention (p< .001).30 A similar finding (reduction of pain) was also reported in randomized trial that compared TSM intervention to an active exercise program.133 A subsequent randomized trial by Cleland et al34 which compared TSM to non-thrust manipulation (mobilization) found significant differences in favor of the TSM group in pain, disability, and patient perceived improvement upon re-evaluation 48 hours later.

While preliminary reports indicate that patients with complaints of primary neck pain experience a significant benefit when treated with TSM, it is still unclear which patients benefit most. Cleland et al29 reported a preliminary clinical prediction rule for patients with primary neck pain who experience short-term improvement (1-week) with TSM. Each subject received a total of three thoracic manipulations directed at the upper and middle thoracic spine for up to two sessions. Using a global rating of change score ≥5 as a reference criterion, 6 variables were reported as predictors of improvement and included:29

- Symptom duration of < 30 days
- No symptoms distal to the shoulder
- Subject reports that looking up does not aggravate symptoms
• Fear-avoidance Beliefs Questionnaire-Physical Activity Scale score <12  
• Diminished upper thoracic spine kyphosis (T3–T5)  
• Cervical extension of < 30 degrees

Interestingly, the lack of symptom aggravation with looking up was also one of the predictors reported by Tseng et al. in the cervical manipulation clinical prediction rule. Validation of both the cervical and TSM clinical rules is required before they can be recommended for wide-spread clinical use.

In a randomized clinical trial Fernández de las Peñas et al. demonstrated that patients with neck pain related to a whiplash-associated disorder receiving thoracic spine manipulation experienced a significantly greater (p < 0.003) reduction in pain as measured by the visual analog scale (VAS), than those who did not receive the thoracic manipulation. The mean change in pain levels in the group receiving thoracic spine manipulation was 54.1 mm (SD 18.8) compared to change in the group not receiving thoracic manipulation 13.4 mm (SD 8.9). The length of follow-up was not clearly defined.

Self-reported levels of pain and cervical AROM were assessed before and immediately after TSM in 26 patients with a primary complaint of neck pain. The mean reduction in pain on an 11-point numeric pain rating scale was approximately two points (p<0.01), which has been shown to indicate that a clinically meaningful improvement has occurred. Significant increases in cervical AROM were also observed in all directions except extension (p<0.001). This study did not include a control group and only consisted of an immediate follow-up, but the immediate improvements in pain and cervical AROM suggest that TSM may have some merit in patients with neck pain.

There have been 3 case series that have incorporated thoracic spine thrust manipulation in the multi-modal management of patients with cervical radiculopathy. In the first case series 10 of the 11 patients (91%) demonstrated a clinically meaningful improvement in pain and function at the 6-month follow-up following a mean of 7.1 physical therapy visits. In the second case series all patients except for 1 exhibited a significant reduction in disability. In the third case series, full resolution of pain was reported in eight of 15 (53%) patients, where all six of the patients receiving mobilization and manipulation achieved full resolution of pain. In addition, there has been one case series that included thoracic spine thrust manipulation in the management of 7 patients with grade I cervical compressive myelopathy. All patients exhibited a reduction in pain and improvement in function at the time of discharge.

**Recommendation:** Thoracic spine thrust manipulation can be used for patients with primary complaints of neck pain. Thoracic spine thrust manipulation can also be used for reducing pain and disability in patients with neck and arm pain.
STRETCHING EXERCISES

In a randomized control trial, Ylinen et al\textsuperscript{172} assessed the effectiveness of manual therapy procedures implemented twice a week compared with a stretching regimen performed five times a week in those with non-specific neck pain. At the 4 and 12 week follow-up both groups improved but there were no significant differences between the groups related to pain. Neck and shoulder pain and disability index decreased as well as neck stiffness improved significantly more in those receiving manual therapy, but the clinical difference was minimal. The authors concluded that the low-cost of stretching exercises should be included in the initial treatment plan for patients with neck pain.

The authors have observed that patients with neck pain often present with impairments of flexibility of key muscles related to the lower cervical and upper thoracic spine, such as the anterior, medial, and posterior scalenes, upper trapezius, levator scapulae, pectoralis minor, and pectoralis major, that should be addressed with stretching exercises. One study reported that upper quarter muscle flexibility deficits were common in dental hygenists,\textsuperscript{82} an occupation that requires frequent repetitive activities involving the shoulders, arms and hands. Although research generally does not support the effectiveness of interventions that focus on stretching and flexibility, clinical experience suggests that addressing specific impairments of muscle length for an individual patient may be a beneficial addition to a comprehensive treatment program.

**Recommendation:** There is minimal evidence to suggest that flexibility exercises improve neck symptoms. Examination and targeted flexibility exercises for the following muscles are suggested: anterior/medial/posterior scalenes, upper trapezius, levator scapulae, pectoralis minor and pectoralis major.
Jull et al\textsuperscript{86} conducted a multi-centered, randomized clinical trial (n=200) in participants who met the diagnostic criteria for cervicogenic headache. The inclusion criteria were unilateral or unilateral dominant side-consistent headache associated with neck pain and aggravated by neck postures or movement, joint tenderness in at least one of the upper three cervical joints as detected by manual palpation, and a headache frequency of at least one per week over a period of two months to ten years. Subjects were randomized into four groups: mobilization/manipulation group, exercise therapy group, combined mobilization/manipulation and exercise group, and a control group. The primary outcome was a change in headache frequency. At the 12-month follow-up, the mobilization/manipulation, combined mobilization/manipulation and exercise, and the specific exercise groups had significantly reduced headache frequency and intensity. Additionally 10% more patients experienced a complete reduction in headache frequency when treated with mobilization/manipulation and exercise than those treated with the alternative approaches\textsuperscript{86}.

The exercise program in this clinical trial by Jull et al\textsuperscript{86} used low load endurance exercises to train muscle control of the cervicoscapular region. The first stage consisted of specific craniocervical flexion exercises, performed in supine lying, aimed to target the deep neck flexor muscles, which are the longus capitus and longus colli. Subsequently, isometric exercises using a low level of rotatory resistance were used to train the co-contraction of the neck flexors and extensors. The exercise groups had significantly reduced headache frequency and intensity when compared to the controls.

Chiu et al\textsuperscript{25} assessed the benefits of an exercise program that focused both on motor control training of the deep neck flexors and dynamic strengthening. A total of 145 patients with chronic neck pain were randomized to either an exercise or a non-exercise control group. At week six, the exercise group had significantly better improvements in disability scores, pain levels, and isometric neck muscle strength. However, significant differences between the two groups were found only in pain and patient satisfaction at the six-month follow-up.

In a cross-sectional comparative study, Chiu et al\textsuperscript{26} compared the performance of the deep cervical flexor muscles on the craniocervical flexion test in individuals with (n = 20) and without (n = 20) chronic neck pain. Those with chronic neck pain had significantly poorer performance on the craniocervical flexion test (median pressure achieved, 24 mmHg when starting at 20 mmHg) when compared with those in the asymptomatic group (median pressure achieved, 28 mmHg when starting at 20 mmHg).

O’Leary et al\textsuperscript{113} compared the effect of two specific cervical flexor muscle exercise protocols on immediate pain relief in the cervical spine of people with chronic neck pain. They found that the specific craniocervical flexion exercise demonstrated greater improvements in pressure pain thresholds, mechanical hyperalgesia, and perceived pain relief during active movement.
In a randomized, clinical trial, Ylinen et al\textsuperscript{173} demonstrated the effectiveness of both strengthening exercises and endurance training of the deep neck flexor muscles to reduce pain and disability at a one-year follow-up in women (n = 180) with chronic, nonspecific neck pain. The endurance training group performed dynamic neck exercises, which included lifting the head up from the supine and prone positions. The strength training group performed high-intensity isometric neck strengthening and stabilization exercises with an elastic band. Both training groups performed dynamic exercises for the shoulders and upper extremities with dumbbells. All groups were advised to do aerobic and stretching exercises regularly 3 times a week. In a three-year follow-up study, Ylinen et al\textsuperscript{171} found that women (n = 118) in both groups achieved long-term benefits from the 12-month programs.

In a randomized, clinical trial, Bronfort et al\textsuperscript{19} found that a combined program of strengthening and endurance exercises combined with manual therapy resulted in greater gains in strength, endurance, range of motion, and long-term patient pain ratings in those with chronic neck pain than programs that only incorporated manual therapy. Additionally, Evans et al\textsuperscript{51} found that these results were maintained at a two-year follow-up.

In a randomized, clinical trial, Taimela et al\textsuperscript{149} compared the efficacy of a multimodal treatment emphasizing proprioceptive training with activated home exercises and recommendation of exercise in patients with nonspecific chronic neck pain (n = 76). The proprioceptive treatment, which consisted of exercises, relaxation, and behavioral support was more efficacious than comparison groups that consisted of 1) a group that received a neck lecture and two sessions of practical training for their home exercise program, and 2) a group that received a lecture regarding care of the neck with a recommendation to exercise. Specifically, the proprioceptive treatment group had greater reductions in neck symptoms, improvements in general health, and improvements in the ability to work.

In a randomized, clinical trial, Chiu et al\textsuperscript{27} found in patients with chronic neck pain (n = 218), that a 6-week treatment of TENS or exercise group had a better and clinically relevant improvement in disability, isometric neck muscle strength, and pain compared to a control group. All the improvements in the intervention groups were maintained at the six-month follow-up.

In a randomized, clinical trial, Viljanen et al\textsuperscript{160} assessed the effectiveness of dynamic muscle training (n= 135), relaxation training (n = 128), or ordinary activity (n = 135) for those with chronic neck pain in female office workers. Dynamic muscle training and relaxation training did not lead to better improvements in neck pain compared with ordinary activity.

In a systematic review, Kay et al\textsuperscript{90} concluded that specific exercises may be effective for the treatment of acute and chronic mechanical neck pain, with or without headache.
A recent Cochrane review\textsuperscript{62} concluded that mobilization and/or manipulation when used with exercise are beneficial for patients with persistent mechanical neck disorders with or without headache. However, manual therapy without exercise or exercise alone were not superior to one another.

Hammill et al\textsuperscript{66} used a combination of postural education, stretching, and strengthening exercises to reduce the frequency of headaches and improve disability in a series of 20 patients, with results being maintained at a 12-month follow-up.

In a systematic review of nine randomized clinical trials and seven comparative trials with moderate methodological quality for patients with mechanical neck disorders, Sarig-Bahat\textsuperscript{131} reported relatively strong evidence supporting the effectiveness of proprioceptive exercises and dynamic resisted strengthening exercises of the neck-shoulder musculature for chronic or frequent neck disorders. The evidence identified could not support the effectiveness of group exercise, neck schools or single sessions of extension-retraction exercises.

Jull et al\textsuperscript{84} compared the effects of conventional proprioceptive training and craniocervical flexion training on cervical joint position error in people with persistent neck pain. The aim was to evaluate whether proprioceptive training was superior in improving proprioceptive acuity compared to a form of exercise that has been shown to be effective in reducing neck pain. Sixty-four female subjects with persistent neck pain and deficits in cervical joint position error were randomized into two exercise groups: proprioceptive training or craniocervical flexion training. Exercise regimens were conducted over a six-week period. The results demonstrated that both proprioceptive training and craniocervical flexion training have a demonstrable benefit on impaired cervical joint position error in people with neck pain, with marginally more benefit gained from proprioceptive training. The results suggest that improved proprioceptive acuity following intervention with either exercise protocol may occur through an improved quality of cervical afferent input or by addressing input through direct training of relocation sense.\textsuperscript{84}

In a prospective case series, Nelson et al\textsuperscript{110} followed patients with cervical and lumbar pain and found that an aggressive strengthening program was able to prevent surgery in 35 of the 60 patients (46 of the 60 completed the program, 38 were available for follow-up, and only 3 reported having surgery). Despite the methodological limitations of this study, some patients that were originally given the option of surgery were able to successfully avoid surgery in the short term following participation in an aggressive strengthening exercise program.

Although evidence is generally lacking, postural correction and body mechanics education and training may also be indicated if clinicians identify ergonomic inefficiencies during either the examination or treatment of patients with motor control, movement coordination, muscle power, or endurance impairments.
Recommendation: There is high quality evidence from randomized, controlled trials supporting the use of specific coordination, strengthening, and endurance exercises to reduce neck pain and headache.

CENTRALIZATION PROCEDURES AND EXERCISES

Kjellman et al colleagues\(^9\) randomly assigned 77 patients with neck pain (29 of which presented with cervical radiculopathy) to general exercise, McKenzie treatment to promote centralization (consisting of specific repeated movements), or a control group (low intensity ultrasound and education). At the 12 month follow-up all groups showed significant reductions in pain intensity and disability but no significant difference between groups existed. 79% of patients reported that they were better or completely restored after treatment, although 51% reported constant/daily pain. All three groups had similar recurrence rates.

Murphy et al\(^10\) incorporated McKenzie treatment to promote centralization (consisting of specific repeated movements), in the management of a cohort of 31 patients with cervical radiculopathy. These patients also received cervical manipulation or muscle energy techniques and neural mobilization. 77% of patients at the short-term follow-up and 93% of patients at the long term follow-up exhibited a clinically important improvement in disability. However, specific details regarding the number of patients’ receiving exercises to promote centralization was not reported.

Recommendation: Specific repeated movements or procedures to promote centralization are not more beneficial in reducing disability when compared to other forms of interventions.
### UPPER QUARTER MOBILIZATION PROCEDURES AND NERVE MOBILITY EXERCISES

Allison et al\(^2\) examined the effectiveness of two different manual therapy techniques (neural mobilization and cervical/upper quadrant mobilizations) in the management of cervico-brachial syndrome. All patients received treatment for 8 weeks in addition to a home exercise program. The results demonstrated that both manual therapy groups exhibited improvements in pain and function. At the final data collection there existed no difference between the manual therapy groups for function but a significant between groups for reduction in pain was identified in favor of the neural mobilization group.

In a randomized clinical trial, Coppieters et al\(^3^7\) randomly assigned 20 patients with cervico-brachial pain to receive either cervical mobilization with the upper extremity in an upper limb neurodynamic position or therapeutic ultrasound. The group receiving the mobilizations exhibited significantly greater improvements in elbow range of motion during neurodynamic testing as well as greater reductions in pain compared to the ultrasound group.

Murphy et al\(^{108}\) incorporated neural mobilization in the management of a cohort of patients with cervical radiculopathy. 77% of patients at the short-term follow-up and 93% of patients at the long term follow-up exhibited a clinically important improvement in disability. However, no specifics were provided relative to which patients received specific neural mobilization procedures.

Cleland et al\(^{35}\) performed a case series to describe the outcomes of a consecutive series of patients presenting to physical therapy and received cervical mobilization (cervical lateral glides) with the upper extremity in a neurodynamic position as well as thoracic spine manipulation, cervical traction and strengthening exercises. 10 of the 11 patients (91%) demonstrated a clinically meaningful improvement in pain and function following a mean of 7.1 physical therapy visits and at the six month follow-up.

**Recommendation:** Clinicians should consider the use of neural mobilization procedures for the reduction of pain and disability in patients with neck and arm pain.
A systematic review by Graham et al colleagues reported that there is moderate evidence to support the use of intermittent cervical traction.

Taghi Joghataei et al randomly assigned 30 patients to receive a treatment program consisting of ultrasound and exercise either with or without intermittent cervical traction for 10 sessions. The group receiving intermittent cervical traction exhibited greater improvements in grip strength, the primary outcome measure, after 5 sessions. However, no statistically significant difference between groups existed at the time of discharge from physical therapy.

Saal et al investigated the outcomes of 26 consecutive patients who fit the diagnostic criteria for herniated cervical disc with radiculopathy who received a rehabilitation program consisting of cervical traction and exercise. 24 patients avoided surgical intervention and 20 exhibited good or excellent outcomes.

In a prospective cohort design Cleland et al identified predictor variables of short-term success for patients presenting to physical therapy with cervical radiculopathy. One of the predictor variables for patients who exhibited a short-term success included a multimodal physical therapy approach consisting of manual or mechanical traction, manual therapy (cervical or thoracic mobilization/manipulation) and deep neck flexor strengthening. The pretest probability for the likelihood of short-term success was 53%. The mean duration of traction used on patients in this study was 17.8 minutes with an average force of pull of 24.3 pounds. The positive likelihood ratio for patients receiving the multimodal treatment approach (excluding other predictor variables) was 2.2, resulting in a post-test probability of success of 71%.

Raney et al recently developed a clinical prediction rule to identify patients with neck pain likely to benefit from cervical mechanical traction. 68 patients (38 female) were included in data analysis of which 30 had a successful outcome. All patients received 6 sessions of intermittent cervical traction starting with a force of pull between 10-12 pounds for a duration of 15 minutes. The force of pull progressively increased based on centralization of symptoms at each subsequent session. A CPR with five variables was identified:

- Patient reported peripheralization with lower cervical spine (C4-7) mobility testing
- Positive shoulder abduction sign
- Age ≥ 55
- Positive upper limb tension test (median nerve bias utilizing shoulder abduction to 90°)
- Relief of symptoms with manual distraction test

Having at least 3 out of 5 variables present resulted in a +LR equal to 4.81 (95% CI = 2.17-11.4), increasing the likelihood of success with cervical traction from 44% to 79.2%. If at least 4 out of 5 variables were present, the +LR was equal to 11.7 (95% CI = 2.09-69.58), increasing the post-test probability of having
improvement with cervical traction to 90.2%.

Three separate case series describe the management of patients with cervical radiculopathy, where the interventions included traction. In these case series, the patients were treated with a multimodal treatment approaches and the vast majority of patients exhibited improved outcomes.

Cleland et al\textsuperscript{35} described the outcomes of a consecutive series of 11 patients presenting to physical therapy with cervical radiculopathy and managed with the use of manual physical therapy, cervical traction and strengthening exercises. 91% demonstrated a clinically meaningful improvement in pain and function following a mean of 7.1 physical therapy visits and at the six-month follow-up.

Waldrop\textsuperscript{163} treated 6 patients with cervical radiculopathy with intermittent cervical traction, thoracic thrust joint manipulation, range of motion and strengthening exercises for the cervical spine. Upon discharge (mean treatment 10 visits, range 5-18; duration 33 days, range 19-56), there was a reduction in disability between 13\% and 88\%.

Moeti and Marchetti\textsuperscript{106} investigated the outcomes associated with cervical intermittent traction, neck retraction exercises, scapular muscle strengthening, and mobilization/manipulation techniques (used for some patients) for 15 patients with cervical radiculopathy. These authors reported full resolution of pain in 53\% of patients at the time of discharge.

Browder and colleagues\textsuperscript{20} investigated the effectiveness of a multimodal treatment approach in the management of seven female patients with grade I cervical compressive myelopathy. Patients were treated with intermittent cervical traction and thoracic manipulation for a median of nine sessions over a median of 56 days. The median decrease in pain scores was five from a baseline of six, and median improvement in Functional Rating Index scores was 26\% from a baseline of 44\%.

**Recommendation:** Mechanical intermittent traction, combined with other interventions such as manual therapy and strengthening exercises, can be used for the reducing pain and disability in patients with neck and neck-related arm pain.
There is a paucity of high quality evidence surrounding efficacy of treatments for whiplash-associated disorder (WAD). However, existing research supports instructing patients in active interventions, such as exercises, and early return to regular activities as a means of pain control. Rosenfeld et al.\textsuperscript{128} compared the long-term efficacy of active intervention with that of standard intervention and the effect of early versus delayed initiation of intervention. Patients were randomized to an intervention using frequent active cervical rotation complemented by assessment and treatment according to McKenzie's principles or to an intervention that promoted initial rest, soft collar utilization, and gradual self-mobilization. In patients with WAD, early active intervention was more effective in reducing pain intensity and sick leave, and in retaining/regaining total range of motion than intervention that promoted rest, collar usage, and gradual self-mobilization. Patient education promoting an active approach can be carried out as home exercises and progressive return to activities initiated and supported by appropriately trained health professionals.

An often prescribed intervention for acute whiplash injury is the use of a soft cervical collar. Crawford et al.\textsuperscript{41} prospectively investigated 108 consecutive patients following a soft tissue injury of the neck that resulted from motor vehicle accidents. Each patient was randomized to a group instructed to engage in early mobilization using an exercise regime or to a group that was instructed to utilize a soft cervical collar for 3 weeks followed by the same exercise regime. Patients were assessed clinically at 3, 12 and 52 week intervals from injury. Intervention that utilized a soft collar was found to have no obvious benefit in terms of functional recovery after neck injury and was associated with a prolonged time period off work. Other investigations have reported similar results.\textsuperscript{134, 157} Interventions that instruct patients to perform exercises early in their recovery from whiplash type injuries have been reported to be more effective in reducing pain intensity and disability following whiplash injury than interventions that instruct patients to use cervical collars.\textsuperscript{134, 157}

Existing research supports active interventions and early return to regular activities but it has largely been unknown as to which type of active intervention would yield the most benefit. Brison et al.\textsuperscript{18} assessed the efficacy of an educational video in the prevention of persistent WAD symptoms following rear-end motor vehicle collisions. The video provided reassurance, and education about posture, return to regular activities, specific exercises, and pain management. Patients were randomized to receive either an educational video plus usual care or usual care alone. The primary outcome was presence of persistent WAD symptoms at 24 weeks post injury, based on the frequency and severity of neck, shoulder, or upper back pain. The group receiving the instructional video demonstrated a trend toward less severe WAD symptoms suggesting that the ‘act as usual’ recommendation that is often prescribed as a management strategy for patients with WAD is not sufficient and, in fact, may exacerbate their symptoms if such activities are provocative of pain.\textsuperscript{18}
A reduction in pain alone is not sufficient to address the neuromuscular control deficits in patients with chronic symptoms, as these deficits require specific rehabilitation techniques. For example, persistent sensory and motor deficits may render the patient at risk for symptom persistence. Support for specificity in rehabilitation can be indirectly found from a recent population-based, incidence cohort study evaluating a government policy of funding community and hospital-based fitness training and multidisciplinary rehabilitation for whiplash. No supportive evidence was found for the effectiveness of a general population-based program of fitness training and multidisciplinary rehabilitation for whiplash. Therefore, only addressing the lack of mobility in this patient population may not be the most efficacious approach to treatment.

Ferrari et al studied whether an educational intervention using a pamphlet provided to patients in the acute stage of whiplash injury might improve the recovery rate. 112 consecutive subjects were randomized to one of two treatment groups: educational intervention or usual care. The education intervention group received an educational pamphlet based on the current evidence, whereas the control group only received usual emergency department care and a standard non-directed discharge information sheet. Both groups underwent follow-up by telephone interview at two weeks and three months. The primary outcome measure of recovery was the patient's response to the question, "How well do you feel you are recovering from your injuries?" At three months post collision, 21.8% in the education intervention group reported complete recovery compared with 21.0% in the control group (absolute risk difference, 0.8%; 95% confidence interval = -14.4% to 16.0%). At three months, there were no clinically or statistically significant differences between groups in severity of remaining symptoms, limitations in daily activities, therapy use, medications used, lost time from work, or litigation. This study concluded that an evidence-based educational pamphlet provided to patients at discharge from the emergency department is no more effective than usual care for patients with grade I or II whiplash-associated disorder.

Jull et al conducted a preliminary randomized controlled trial with 71 participants with persistent neck pain following a motor vehicle accident to explore whether a multimodal program of physical therapies was an appropriate management strategy compared to a self-management approach. Participants were randomly allocated to receive either a multimodal physical therapy program or a self-management program (advice and exercise). Furthermore, participants were stratified according to the presence or not of widespread mechanical or cold hyperalgesia. The intervention period was 10 weeks and outcomes were assessed immediately following treatment. Even with the presence of sensory hypersensitivity in 72.5% of subjects, both groups reported some relief of neck pain and disability, measured using Neck Disability Index scores, and it was superior in the group receiving multimodal physical therapy (p=0.04). However, the overall effects of both programs were mitigated in the group presenting with both widespread mechanical and cold hyperalgesia. Further research aimed at testing the validity of this sub-group observation is warranted.
A comprehensive review\textsuperscript{104} of the available scientific evidence produced a set of unambiguous patient centered messages that challenge unhelpful beliefs about whiplash, promoting an active approach to recovery. This rigorously developed educational booklet (\textit{The Whiplash Book}) was capable of improving beliefs about whiplash and its management for patients with whiplash-associated disorders.\textsuperscript{104}

In a small case series, Soderlund and Lindberg\textsuperscript{139} reported that physical therapy integrated with cognitive behavioral components decreased pain intensity in problematic daily activities in 3 individuals with chronic WAD.

Predictors of outcome following whiplash injury have been limited to socio-demographic and factors of symptom location and severity, which are not readily amenable to intervention. However, evidence exists to demonstrate that psychological factors are present soon following injury and play a role in recovery from whiplash injury.\textsuperscript{85, 141, 144} These factors can be as diverse as the physical presentation and can include affective disturbances, anxiety, depression and fear of movement.\textsuperscript{109, 118, 165} Furthermore, post-traumatic stress disorder\textsuperscript{99} has also featured in both the acute\textsuperscript{45} and chronic conditions and shown to be prognostic.\textsuperscript{171} Identifying these factors in patients may assist in the development of relevant subgroups and appropriately matched education and counseling strategies that practitioners should utilize in management of patients with WAD.

\textbf{Recommendation:} In patients with whiplash-associated disorder, recovery is improved by educating the patient that early return to normal, non-provocative pre-accident activities is important and by providing reassurance to the patient that good prognosis and full recovery commonly occurs in many.
SUMMARY OF RECOMMENDATIONS

Pathoanatomical Features
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 impairments in muscle, connective, and nerve tissues associated with the identified pathological tissues when a patient presents with neck pain.

Risk Factors
Clinicians should consider age > 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.

Diagnosis/Classification
Neck pain, without symptoms or signs of serious medical or psychological conditions, associated with 1) motion limitations in the cervical and upper thoracic regions, 2) headaches, and 3) referred or radiating pain into an upper extremity are useful clinical findings for classifying a patient with into the following International Statistical Classification of Diseases and Related Health Problems (ICD) categories: cervicalgia, pain in thoracic spine, headaches, cervicocranial syndrome, sprain and strain of cervical spine, spondylosis with radiculopathy, and cervical disc disorder with radiculopathy; and the associated International Classification of Functioning, Disability, and Health (ICF) impairment-based category neck pain with the following impairments of body function:

- Neck pain with mobility impairments (b7101 Mobility of several joints)
- Neck pain with headaches (28010 Pain in head and neck)
- Neck pain with movement coordination impairments (b7601 Control of complex voluntary movements)
- Neck pain with radiating pain (b2804 Radiating pain in a segment or region)

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with mobility impairments and the associated ICD category of cervicalgia, or pain in thoracic spine.

- Cervical active range of motion
- Cervical and thoracic segmental mobility

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with headaches and the associated ICD category of headaches, or cervicocranial syndrome.

- Cervical active range of motion
- Cervical segmental mobility
- Cranial cervical flexion test

The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of neck pain with movement coordination impairments and the associated ICD category of sprain and strain of cervical spine (recommendation based on moderate evidence).

- Cranial cervical flexion test
- Deep neck flexor endurance
The following physical examination measures may be useful in classifying a patient in the ICF impairment-based category of **neck pain with radiating pain** and the associated ICD category of **spondylosis with radiculopathy** or **cervical disc disorder with radiculopathy**.

- Upper limb tension test
- Spurling’s test
- Distraction test

**Differential Diagnosis**

Clinicians should consider diagnostic classifications associated with serious pathological conditions or psychosocial factors when the patient’s reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline, or, when the patient’s symptoms are not resolving with interventions aimed at normalization of the patient’s impairments of body function.

**Examination – Outcome Measures**

Clinicians should use validated self-report questionnaires, such as the Neck Disability Index and the Patient-Specific Functional Scale 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 patient’s status throughout the course of treatment.

**Examination – Activity Limitation Measures**

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

**Interventions – Cervical Mobilization/Manipulation**

Clinicians should consider utilizing cervical manipulative procedures, thrust and non-thrust, to reduce neck pain and headache. Combining cervical manipulation and exercise is more effective for reducing neck pain, headache, and disability than manipulation alone.

**Interventions – Thoracic Mobilization/Manipulation**

Thoracic spine thrust manipulation can be used for patients with primary complaints of neck pain. Thoracic spine thrust manipulation can also be used for reducing pain and disability in patients with neck and arm pain.

**Interventions – Stretching Exercises**

There is minimal evidence to suggest that flexibility exercises improve neck symptoms. Examination and targeted flexibility exercises for the following muscles are suggested by the authors: anterior/medial/posterior scalenes, upper trapezius, levator scapulae, pectoralis minor and pectoralis major.
Interventions – Coordination, Strengthening and Endurance Exercises
Coordination, strengthening, and endurance exercises should be used to reduce neck pain and headache.

Interventions – Centralization Procedures and Exercises
Sufficient evidence does not exist to suggest that specific repeated movements or procedures to promote centralization are more beneficial in reducing disability when compared to other forms of interventions.

Interventions – Upper Quarter Mobilization Procedures and Nerve Mobility Exercises
Clinicians should consider the use of neural mobilization procedures for the reduction of pain and disability in patients with neck and arm pain.

Interventions – Traction
Mechanical intermittent traction, combined with other interventions such as manual therapy and strengthening exercises, can be used for the reducing pain and disability in patients with neck and neck-related arm pain.

Interventions – Patient Education and Counseling
In patients with whiplash-associated disorder, recovery is improved by educating the patient that early return to normal, non-provocative pre-accident activities is important and by providing reassurance to the patient that good prognosis and full recovery commonly occurs in many.
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