

## Evaluation and Management of Cervical Radiculopathy from Disc Herniation and Degenerative Disorders

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### Abstract

Cervical radiculopathy (CR) is the disturbance of cervical spinal nerve roots giving rise to significant pain and functional impairment. While degenerative spinal diseases are the most common cause of CR, especially in the older age groups, herniation of the cervical discs is the most common cause in the younger population.

The primary symptom of CR is neck pain that radiates down to the shoulders, arms, forearm, and hands up to the fingers. Pain is often associated with sensory and/or motor symptoms depending upon the stage and severity of the impingement of the nerve root(s). The symptoms may start as acute from a single event or as chronic from repeated episodes.

Most cases of CR are managed by conservative measures which include anti-inflammatory medications, cervical collars, physical therapy, and exercises. Surgical interventions are rarely necessary and are reserved for those cases with significant neurological deficits.

In this article, we discuss key points in the clinical evaluation and methods of conservative management of the two major causes of cervical radiculopathy, i.e. cervical degenerative disorders and cervical disc herniation.

**Keywords:** Neck Pain; Cervical Radiculopathy; Disc Herniation; Spondylosis

### Introduction

In 2010, The North American Spine Society (NASS) comprehensively defined CR as “A pain in a radicular pattern in one or both upper extremities related to compression and/or irritation of one or more cervical roots. Frequent signs and symptoms include varying degrees of sensory, motor, and reflex changes as well as dysesthesias and paresthesias related to nerve root(s) without evidence of spinal cord dysfunction” [1].

Disturbances of nerve roots are usually brought about by two distinctive pathologies. About 75% of cases are due to degenerative diseases and 20 - 25% of cases are by herniation of the intervertebral discs [2]. Numerous studies from diverse backgrounds have confirmed these findings. Some rare causes of CR such as trauma malignancy, infection, and inflammatory arthritis (called red flags) are not discussed here.

### Etiology

Irritation, impingement, or compression of a spinal nerve root by any pathology can result in radicular symptoms in the presence or in the absence of neck pain. In younger populations, cervical radiculopathy is most commonly caused by disc herniation, which accounts for one-fourth of total cases. In older patients, it is the result of degenerative spinal disorders. Degenerative changes which contribute to radicular symptoms include a decrease in disc height, foraminal narrowing, thickened ligaments, and formation of osteophytes. The most commonly affected nerve roots are C7 followed by C6. Manual laborers, smokers, drivers, and vibrating equipment operators have been found to be the high-risk groups [3]. Poor neck posture is the major contributing factor both in disc herniation and spondylosis. Studies have shown that sedentary workers such as computer jobs are having a higher risk for neck pain compared with other jobs [4].

### Epidemiology

Neck pain is a common problem in the general population. Yearly, about 30–50% of adults are found to be experiencing neck pain [5].

Neck pain with neurological symptoms (i.e. cervical radiculopathy) is less common than simple neck pain. The annual incidence of cervical radiculopathy is about 85 per 100,000 people and the prevalence is about 3.5 in 1000. The most common age to be affected is between 50 - 60 years.

According to a population-based study, about 21.9% of patients with cervical radiculopathy showed cervical disc herniation and about 68.4% showed degenerative spondylotic changes [2]. A recent systematic review by Mansfield, *et al.* showed the incidence of cervical radiculopathy between 0.83 and 1.79 per 1000 person-years, and prevalence between 1.2 to 5.8 per 1000 persons [6].

### Pathoanatomy

There are 7 vertebrae, 5 intervertebral discs, and 8 nerve roots present in the cervical spine. Intervertebral discs are located between the bodies of C2-C7. The discs are composed of an outer annular fibrosus and an inner nucleus pulposus the discs are thicker anteriorly which contributes to normal cervical lordosis.

**Cervical spondylosis:** Involves the intervertebral discs, uncovertebral joints, and facet joints. Reduction in disc space loosens the ligaments and makes the joints unstable. These changes throw abnormal loads on the facet and uncovertebral joints which eventually result in the development of osteophytes. The collapse of the cervical discs also leads to the loss of normal lordosis of the cervical spine. Hypertrophy of ligaments and formation of osteophytes singly or in combination result in foraminal stenosis and subsequent impingement/compression of the nerve roots [7].

**Cervical disc herniation:** It is due to rupture of the annulus fibrosus, which allows a portion of the nucleus pulposus materials to herniate posterolaterally between the posterior edge of the uncinat process and the lateral edge of the posterior longitudinal ligament. The herniated nucleus pulposus mechanically compresses the nerve roots and causes neurological impairment, thereby resulting in acute radiculopathy.

So, acute nerve compression is secondary to herniated nucleus pulposus, and chronic nerve compression is due to degenerative osteophytes-hypertrophied ligament complexes. Muscular weakness follows a myotomal pattern and sensory disturbances follow the distinctive dermatomal distribution of the specific nerve roots.

### Symptoms

The classical presentation of CR is neck pain, arm pain, and sensory symptoms along the distribution area of the affected nerve root. Severity may range from dull aching to severe burning pain [8].

The onset of radicular symptoms may be sudden or gradual. The symptoms may be disturbances of sensory and /or motor functions. They are almost always unilateral, and in rare situations such as trauma or mass lesions, both sides of nerve roots may be compressed, resulting in bilateral deficits. The area of the symptoms corresponds to the distribution of the affected nerve roots.

Sensory symptoms manifest as paresthesia, numbness or blunted sensation, and motor disturbances such as weakness and/or decreased tendon reflexes in the areas supplied by the affected nerve roots.

Henderson CM., *et al.* reviewed over 800 patients with cervical radiculopathy and found arm pain in 99.4%, sensory deficits in 85.2%, scapular pain in 52.5%, anterior chest pain in 17.8%, headaches in 9.7%, anterior chest and arm pain in 5.9%, and left-sided chest pain and arm pain in 1.3% [9].

### Clinical evaluation

Look for loss of normal lordosis of the cervical spine. Palpate for localized tenderness. Document range of motion: flexion, extension, rotation, lateral flexion. Below are some of the provocative tests which can assist in the diagnosis of CR.

**Spurling's test:** is performed by extending and laterally rotating the neck on the symptomatic side. Reproduction of radicular symptoms is considered positive. This test is useful and very specific for diagnosing cervical radiculopathy. As it has low sensitivity, a negative test does not rule out the disease [10].

**Shoulder abduction test:** if the overhead abduction of the shoulder on the affected side relieves pain, it is considered positive. This test has low to moderate sensitivity and moderate to high specificity [11].

**Traction/neck distraction test:** Gentle traction of the head is applied while the patient is lying supine on the table. Relief from pain is a positive sign for CR [11].

**Upper limb tension test:** This is the upper limb equivalent of a straight leg raising test conducted for sciatica of the lower limb. While the patient is lying supine on a table, the shoulder is abducted, then the forearm is supinated, and the wrist is extended. From this position, the shoulder is externally rotated and the elbow extended. Lateral bending of the neck will result in pain in the upper limb. This is the most sensitive of all provocative tests [12].

Neurologic examination is the critical aspect of the physical examination in the evaluation of radiculopathy. The key neurological findings of individual nerve roots in CR:

- C5: Deltoid and biceps weakness, reduced biceps reflex.
- C6: Brachioradialis and wrist extensor weakness, reduced brachioradialis reflex, thumb paraesthesia.
- C7: Triceps and wrist flexion weakness, diminished triceps reflex, paraesthesia in the index, middle, and ring fingers.
- C8: Weakness of distal phalanx flexion, paraesthesia of little finger.

### Radiological evaluation

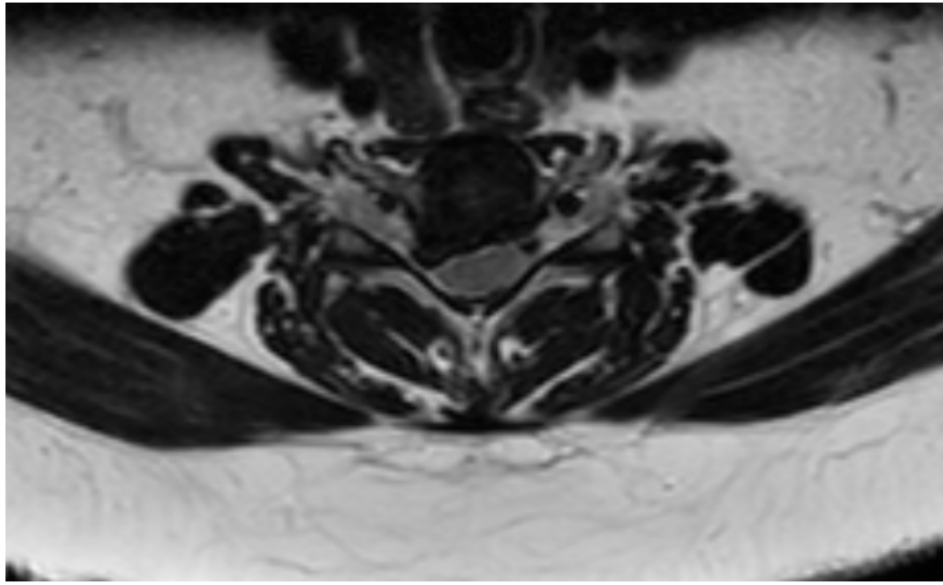
Cervical spine radiographs are the initial step in the evaluation of CR. They can identify fractures, narrowed disk space, osteophytes, tumors, or spondylolisthesis. Flexion and extension films should be obtained if segmental instability is suspected. However, these dynamic radiographs have limited value if neck mobility is affected by pain and spasm [13].



**Figure 1:** Lateral view of the cervical spine showing degenerative changes at C5-6 level and kyphotic alignment.



**Figure 2:** T2-weighted sagittal MRI image demonstrating disc protrusion at C5-6 with indentation of the spinal cord.



**Figure 3:** T2-weighted axial MRI at the level of the herniated disc demonstrating posterolateral disc herniation with narrowing of neural foramina.

**Magnetic resonance imaging (MRI):** MRI is the imaging modality of choice for evaluating radiculopathies. MRI images provide excellent details of soft tissue abnormalities including annulus tears, disc herniations, ligament hypertrophies, foraminal narrowing, thecal, and nerve compressions.

However, we must be aware that asymptomatic degenerative changes are quite common in the general population; hence the MRI findings alone are not sufficient and systematic clinical examination must be carried out for the symptoms [14].

**Upright/dynamic MRI:** The symptoms of cervical spine pathology may become less severe in the supine position but exacerbated in upright and flexion/extension positions. Hence, imaging in a supine position can be misleading.

MRI scan taken in an upright position allows natural compression of cervical structures by the weight of the head. The images can be captured in dynamic flexion and extension positions of the neck. As patients can be scanned in symptomatically provocative positions, suspicious occult stenosis, disc protrusion, or instability can be detected with better certainty [15].

**Computed tomography (CT):** Bone anatomy, osteophytes and calcification can be effectively visualized with CT images. A CT myelography helps to visualize the spinal cord and nerve roots. This imaging modality is an alternative option if MRI is contraindicated [16].

**Electromyography (EMG) and nerve conduction study (NCS):** It can be ordered if clinical signs and symptoms do not match with specific findings on imaging studies, i.e. in confusing situations. There are several conditions that could share clinical symptoms of cervical radiculopathy. These include entrapment neuropathies of median/ulnar/radial nerves, brachial neuritis, thoracic outlet syndrome, and inflammatory polyneuropathies. Detailed clinical examination and careful interpretation of EMG/NCS by well-experienced physicians will minimize the ambiguities in the clinical diagnosis [17].

**Inflammatory mediators:** Both chemical and mechanical factors have been proposed in producing nerve root pain caused by disc herniation. Torn annulus fibrosus induces an inflammatory reaction in the vicinity of nerve roots. Serum levels of proinflammatory cytokines (IL-2, IL-6, IL-8, TNF- $\alpha$ ) have been found higher in lumbar disc herniation and sciatica than with control subjects. We can find only a few studies in the literature that have investigated the relationship between cervical disc herniation and serum inflammatory markers [18].

### Diagnosis

There are no universally accepted criteria to diagnose cervical radiculopathy. The final diagnosis must be arrived at after combining the history of presenting symptoms, physical examination findings, clinical signs, and radiological investigations. During the evaluation, serious causes of radiculopathy and signs of myelopathy should be meticulously looked into and ruled out before the commencement of treatment.

### Treatment

The aims of treatment in cervical radiculopathy are health education with regard to good ergonomics, pain relief, functional improvement, resolution of neurologic deficits, and prevention of future episodes. It is to be noted that over 85% of acute cervical radiculopathy resolves without any specific treatments within 8 - 12 weeks [19].

So, a nonsurgical treatment approach is the most appropriate and preferred choice in the initial management of cervical radiculopathy. It is also the definitive form of management in the majority of patients. However, a complete recovery may be prolonged for more than 2 years. In a study by Wong JJ., *et al.* up to 90% of patients showed resolution of symptoms with non-operative care alone. But, the time for recovery ranged from 24 to 36 months [20].

**Analgesics:** The initial agents for controlling pain in cervical radiculopathy are non-steroidal anti-inflammatory drugs (NSAIDs). They are taken for a period of 1 to 2 weeks in the acute phase to get relief from acute pain. The intake of oral steroids is controversial; if advised, it must be limited for a short duration.

The guidelines by the International Association for the Study of Pain included tricyclic antidepressants, serotonin-norepinephrine reuptake inhibitors, gabapentin, pregabalin, and topical lidocaine as first-line choices in managing neuropathic pain. Opioid analgesics and tramadol were recommended as good second-line drugs [21].

Opioid analgesics are generally not recommended but are reserved for intractable radicular pain. The use of opioid medications should be avoided whenever possible, due to their dependence and addiction potential [22]. Skeletal muscle relaxants are useful in controlling acute neck muscle spasm and as adjunctive agents in the treatment of CR.

### Physical therapy

In acute neck pain secondary to cervical radiculopathy, starting physical therapy can worsen the pain and may prolong the duration of symptoms. Neck immobilization for a short duration (5 - 7 days) will reduce symptoms in the inflammatory phase. Immobilization is carried out by soft cervical collars, which can reduce acute pain in up to 75% of patients. Range of movement exercises and strengthening exercises should be discouraged during the acute phase of the disease. These exercises can be started after the resolution of acute symptoms [23].

Physiotherapy is an important non-operative modality. It is aimed at restoring the range of motion and strengthening the neck muscles [24]. After the pain subsides, stretching, strengthening, range of motion, and resistance exercises may be incorporated into physical therapy.

**Traction:** Cervical traction has been widely used to help relieve neck pain with or without radicular symptoms. The mechanical effects of traction are the separation of vertebral bodies, movement of facet joints, expansion of intervertebral foramen, and stretching of soft tissues. Continuous as well as intermittent traction have been found to be an effective strategy in CR as they widen the disc spaces and relieve the pressure on the nerve roots from herniated cervical discs or osteophytes. Traction as an adjunct therapy has been evaluated for the treatment of 1. Neck pain, 2. Radicular pain resulting from disc herniation and 3. Radicular symptoms due to cervical spondylosis. Most reports in the literature showed favorable results in all three scenarios [25].

**Manual therapy:** Manual therapy includes mobilization and manipulation. Mobilizations are low-velocity, passive movements applied within the range of motion of the involved joints. On the other hand, manipulation is a high-velocity force directed near the terminal range of motion [26].

Spinal manipulation as a recommended method in managing cervical spine disorders remains unsettled owing to some serious, albeit rare, neurovascular adverse events reported with this technique [27].

**Exercises:** Exercise is the key element in the rehabilitation of musculoskeletal disorders. Cervical spine disorders are known for recurrence. Exercise will achieve good neuromuscular control that will decrease recurrence and help slow down disease progression. For this reason, adequate rehabilitative exercises to restore normal muscle function should always be emphasized [28].

**Steroid injections:** Epidural steroid injections are given under fluoroscopic or CT guidance. They act by decreasing inflammation at the site of nerve irritation, thereby offering immediate relief from pain. Again, the injections are advisable for those who fail to show improvement with other methods of the above-discussed nonoperative care.

### Discussion

In one of the largest cohort studies, 75% of patients managed nonsurgically with a cervical collar, analgesics, muscle relaxants, physical therapy, and isometric exercises showed improvement [2].

In another cohort study of 26 patients with herniated discs and symptomatic radiculopathy, a non-operative treatment program showed successful results in 92 percent of patients after a one-year follow-up [29]. The conservative treatment included a program of physical exercise, cervical traction, patient education, and administration of oral NSAIDs.

Symptoms related to prolonged poor posture may not respond to changing of lifestyle to healthy ergonomics alone. In addition to good posture, stretches and exercises are recommended for better relief of symptoms.

It also must be noted that patients' responses to exercise programs may vary depending on the stage of the disease and the scale of the pain and disability. Therefore, different training protocols appropriate for individual cases should be formulated. A multidisciplinary approach with a team of physicians and physiotherapists is essential in this regard [30].

The progression of radiculopathy to myelopathy is very rare. In the absence of a significant neurological deficit or progressive weakness, nonsurgical management should be tried for an extended period of time [31].

A task force on neck pain and its associated disorders concluded that there is no clear evidence that surgical treatment of cervical radiculopathy provides better long-term outcomes than nonoperative measures [32].

Intervention by surgical procedure should be kept as a last resort in patients who do not show satisfactory improvement after spending an adequate and extended period of conservative management. It also must be emphasized that the physician should differentiate between cervical spine disease that can be managed conservatively and more serious diseases which may require surgical intervention.



Treatment modalities of CR discussed in this paper have not covered the rare causes of CR such as congenital abnormalities, cancer, traumatic injury, infections, etc. Managing these situations warrants careful evaluation, separate sets of investigations, and specific treatment protocols.

### Conclusion

The clinical course of CR is usually long. Though most of the reduction in symptoms occurs within 6 months, complete relief may take more than a year. Medications help alleviate pain and neuropathic symptoms. Cervical collars are used for short-term immobilization, and traction to decompress nerve impingement. Physical therapy and manipulation improve neck discomfort. The effectiveness of individual treatment alone will not adequately relieve the symptoms. Hence, a multimodal approach will certainly benefit patients with cervical radiculopathy.

### Conflict of Interest

The authors declare no conflict of interest.

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