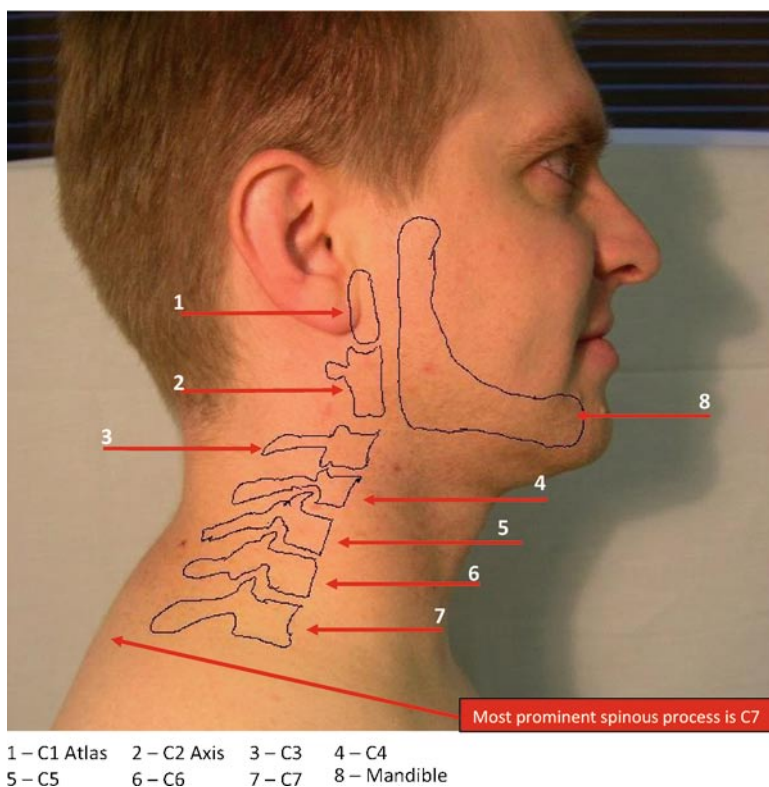


## Chapter 2

# The Cervical Spine

James M. Daniels and Joel Kary

### Functional Anatomy



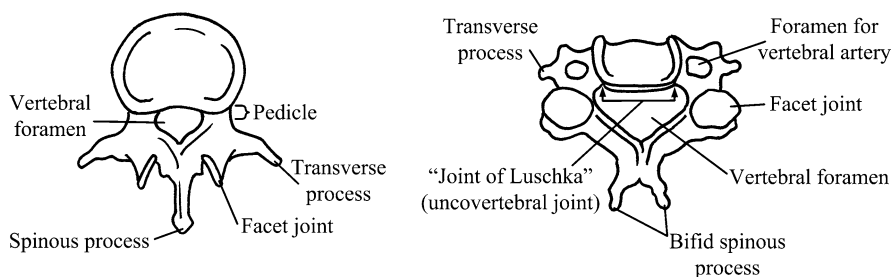
**Fig. 2.1** Surface anatomy of cervical spine

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Figure 2.1 illustrates the surface anatomy of the cervical spine (C-spine). The C-spine consists of seven vertebrae (C1–C7) and supports the weight of the head (approximately 14 pounds). The first two vertebrae are called the axis and atlas, respectively, and do not have a disc between them, but are closely bound together by a complex of ligaments. The C1 (axis) “ring” rotates around the odontoid or “peg” of C2 (atlas), allowing for almost 50% of total cervical rotation. The spinal canal is housed within the cervical vertebrae and is widest between the C1 and C3 levels (A-P diameter 16–30 mm) and narrows as it progresses caudally (14–23 mm). When the neck is fully extended, this canal can narrow an additional 2–3 mm.

Cervical spine vertebrae differ from lumbosacral vertebrae in several ways. First, there are foramina on each side which allow passage of the vertebral arteries. Additionally, the facet joints in the C-spine have steeper angles which allow for more rotation between vertebrae without subluxation. The most important difference, however, is the nonsynovial joint, known as the uncovertebral joint or “joint of Luschka.” During midlife, this joint prevents a disc rupture from directly pressing onto the nerve root. This means that most disc herniations in the neck occur posteriorly (unlike the LS spine, in which most herniations occur laterally). As we age, these joints can form osteophytes that can impinge upon the nerve root or compress the cervical cord directly causing cervical myelopathy. Figure 2.2 shows the major differences between lumbar and cervical vertebrae.



**Fig. 2.2** Comparison of cervical (*left*) and lumbosacral (*right*) vertebrae

## Red Flags

Some serious conditions can present as neck pain, and the following are considered “red flag” conditions which should spur further evaluation.

1. **Trauma:** Neck pain in the setting of trauma should receive emergent evaluation and is best managed in an emergency department. If there is any fear of spine instability, 9-1-1 should be summoned.

2. *History of neck surgery*: New neck pain in a patient who has had prior neck surgical intervention must be approached with caution. Strong consideration to immediate referral should be given in all but the most clear-cut cases.
3. *Rapidly progressing neurological deficit*: Patients who present with rapid, progressive neurologic deficits should be suspected of having CNS involvement and should be urgently referred.

## Approach to the Patient with Cervical Spine Pathology

Neck pain is extremely common; almost 70% of the population experiences neck pain at some time. Neck pain accounts for almost 1% of all visits to primary care physicians in the United States.

History is quite helpful in sorting out different types of C-spine pathologies. Important questions include the nature, duration, and location of the pain, associated numbness or tingling in either or both upper extremities, duration of the pain, other musculoskeletal symptoms, and inquiring about any history of trauma.

In patients presenting with neck pain, the physical exam must include a neurologic evaluation. The necessary exam will differ with different types of patient presentations (evaluation is described in detail below). Most patients with neck pain in the absence of neurologic findings will have benign neck pain which requires no further workup. Two different sets of rules have been created to assist health care providers in determining when imaging is appropriate (the Canadian Task Force (CTF) X-ray Rules and the Nexus Rules). It has been suggested that the CTF rules are more relevant in the primary care setting. These rules are shown in Table 2.1.

## Common Clinical Presentations

### *“Mechanical” Neck Pain*

This is by far the most common neck condition the primary care provider will encounter. Mechanical neck pain is typically reported as diffuse, nonspecific, and made worse with neck movement. Two-thirds of these patients have pain in their shoulders and upper arms in a nonradicular pain pattern. The other one-third of these patients will present with headaches sometimes radiating to the front of the head.

The primary goal in evaluation of patients with mechanical neck pain is to exclude worse pathology. In the absence of neurologic symptoms or neurologic

**Table 2.1** Canadian C-spine task force rules

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*Condition 1:* Perform radiography in patients with any of the following

- Age 65 years or older
- Dangerous mechanism of injury
  - Fall from 3 feet (1 m) or 5 stairs
  - Axial load to the head, such as diving accident
  - Motor vehicle crash at high speed (>62 mph)
  - Motorized recreational vehicle accident
  - Ejection from a vehicle
  - Bicycle collision with an immovable object
- Parasthesias in the extremities

*Condition 2:* In patients with none of the above characteristics, assess for any low-risk factor that allows safe assessment of neck range of motion. Perform radiographs to assess patients **WITHOUT** any of the low-risk factors listed here. Perform the range of motion examination described in Condition 3 to assess patients **WITH** any of the low-risk factors listed.

- Simple rear-end motor vehicle accident
- Sitting position in emergency department
- Ambulatory at any time
- Delayed onset of neck pain
- Absence of midline cervical spine tenderness

*Condition 3:* Test active range of motion in patients with **ANY** of the low-risk factors listed in Condition 2. Perform radiography in patients who are unable to actively rotate the neck 45° both left and right. Patients able to rotate their neck, regardless of pain, do not require imaging.

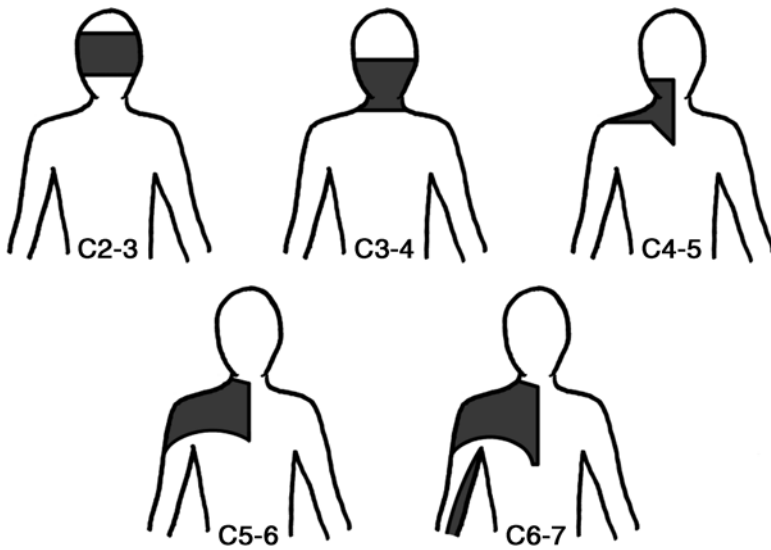
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findings, these patients can be managed conservatively. Management strategies include use of NSAIDs, activity and postural modification, physical therapy (PT), muscle relaxants, and occasionally, limited use of opioids.

## ***Cervical Radiculopathy***

Cervical radiculopathy is the result of nerve root irritation or ischemia and can occur at multiple levels. It usually presents with nonspecific neck pain, but the most prominent symptom is that of weakness, numbness, and tingling in one of the upper extremities. Patients with these symptoms that occur before the age of 35 should be suspected of having congenital abnormalities. The pain pattern may help make the diagnosis of cervical radiculopathy (see Fig. 2.3).

At times it is difficult to determine if a patient's pain is coming from the C-spine, the shoulder, or both. Patients complaining of pain in the posterior part of their shoulder or who have symptoms below their elbow often have a cervical pathology as the source of their pain. In addition to this, patients with C-spine pathology will complain of increased symptoms doing overhead work and will sometimes have their symptoms relieved by adducting their shoulder and resting their hand on the top of their head. Figure 2.4 describes the common motor and sensory evaluation of nerve roots C5–T1.



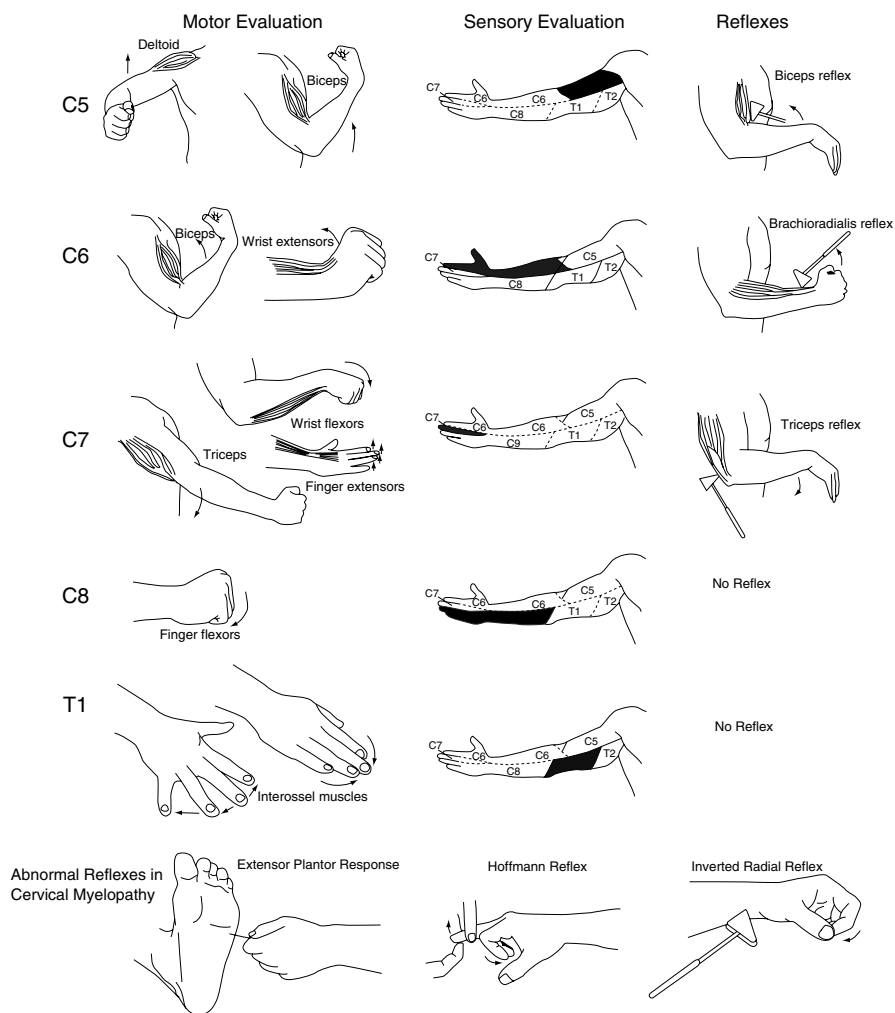
**Fig. 2.3** Pain patterns at each cervical level. (Adapted from Grubb SA, Kelly CK, Bgодук N (2000) Cervical discography: clinical implications from 12 years of experience. *Spine* 25:1382–1389.)

There have been a large number of studies that have tried to identify clinical signs or symptoms that can be associated with the diagnosis of nerve root impingement. Perhaps the most clinically useful set was described by Dr. Weiner et al., who identified a test item cluster. In this study, the authors found that there were four predictable variables that most likely identified patients with cervical radiculopathy:

1. Cervical rotation of less than  $60^\circ$  to the ipsilateral side.
2. A *positive Spurling's test*. This test is performed with the patient in a seated position. The patient laterally flexes the neck to the ipsilateral side and the examiner places pressure on the top of the patient's head. If the pressure on the patient's head reproduces the patient's symptoms into the arm, then the test is positive (see Fig. 2.5).
3. A *positive distraction test*. This test is performed with the patient in a supine position. The examiner cradles the patient's neck on the occiput and exerts traction. If this relieves some of the patient's symptoms, it is positive.
4. A *positive upper limb test*. This test is performed with the patient in a seated position. The patient abducts the arm to  $90^\circ$  and with the elbow completely extended, the examiner dorsiflexes the wrist. This maneuver can reproduce patient's symptoms if the cause is cervical nerve related.

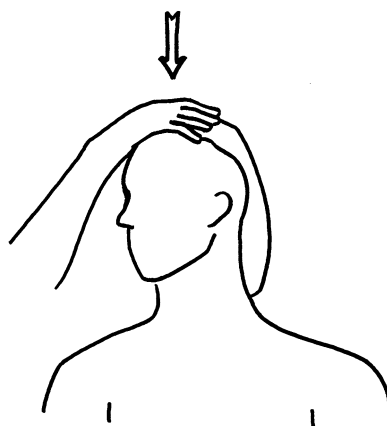
These four tests combined are useful for the evaluation of radiculopathy: if three of the signs are present, the LR+ for radiculopathy is 6.1; if all four are present, the LR+ is 30.3; fewer than three of the signs are less helpful for predicting radiculopathy.

In most cases, PT and pain control are reasonable treatment modalities for radiculopathy. An MRI should be ordered to confirm the diagnosis and to identify



**Fig. 2.4** Motor, sensory, reflex evaluation of cervical spine nerve roots

**Fig. 2.5** Spurling's maneuver



any other anomalies; if this is negative, the patient generally does not need orthopedic referral. If the MRI shows significant findings, or if the patient does not respond to PT, referral should be considered. Steroid injections have sometimes been used, but are somewhat technically difficult, and there are concerns about potential complications.

### *Cervical Myelopathy*

Cervical myelopathy occurs when the spinal cord is either directly compressed or rendered ischemic by compression. This can be caused by a congenitally small spinal canal or the normal “degeneration” of structures of the cervical spine. The most common culprits include the thickening of the ligamentum flavum and the spurring of the uncus vertebral joint. The uncus vertebral joint “protects” the cord from lateral disc herniation in midlife, but as a patient ages and osteophytes start to form in this joint, they can exert direct pressure on the spinal cord. This is most commonly seen in the sixth decade of life and may present acutely as a result of a minor fall or injury. There are a number of other entities that can also masquerade as cervical myelopathy. These include peripheral neuropathy, upper motor neuron disease, multiple sclerosis, cerebral vascular disease, and syringomyelia.

Cervical myelopathy may present with neck pain and bilateral upper extremity symptoms (pain, numbness, or tingling as in radiculopathy), along with report of loss of balance or lack of coordination. Most commonly, patients with cervical myelopathy present with clumsiness or lack of fine motor skills in the hands or an increasingly awkward gait and difficulty in maintaining balance. Patients may also complain of urinary urgency and hesitation, but rarely of incontinence.

Physical exam findings include abnormal reflexes often found in patients with cervical radiculopathy. These patients are often hyper-reflexic and may have upgoing Babinski reflexes, inverted radial reflex (flexor tendons of the wrist are struck on the radial aspect of the forearm with a reflex hammer and the index finger will flex), and Hoffman’s reflex (flexion of the index finger and thumb when the examiner “flicks” the patient’s middle finger nail) (Fig. 2.4).

Occasionally, these patients may present acutely after falling or may present when ischemic insult occurs in the cord such as a thrombosis of the posterior inferior cerebral artery. Patients with these symptoms should be evaluated and referred on for further evaluation.

Patients with suspected or confirmed cervical myelopathy should be referred to an orthopedic or spinal surgeon. MRI can confirm the diagnosis, but if clinical symptoms are suggestive without imaging, referral should be made at that time.

## Whiplash Associated Disorder

Whiplash associated disorder (WAD) commonly occurs in “rear-end” motor vehicle crashes. There are many theories as to why patients have so much discomfort after sustaining this type of injury. Facet joints may be the primary generators.

Although our legal system has long been blamed for perpetuating this problem, studies have shown that in countries where there is little or no involvement of the legal system in a motor vehicle injury, there is no difference in persistent neck symptoms in patients involved in rear-end car crashes. A number of high quality studies have shown that a certain percentage of patients, an average of 33%, reported chronic symptoms after sustaining this type of injury. The Quebec task force recommends that only patients with peripheral neurological findings and those with fracture dislocation require surgical intervention.

These patients will generally complain of symptoms similar to those associated with mechanical neck pain. Headaches are common, but physical examination will reveal no evidence of neurologic compromise. Treatment of WAD generally mimics that for mechanical neck pain (see above).

## Conclusion

Most patients with neck pain have benign “mechanical” neck pain. The primary goal in evaluation of these patients is to rule out more serious pathology. Those with serious pathology require more intense workup and management, while those with mechanical symptoms can be reassured and managed conservatively. Careful history and physical exam can easily distinguish between potentially serious and benign causes of pain.

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Common Musculoskeletal Problems

A Handbook

Hoffman, M.R.; Daniels, J.M. (Eds.)

2011, IX, 157 p. 71 illus., 36 illus. in color. With online files/update., Softcover

ISBN: 978-1-4419-5522-7