

Evidence-based diagnosis and treatment of cervical spine disorders



Abstract: Neck pain from cervical spine disorders is the second-leading cause of musculoskeletal disorders. Neck pain can exist alone or with the presence of upper extremity symptoms. This review of evidence-based guidelines assists the provider in identifying and treating various cervical disorders.

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The prominence of neck pain in the US requires primary care providers to have knowledge regarding the diagnosis and treatment of cervical spine disorders. These disorders include cervical spondylosis, cervical disk herniation, cervical stenosis, cervical myelopathy, spinal column instability, and fractures. This article reviews evidence-based practices providers should follow when diagnosing and treating patients with neck pain caused by cervical spine disorders. Providers must consider serious differential diagnoses before recommending patient treatment and note that multimodal forms of treatment are typically more successful.

■ Epidemiology

Neck pain from various cervical spine disorders ranks second among the leading causes of musculoskeletal disorders.¹ With an incidence of 83.2 out of 100,000 of the US population.²⁻⁵ Neck pain is common among both the general and workers' compensation populations.⁵ Globally, prevalence of neck pain varies between 1.7% to 11.5% over a 12-month period.¹ It typically presents between the ages of 40 and 60, with the highest prevalence between the ages of 50 and 54.^{4,5} It is also more common in women versus men, in urban versus rural communities, and in higher-income countries versus lower-income countries.^{6,7}

Evidence of arthritic changes, also known as cervical spondylosis, is documented in 60% of asymptomatic patients over the age of 40 and 80% over the age of 80.⁵ These cervical changes are rarely seen in children. A patient's risk of neck pain increases with history of prior neck injuries, cervical strains, and osteoarthritis.

■ Clinical presentations

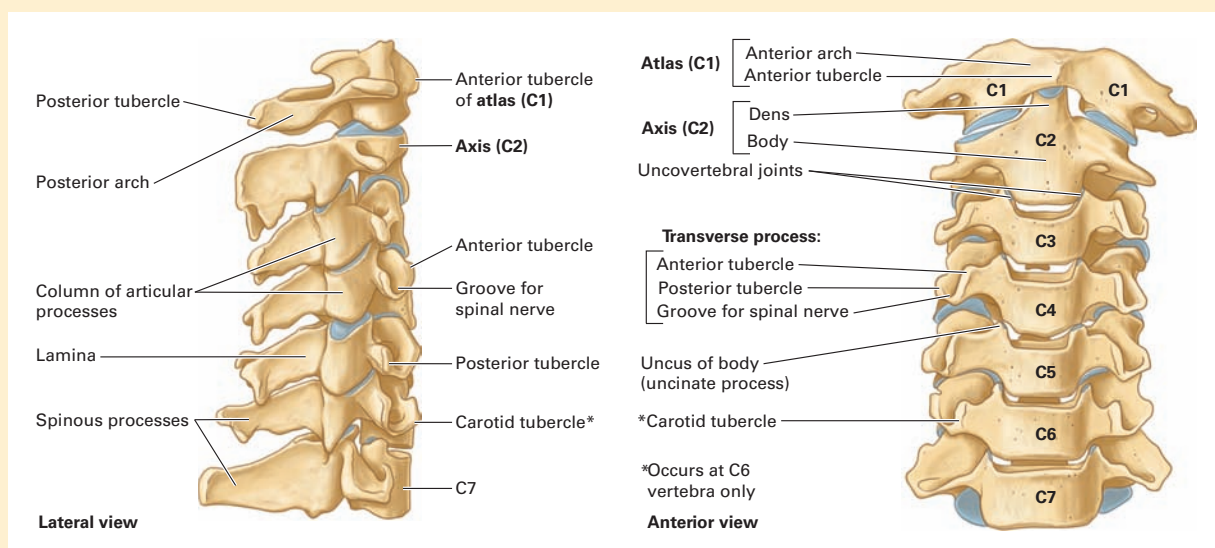
Cervical spondylosis. The most common cervical spine disorder is cervical spondylosis, better known as degeneration. Cervical disks can begin deteriorating as part of the normal aging process. C4 to C5, C5 to C6, and C6 to C7 are the most involved segments related to the degree of flexion and extension of the spine at these levels.⁸ (See *Lateral and anterior views of the cervical vertebrae.*) Further degenerative changes include osteophytic spurring, facet joint hypertrophy, posterior longitudinal ligament calcification, and ligamentum flavum thickening.⁹ These arthritic changes can lead to tightness and stiffening within the motion segments and subsequent loss of the normal lordosis of the cervical spine. Pain from spondylosis is mechanical and described as a deep, dull, throbbing ache with occasional stiffness and/or headaches.^{6,7} The pain is typically located posterior along the midline or paraspinal aspects but can radiate to the occiput, trapezii, scapulae, and shoulders in a nondermatomal pattern.^{6,7}

Cervical disk herniation. Typically found over the lower segments from C4 to C7, this disorder is related to mechanical stress, which causes inflammation, osteophytes, bulging of the disk material, and/or facet joint degeneration, all of which can lead to nerve impingement.^{3,10} However, trauma can also produce herniation and is typically related to hyperflexion or compressive forces.¹¹ Symptoms of disk herniation are similar to spondylosis and occur in 80% of cases, but usually will involve radiating neuropathic pain called cervical radiculopathy.²

Cervical radicular pain is typically described as numbness, tingling, burning, shooting, stabbing, and/

Keywords: cervical disk herniation, cervical myelopathy, cervical spine disorders, cervical spondylosis, cervical stenosis, fractures, neck pain, radiculopathy

Lateral and anterior views of the cervical vertebrae



Source: Moore KL, Dalley AF, Agur AM. *Clinically Oriented Anatomy*. 8th ed. Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2018.

or electrical shocks in the upper extremities (unilateral or bilateral).⁷ These pains can follow a dermatomal fashion and can lead to sensory, motor, or reflex deficits.^{1,4,5} (See *Herniated disk between vertebrae C5 and C6*.) The pain can also radiate across or between the scapulae, and in some cases in an anterior cape pattern across the clavicles.^{5,12} Pain is typically increased when turning or bending the head ipsilateral to the source.⁷ Many patients state that their pain is alleviated when they rest their ipsilateral arm on top of their head, known as the abduction relief sign, or by tilting their head contralaterally.⁷

Cervical stenosis. Cervical stenosis is the narrowing of the neuroforaminal, lateral recesses, or central canal. It is classified as either degenerative relating to disk degeneration, facet hypertrophy, kyphosis, or ligamentum flavum hypertrophy; or congenital, which is associated with an altered spinal canal development causing spinal canal narrowing independent of degenerative changes.¹³ Symptoms of stenosis include those mentioned previously for spondylosis and may include radiculopathy. Stenosis is typically seen in older patients over age 50.

Cervical myelopathy. Left untreated, long-term compression of the spinal cord can result in an irreversible pathology called cervical myelopathy. Its onset and progression typically follow a slow, step-wise fashion with periods of static function.¹⁴ Cervical

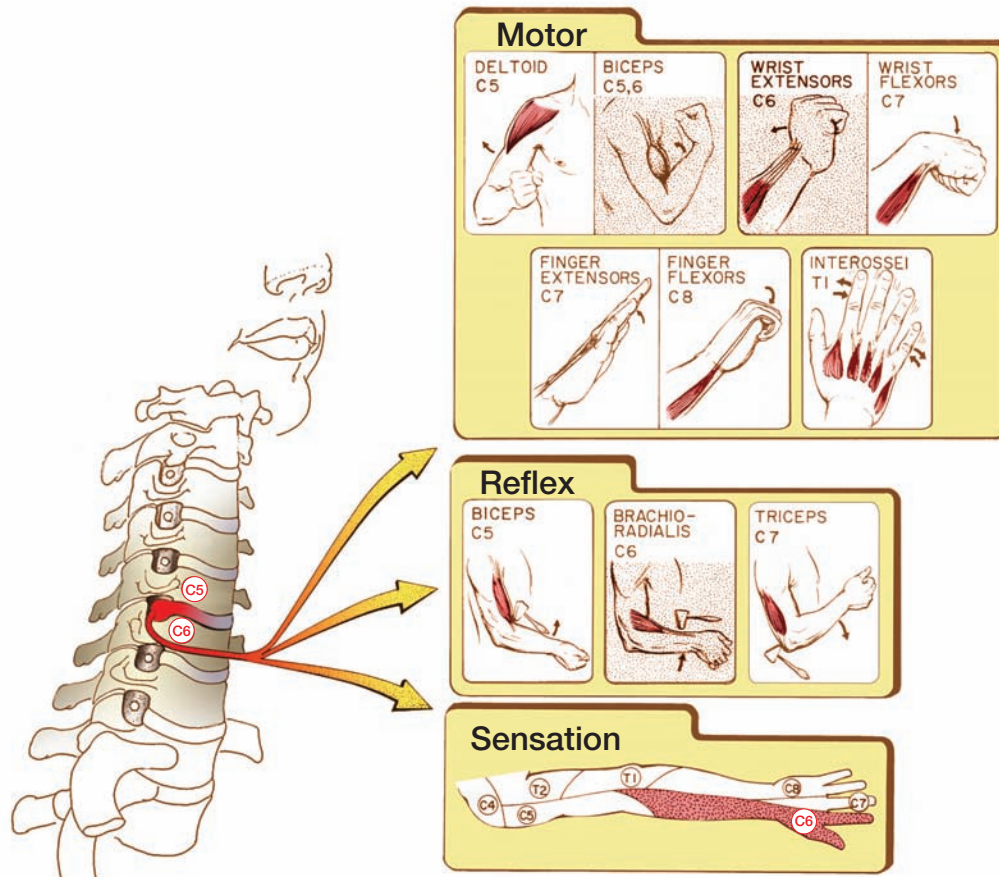
myelopathy, typically seen in those over age 55, is the most frequent cause of spinal cord dysfunction worldwide.¹⁵ Symptoms typically follow the dermatomal pattern of the involved vertebral level with development of fine motor disturbances, including grip difficulty, inability to manipulate buttons or zippers, imbalance, gait disturbances, sensory changes, hyperreflexia, pathologic reflexes, spasticity, and bladder or bowel incontinence.^{5,15,16}

Spinal column instability. Various other disorders involve the stability of the spinal column. Most instability in the spinal column is related to either degenerative or traumatic influences. Spondylolisthesis is the anterior or posterior vertebral displacement to the adjacent vertebra, typically related to disk or facet degeneration. Loss of lordosis, the natural curve of the cervical spine, can be noted in cervical sprain because of muscle tightness. Kyphosis, the reversal of lordosis, is associated with severe spondylosis or trauma.

Fractures. Fractures are commonly caused by traumatic forces on the spine and can occur at any vertebral level. A fracture of the atlas (C1) is called a Jefferson fracture. A traumatic spondylolisthesis of the axis (C2) is called a hangman's fracture, whereas an odontoid fracture, labeled Type I to III depending on the location, is a fracture of the C2 body.¹⁷ Compression fractures of any vertebral body can occur with trauma but also from pathologic processes, such as multiple myeloma.

Herniated disk between vertebrae C5 and C6

This illustration shows a herniated disk between vertebrae C5 and C6 involving the C6 nerve root. This is the most common level of disk herniation in the cervical spine.



Source: Hoppenfeld JD, Hoppenfeld S. *Orthopaedic Neurology: A Diagnostic Guide to Neurologic Levels*. 2nd ed. Philadelphia, PA: Wolters Kluwer; 2018.

Fractures can also occur across the facet joint itself with or without any instability. Fractures of the transverse or spinous process rarely result in instability.

■ Patient examination

When evaluating patients with neck pain, first determine if the causes are more mechanical or neuropathic. Neck pain should also be classified based on its duration, with acute pain lasting less than 6 weeks, subacute between 6 weeks and 3 months, and chronic more than 3 months, as this can help predict outcomes.⁷ The best approach in making this determination is an accurate history and physical examination. The patient history should be descriptive, including

any mechanism of injury; location of pain and if it radiates to the shoulder or scapulae; presence or absence of arm pain (unilateral or bilateral); balance and gait disturbances; pain with lateral, flexion, and/or extension range of motions; sensorimotor deficits; and aggravating or alleviating factors. Document prior beneficial or failed treatments, especially responses to specific medication regimens.

The physical examination should be thorough, encompassing inspection and palpation of the spine for alignment, tenderness, and any erythema or edema, assessment of the gait pattern, motor strength testing for weakness, sensory testing for dermatomal deficits, and reflex testing. (See *Associated dermatomal findings*

Associated dermatomal findings from motor, sensory, and reflex testing^{7,17}

Nerve root	Motor testing	Reflex testing	Sensory testing
C1-C2	Neck flexion	N/A	C1-none; front of face; skull (temporal & occipital)
C3	Lateral flexion	N/A	Lateral face; front and upper portion of neck
C4	Scapular elevation	N/A	Lateral and lower portion of neck; trapezius; supraclavicular (cape pattern)
C5	Shoulder abduction (deltoids); elbow flexion (biceps)	Bicep	Anterolateral deltoid; bicep; anterior upperarm to elbow; and forearm to wrist
C6	Wrist extension	Brachioradialis	Lateral upperarm and forearm to thumb, index finger, and 1/2 of middle finger
C7	Elbow extension (triceps); wrist flexion; finger extension	Triceps	Posterior forearm; middle finger
C8	Finger flexion	N/A	Medial forearm; ring and pinky fingers
T1	Finger abduction	N/A	Axilla; medial upperarm

from motor, sensory, and reflex testing.) A Hoffman sign, which is elicited by the downward flicking of the middle fingernail and considered positive with flexion of the thumb, index, or ring finger, is typically indicative of an upper motor neuron lesion but can be a false-positive finding in some patients.¹⁷ Rectal assessment is needed for patients complaining of bladder or bowel incontinence.

Special provocative tests, used to identify radiculopathy or cord compression, include the Spurling, shoulder abduction, and upper limb tension tests as well as the Lhermitte sign. The Spurling test involves turning the patient's head contralateral and ipsilateral to the pain, each time applying gentle downward axial compression.^{4,17} A positive result reproduces radicular pain related to constriction of the neural foramen. Shoulder abduction, as previously described above, is indicative of radicular symptoms. The upper limb tension test can be used to rule out radiculopathy but is not as frequently performed due to high sensitivity but low specificity.⁷ Lhermitte sign is an electrical sensation radiating down the spine and into the arms and/or legs when the patient flexes or extends his or her head.^{7,17} Lhermitte sign is indicative of cord compression but has less than 20% sensitivity.

■ Diagnostic evaluation

Routine imaging, including plain radiographs, is not warranted based on clinical guidelines due to the exposure to radiation and pathology identification, which does not always require treatment.¹⁸ If there is

concern for red flags, history of trauma, or the patient has failed conservative treatments after 6 weeks, then plain anterior/posterior and lateral radiographs can be ordered with the addition of flexion/extension views if there is concern for spinal instability.⁴

In patients with persistent or progressive neurologic involvement, use an MRI for all cervical spinal conditions.^{4,7,19} This is followed by a computed tomography (CT) scan or CT myelogram for patients unable to undergo MRIs, with CT myelography having preference over CT scan if there is concern for neurologic impingement.¹⁹ Contrast with MRI or CT is only needed if patients have had prior surgery. An important T2-weighted MRI finding for patients with cervical myelopathy is the presence of a hyperintense area near the spondylotic spine.¹⁶

■ Differential diagnoses

Serious pathology must first be ruled out before diagnosing any cervical spine disorders. This includes pain that is unrelieved in any position; typically worse at night or during rest; and/or associated with trauma, infection, malignancy, severe neurologic symptoms, and an age younger than 20 or older than 50.^{4,7,18,20} (See *Red flags: Neck pain differential diagnoses.*) For patients who experience more distal than proximal peripheral neuropathy, or whose radicular symptoms do not correlate with MRI findings, an electromyography and/or a nerve conduction study can provide clarification and possible diagnosis of ulnar neuropathy or carpal tunnel syndrome.⁴

Other possible differential diagnoses with neurologic changes in the upper extremity include Brown-Séquard syndrome, Guillain-Barré syndrome, brachial plexus injury, or thoracic outlet syndrome. Rheumatoid arthritis can lead to atlantoaxial or subaxial subluxation. Other inflammatory and spondylotic conditions affecting the spine include Marfan syndrome, ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis, and ossification of the posterior longitudinal ligament. Congenital deformities, such as Klippel-Feil syndrome, can cause restrictions to neck movements and pain.²¹ Adjacent segment degeneration, which is when a disk above or below a previously fused disk degenerates, can occur postoperatively. Metabolic syndrome has been documented to quadruple the prevalence of cervical spondylosis.²¹

■ Treatment

A correlation exists between a poorer prognosis and duration of pain from cohort studies.⁷ Most patients with acute neck pain will see resolution within 2 months. Even symptoms of cervical radiculopathy or stenosis can have a 40% to 76% spontaneous resolution over a variable length of time without treatment or surgery.⁷ However, some patients will require assistance through conservative treatments, which should always be the first option in the absence of serious pathology, to achieve the outcomes of pain relief, improved function, and enhanced quality of life. However, the evidence in support of any intervention remains overall low.²²

Nonpharmacologic. The traditional nonpharmacologic treatments for cervical spine disorders include physiotherapy, cervical traction, manipulation, transcutaneous electrical nerve stimulation (TENS), ultrasound, and acupuncture. Physiotherapy followed by an independent home exercise program has been shown in randomized controlled trials to reduce acute neck pain but lacked benefit in managing chronic pain, which was verified with low-quality evidence by Cochrane Review.^{1,3-5} Traction, based on Cochrane Review data, also had no support in patients with chronic neck pain; however, other studies documented low-level support for its use in acute neck pain.^{3,4,22} Manipulation also demonstrated low-level support from systematic review for use in acute neck pain, lacked support for chronic pain, and caution was recommended due to possible worsening of symptoms, especially in cases of cervical myelopathy.^{1,4,19,22} Cochrane Review found TENS to be more effective than placebo, and no evidence was

Red flags: Neck pain differential diagnoses^{4,7}

Trauma (fractures, ligament disruption)

- Spinal instability with or without spinal cord injury
- Neurologic symptoms, including loss of consciousness

Infection (immunosuppression, prior spinal injections or I.V. drug use, spinal abscess or diskitis)

- Fever
- Neck stiffness
- Elevated white blood cell count
- Neurologic deficits

Malignancy (history of cancer—personal or familial, multiple myeloma, bony metastasis)

- Fever
- Anorexia
- Unexplained weight loss
- Diffuse joint pain and stiffness
- Abnormal lab tests
- Unilateral versus bilateral neurologic findings

Severe neurologic symptoms (cervical myelopathy/demyelinating disease)

- Gait abnormalities
- Hyperreflexia
- Spasticity
- Bladder/bowel urgency or incontinence

Chest pain (myocardial infarction)

- Pain into the medial upper left arm
- Nausea

Age <20 (congenital abnormalities)

- Torticollis
- Birthmarks or skin tags
- Poor school performance

Age >50 (fracture, metastases, or carotid/vertebral artery disorders)

- Carotid bruits
- Headache
- Neurologic symptoms

provided for the use of ultrasound in the treatment of neck pain.¹ Systematic reviews did confirm that acupuncture was beneficial for short-term pain relief.^{1,6} In conclusion, most studies documented that multimodality strategies were more effective than employing single modality interventions.²²

Pharmacologic. Based on Cochrane Review and other systematic reviews, there is a lack of evidence supporting medication management, especially when considering their adverse reactions.⁴ If using medications, acetaminophen as first-line treatment has been recommended due to its low profile for adverse reactions but should be avoided in patients with hepatic contraindications, severe kidney impairment, or severe hypovolemia.^{6,7} Providers may use nonsteroidal

anti-inflammatory drugs (NSAIDs) for the relief of neck pain; however, NSAIDs have a gastrointestinal (GI) and cardiovascular (CV) boxed warning and are not to be used in patients with a history of GI bleeding or those at risk for bleeding, and those with CV disease or CV risk factors.^{6,7} There is also a risk of renal toxicity and hepatotoxicity with the use of NSAIDs. Muscle relaxant use is more effective for management of acute pain versus chronic pain.⁷ Benzodiazepines are not recommended because of the misuse potential and lack of greater efficacy.⁷ The use of opioid analgesics should be reserved for patients who have intractable pain unresponsive to prior treatments, used short-term and only as adjuncts to other conservative modalities, and patients must be supervised by providers and monitored for opioid misuse.⁶

Injection therapy. The use of cervical transforaminal epidural corticosteroid injections, which has been considered a mainstay in the treatment of cervical radiculopathy, was acknowledged by limited high-quality studies in systematic review to be used after failing at minimum 6 weeks of other conservative management.^{1,4,7,19,23} Support for other injections, such as trigger-point injections for myofascial pain or medial branch nerve injections or radiofrequency ablation, are weak.⁷ Selective nerve root blocks, typically used as a diagnostic injection, provided correlation with good surgical outcomes in patients with positive responses.¹² Complications can occur with injections from minor issues such as bleeding to serious complications including spinal cord or nerve trauma, epidural hematomas, and/or infection.²³


Surgery. If a patient's pain persists despite conservative treatments and they have evidence of neurologic involvement, surgery is typically recommended and is the main option for management of cervical myelopathy, which is consistent with systematic reviews. Surgeries are typically performed via anterior or posterior approaches, depending on the diagnosis. An anterior cervical decompression

and fusion (ACDF) is the standard procedure for single- to triple-level disk herniation with radiculopathy or myelopathy. A randomized study of 5 to 8 years found that patients who underwent an ACDF combined with physiotherapy had better outcomes than those who had only performed physiotherapy.²⁴ Posterior surgeries are used more for multilevel stenosis, myelopathy, or previously failed surgical outcomes. If a patient must undergo a surgical procedure, smoking cessation is highly recommended.

■ Prevention strategies and patient education

The most important management strategy for cervical spine disorders is evaluating and addressing psychosocial risk factors, also known as yellow flags, which can interfere with recovery, lead to the development of chronic pain, and/or cause long-term disability.⁶ These can include socioeconomic factors, reduced activity levels, compensation or litigation claim status, attitudes that spinal pain is severely disabling, and requests for opioid medications when inappropriate for treatment.⁶ (See *Yellow flags: Psychosocial risk factors*.) All patient treatment should begin with education regarding the diagnosis, which promotes self-management, reassurance, and encouragement for maintenance of an active lifestyle. The employment of cognitive behavioral therapy is a cost-efficient option to assist in handling psychosocial risk factors.²⁵ Another useful tool in the management of neck pain is shared decision-making, especially when it comes to decisions regarding treatment plans, especially surgery. The benefits of this plan include development of a therapeutic relationship with improved patient autonomy, participation, and satisfaction.

■ Conclusion

Cervical spine disorders are the second-most common musculoskeletal diagnoses after low back pain. It is imperative that providers obtain a comprehensive patient history and perform a thorough physical exam while clarifying the mechanism of injury, duration, and seriousness of pathology. Using evidence-based practices, a variety of treatments can be employed for the management of acute neck pain. Providers need to also address psychosocial risk factors and provide appropriate education techniques to include patients in self-management of their pain. By employing evidence-based guidelines as strategies for daily practice, providers can improve both the prognosis and outcomes for patients with cervical spine disorders. 

Yellow flags: Psychosocial risk factors⁶

- Socioeconomic factors
- Reduced activity levels
- Compensation or litigation claims
- Attitudes of severely disabling pain
- Requests for opioid medications when inappropriate for treatment

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The author and planners have disclosed no potential conflicts of interest, financial or otherwise.

DOI-10.1097/01.NPR.0000574648.67659.09

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