Cervical Orthopedic Tests

This protocol contains descriptions of various orthopedic tests applied to the cervical region. The following tests are included:

- Bakody’s Sign
- Cervical Flexion (including Brudzinski’s Sign, Lhermitte’s sign, Lindner’s sign)
- Cervical Compression, Jackson’s Compression, Maximum Foraminal Compression
- Cervical Resisted Muscle Tests (includes O’Donoghue maneuver)
- Doorbell Sign (AKA anterior cervical doorbell push button test)
- Rust’s Sign
- Shoulder Abduction Test
- Shoulder Depression
- Soto-Hall Test

In addition are four appendices, offering an overview of tests that can be performed as “packages” based on the suspected type of condition. There is also one appendix with advice for charting.

- Appendix A: Summary of exam procedures to perform for suspected cervical radiculopathy
- Appendix B: Summary of exam procedures to perform for suspected cord lesions
- Appendix C: Summary of exam procedures to perform for suspected brachial plexus, neurovascular, or other nerve entrapment syndromes
- Appendix D: Summary of exam procedures to perform for suspected lumbosacral radiculopathy
- Appendix E: Charting the results of pain provocation tests

**Note:** These documents present a standardized approach to orthopedic testing to be used in WSCC clinics. Over time, more orthopedic procedures will be added to this document.

Photos contributed by Dr. Novak and Dr. LeFebvre. Formatting done by Anne Byrer.
Indications for Testing
This is not a test but is simply observed in the patient with neck and/or arm symptoms.

Procedure
Patients may present in this posture, which should be immediately recognized as a red flag. The hand may or may not be resting on the head since axial compression can provoke even more discomfort.

Mechanism
Nervous tissue. Raising the arm overhead tends to reduce neurological tension in the nerve roots, spinal nerves, and the brachial plexus, and may also decrease intraforaminal pressure.

Interpretation
The sign, when it reduces peripheral symptoms in the upper extremity, is suggestive of cervical radiculopathy and may be secondary to cervical disc herniation. Patients with radiculopathy from degenerative osteophytosis resulting in foraminal encroachment may also experience relief of symptoms in this posture. Check to see that the cervical spine remains in a neutral position: lateral flexion toward the side of radiculopathy increases foraminal encroachment and disc bulging; lateral flexion away further tractions the nerves. The presence of this sign also suggests that abduction of the arm may be helpful during cervical joint palpation and manipulation. (See WSCC care pathway, Neck Pain and Arm Symptom.)

Charting
Sample language for use in a narrative report: “Patient presented holding the symptomatic arm above his/her head for pain relief (Bakody’s sign).”

See Appendix E: Charting the results of pain provocation tests.

Reliability and Validity
This sign is thought to be nearly pathognomonic for radiculopathy and to have a high likelihood specifically for cervical disc herniation (based level V evidence: published expert opinion). Although unreported, sensitivity is likely to be low. For more information, see Shoulder Abduction Test.

Follow-up Testing
See Appendix A: Summary of exam procedures to perform for suspected cervical radiculopathy.

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Sources


CERVICAL FLEXION (includes Brudzinski’s sign, Lhermitte’s sign, Lindner’s sign) 5/17/05

Indications for Testing
Cervical flexion can be used as a neurodynamic test for lesions of the meninges, spinal cord or nerve roots. It is indicated in suspected cases of

1. meningitis (Cipriano 1997);
2. spinal cord lesions, including multiple sclerosis, cervical spondylitis, and other forms of spinal cord compression (e.g., patients with neck or back pain who also complain of lower extremity symptoms, hand clumsiness, changes in bladder function); and
3. cervical or lumbar disc herniation or radiculopathy. Because this maneuver results in nerve root traction, it can be used to confirm a positive straight leg raise test or be incorporated as part of the maximum straight leg raise test for patients with leg pain.

Procedure
Depending on the circumstances, the patient can be seated or supine. The practitioner supports the patient’s head and moves the neck though the entire range of flexion to patient tolerance. Performing cervical flexion with the patient in long leg sitting (i.e., sitting with the legs straight out on an adjusting table), rather than the normal sitting position, creates more tension and may further sensitize the test similar to the Slump Test.

Mechanism
With neck flexion, the dural sac, meninges, spinal cord, and nerve roots are elongated under a tensile load. The medulla oblongata may elevate 4 mm. (Orient 2000) Stretching of an inflamed dural sac or injured spinal cord will cause pain at the level of irritation. Flexing the hips and knees reduces tension on the meninges (knee flexion decreasing tension on the sciatic nerve and hip flexion decreasing tension on the femoral nerve). (McGee 2001) In the presence of sclerotic lesions or other scarring in the cord or dura, the patient will experience “nerve pain,” described typically as shock-like or electrical, radiating down the spine and into the extremities. The lumbar nerve roots are also placed under increased tension as the spinal cord moves about 1 cm in the lumbar region, potentially reproducing any radicular symptoms.

Procedural Errors
During passive neck flexion, the chin should not be allowed to protrude. In cases of meningeal irritation, getting the patient to lie supine with knees extended to begin the test can prove problematic. When the procedure is performed with the patient sitting, the examiner must be certain that the patient’s cervical spine is not already flexed.

Interpretation
In a suspected meningitis case, the patient can be tested in a supine position. Reactive flexion of the patient’s knees and hips is considered Brudzinski’s sign. Although classically associated with meningitis, it may also be the result of non-infectious meningeal irritation or arachnoiditis following myelopathy. (Evans 2001) Other possible causes include cord tumors or cord inflammation, multiple sclerosis, sphenoid sinusitis, tetanus, subarachnoid hemorrhage, spina bifida, and a tumor in the posterior fossa (Orient 2000).

Whether passive neck flexion is performed with the patient seated or supine, sharp, shooting pain down the spine and into the extremities is Lhermitte’s sign and suggests the presence of
a cord tumor, posterior column disease, meningeal adhesions, multiple sclerosis, or cervical spondylotic myelopathy. This sign may take on other forms, such as increasing spastic rigidity in the lower extremity.

A positive test that recreates symptoms along the nerve distribution in the lower extremity is **Lindner’s sign**, suggesting radiculopathy. The patient can be tested either seated or supine. Another method of eliciting Lindner’s sign in the supine patient is to brace the patient’s head with both hands, lifting the neck into flexion, and continuing to flex the patient’s torso including his/her thoracic and lumbar spine into a C-shape.

Supine cervical flexion can also be performed to load the joints of the cervicothoracic spine resulting in local pain. See Soto-Hall test.

**Charting**

Describe the patient’s position (e.g., sitting, long leg sitting, supine), quality of pain if noteworthy (e.g., “electrical shooting”), and radiation pattern. See Appendix E: Charting the results of pain provocation tests.

Sample language for use in a narrative report: “Passive cervical flexion caused pain [indicate where] and immediate flexion of the knees and hips suggesting meningeal irritation (Brudzinski’s sign);” or “passive cervical flexion caused sharp electrical pain down the spine (Lhermitte’s sign).”

**Reliability and Validity**

Based on pooling patients with Brudzinski and/or Kernig’s sign, the sensitivity for meningitis has been reported to be around 61%. Specificity is not known. (McGee 2001) Lhermitte’s sign has been reported to be present in as many as 25% of patients with cervical spondylotic myelopathy. (An 1998) The accuracy of Lindner’s sign is not reported.

**Follow-up Testing**

Bacterial meningitis must be considered in any adult where signs/symptoms include some combination of the following: sudden rapid progression of headache or neck pain (within a day or two), stiff neck, rash, severe headache, change in mental status, temperature above 101º F, Brudzinski or Kernig’s signs or appearing severely ill. If meningitis is suspected, an emergency referral for cerebrospinal fluid examination by lumbar puncture and bacterial cultures must be accomplished immediately. Prognosis depends on the type of meningitis and the interval between the disease onset and initiation of therapy.

For suspected cord lesions, see Appendix B: Summary of exam procedures to perform for suspected cord lesions. For suspected lumbar radiculopathy, see Appendix D: Summary of exam procedures to perform for suspected lumbosacral radiculopathy.
Sources


Indications for Testing
This is part of a standard examination of the neck and is particularly helpful when neck pain is accompanied by arm symptoms (e.g., pain, paresthesia).

Contraindications
In cases of acute, significant trauma or significant rheumatoid disease, cervical instability and fracture need to be ruled out with preliminary x-rays prior to performing the test.

Procedure
The examiner stands behind, placing hands on top of the seated patient’s head. Gradually increasing pressure is applied axially down through the neck. If arm symptoms are not aggravated, the test may be repeated with the neck in a variety positions.

Lateral flexion. The next option is to laterally flex the neck to the side of pain and again apply an axial load.

Combined. If necessary, lateral flexion can be combined with extension (both of these variations have at times been referred to as Spurling’s test). Rotation to the symptomatic side can be added to the extension and lateral flexion in an attempt to further close down the IVF (maximum foraminal compression). Other variations include holding the compression for 30-60 seconds (Evans 2001), axial compression combined with rotation to the symptomatic side but without lateral flexion or extension (Jackson’s compression), or adding a quick vertical blow to the top of the head (considered part of Spurling’s test).

Mechanism
Nervous tissue. Axial compression reduces the size of the intervertebral foramen, compressing vessels and nerves. The IVF is further compressed with rotation, lateral flexion and extension all to the same side. In cadaver studies, ipsilateral rotation and extension are the most root compromising movements. (Yoos 1992, Farmer 1994).

Joints and ligaments. Facet joints and intervertebral discs are also significantly loaded. The load on the facet is further increased when lateral flexion, extension, and rotation are all combined to the same side (also known as the “quadrant position”).

Muscles. Compression in neutral does not usually involve muscle and, therefore, cannot be used to substantiate a strain or myofascial diagnosis.

Procedural Errors
Insufficient downward force will not compress the IVFs of the lower cervical vertebrae. Cervical flexion may also result in false negative tests. The testing procedure should be performed slowly and steadily to avoid rebound pain.
Interpretation
Creation or reproduction of upper extremity pain, paresthesia or numbness is suggestive of radiculopathy. Herniated cervical disc (especially in patients under 60 years old) and osteophytic compression (more likely in older patients) lead the list of differential diagnoses. However, stenosis, space occupying lesions, traction injuries, and other causes of radiculopathy may also test positive.

Aggravation of local neck pain only suggests cervical disc derangement, facet syndrome, or intersegmental dysfunction (subluxation syndrome). Facet syndrome is thought to be more likely if the pain localizes over the facets or is particularly exacerbated when the weight of the head is shifted over one facet with ipsilateral extension and/or rotation (based on interpretations from common practice).

Charting
Describe neck position, symptoms produced, which arm is affected, and the referral pattern (at least indicating the most distal territory of referral). For example: “Maximum cervical compression to the right is positive for sharp pain into the right fourth and fifth digit.” Other options include the length of time compression is held before arm symptoms are reproduced. In the case of local pain, the patient can also be asked to grade the pain on a 1-10 scale. For other options, see Appendix E: Charting the results of pain provocation tests.

Reliability and Validity
A positive test that reproduces arm symptoms is very useful in suggesting that a C6-C8 nerve root is irritated. The validity of axial compression combined with lateral flexion and extension to the symptomatic side has been studied. Specificity has been reported as high as 93% (Tong 2002) for cervical disc herniations and ranged from 74-100% for cervical radicular syndromes in general (Wainner 2003, Viikari-Juntura 1989). Cervical compression with the neck in lateral flexion toward the side of symptoms has also been evaluated. In one preliminary study of patients with mild to moderate radicular syndromes based on EMG findings, a positive test (any reproduction of symptoms) was very useful in supporting a C6-C7 radicular diagnosis (86% specificity and an LR+ 3.5). In this study, lateral bending with compression actually performed better than maximum cervical compression. A negative test (i.e., no aggravation of arm symptoms) has no value in ruling out cervical radiculopathy since most patients who have disc herniations and/or degenerative changes will have a negative test. The sensitivity has been reported as 50% in lateral flexion (Wainner 2003), 30% in lateral flexion combined with extension (Tong 2002) and even lower (McGee 2001).

Combing with other tests. One preliminary study of mild to moderate C6-C7 radicular syndromes (based on EMG and nerve conduction studies) has suggested that the following cluster of findings may be of particular diagnostic value:
1. symptom reproduction with cervical compression with the neck in lateral flexion to the side of pain
2. symptom reduction with cervical distraction
3. symptom reproduction with an upper limb tension test
4. cervical rotation reduced to less than 60 degrees toward the side of pain.

If 3 out of 4 of the above tests were positive, the likelihood of cervical radiculopathy increased from 23% to 65% (LR+ 6.1); when all four were positive, the probability rose to 90% (LR+ 30.3). (Wainner 2003)

Although provocation of local pain suggests the presence of a cervical joint lesion, test validity for specific cervical diagnoses has not been established. One small study reported that the maximum cervical compression test could differentiate pain-free patients from patients with current or recent neck pain. The positive predictive value was 80% and the negative predictive
value was 91% (Sandmark 1995). Maximum cervical compression may be useful as an outcome marker.

**Follow-up Testing**

To confirm suspicion of radiculopathy, see Appendix A: Summary of exam procedures to perform for suspected radiculopathy. For facet or subluxation syndrome, correlate with palpation findings. Facet block is diagnostic and therapeutic for facet syndrome.

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**Sources**


Indications for Testing
Resisted muscle tests of the cervical spine are used to assess a possible muscle strain, particularly following trauma. Measuring the number of active range of motion repetitions against gravity and timing sustained contractions are preferable methods for assessing muscle endurance for purposes of rehabilitation.

See Jull’s test for assessing deep cervical flexors.

Procedure
The tests are performed to induce isometric contractions. In an acute setting, muscle testing is best performed with the cervical spine in neutral (see photos A). In non-acute settings, a common option is to test the neck in mid-range. The muscle tests can also be done at end-range (see photos B). Testing the muscles in a neutral posture can provide useful information prior to end-range assessment.

Appropriate muscle testing requires an adequate amount of force. The force can be initiated either by the patient (“push into my hand”) or by the practitioner (“resist me”). Each of the cardinal planes is evaluated. The most painful direction identified during active range of motion should be left until last. (McGee 2002)

Once the maximum force is achieved, the contraction should be sustained for one to two seconds. In cases where the suspicion of a muscle strain is high but the muscles test strong and do not elicit pain, the practitioner may choose to increase the challenge by extending the duration of each contraction to 5 seconds or by repeating a one- to two-second contraction, ten times.

Mechanism
The isometric load imposed by the tests may cause pain due to an injured muscle (e.g. muscle strain or occasionally with acute muscle spasm). It may also reveal weakness because of a tear in the muscle fibers. Although an isometric contraction does not result in appreciable movement of the cervical joints, compression of the joints does occur and may be painful, especially during the initial phase of the contraction (the “set phase”).
O’Donoghue maneuver
When muscle testing is followed by passive range of motion into each of the cardinal directions, this combination of procedures has been referred to as the O’Donoghue maneuver and is performed to distinguish between cervical muscle strain and ligament sprain. The passive tests place end range tensile loads on the cervical ligaments and discs. Such tests also load the muscle at end range, without eliciting an active contraction of that muscle.

Procedural Errors
Common errors include inducing too weak of a contraction to adequately load the tissue or, alternately, using too much force and overpowering the patient (especially while testing flexion). Special care must be taken in cases of recent trauma.

Interpretation

Acute Trauma Cases

<table>
<thead>
<tr>
<th>Test result</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local pain, no weakness</td>
<td>Mild (or grade 1)* muscle strain</td>
</tr>
<tr>
<td>Local pain and mild to moderate weakness</td>
<td>Moderate (or grade 2)* muscle strain</td>
</tr>
<tr>
<td>Marked weakness with or without pain</td>
<td>Severe (or grade 3)* muscle strain</td>
</tr>
<tr>
<td>Inability to resist chin nodding up or down</td>
<td>Possible craniovertebral instability (Grieve 1981)</td>
</tr>
</tbody>
</table>

* For more information on grading muscle strains, see CSPE protocol “Severity.”

Non-Traumatic cases

<table>
<thead>
<tr>
<th>Test result</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>More pain with resisted muscle tests than with passive range of motion</td>
<td>Lesion/dysfunction of the muscles tested</td>
</tr>
<tr>
<td>Increased pain only in initial set phase of testing, pain with passive movement</td>
<td>Arthrogenic pain (e.g., ligaments, facets, disc, uncovertebral joint)</td>
</tr>
<tr>
<td>Weakness without pain</td>
<td>Nerve injury</td>
</tr>
<tr>
<td>Grade 4 weakness may be due to “stretch” or “tight” weakness or reflex inhibition.</td>
<td></td>
</tr>
</tbody>
</table>

Neurological cases (rare) (Bland 1987, Magee 2002)

<table>
<thead>
<tr>
<th>Test result</th>
<th>Primary movers</th>
<th>Innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weak flexors</td>
<td>SCM, scalenes, sternohyoid, sternothyroid, thyrohyoid</td>
<td>Anterior primary divisions of C3-C8, cranial nerve XI</td>
</tr>
<tr>
<td>Weak extensors</td>
<td>Paravertebral extensor mass, splenius capitis, semispinalis capitis, upper trapezius</td>
<td>Cranial nerve XI, posterior primary divisions of C3-8.</td>
</tr>
<tr>
<td>Weak lateral flexors</td>
<td>SCM, trapezius, the three scalene muscles, levator scapulae</td>
<td>Cranial nerve XI, anterior primary division of cervical nerves C2-C5</td>
</tr>
<tr>
<td>Weak rotators</td>
<td>SCM, trapezius, scalenes</td>
<td>Cranial nerve XI, anterior primary division of cervical nerves C2-C4</td>
</tr>
</tbody>
</table>

In acute trauma cases: Local pain in the muscles being tested suggests a grade 1 strain. Pain and muscle weakness (+4/5) suggests a possible grade 2 strain. +3/5 weakness with or without pain suggests a possible grade 3 strain. Full passive range of motion in combination with one weak and/or painful resisted movement suggests a muscle lesion (e.g., a strain). If a number of other “contradictory” resisted muscle tests are also painful, then a primary muscle diagnosis becomes less likely (Bland 1987), except in cases where the mechanism of injury suggests that multiple muscles may have been injured (e.g., a hyperextension-hyperflexion injury). Note: Weakness may result from the pain the patient is experiencing with the contraction and may not be due to significant fiber damage. The patient may be able to clarify the reason that s/he cannot create a stronger contraction. It may be necessary to test during another visit after the
acute phase in order to identify a more serious tear.

When resisted muscle testing is negative but symptoms are reproduced by passive movement of the neck, non-contractile tissues, such as the facets, ligaments and discs, are implicated. Marked inability to flex the chin up or down against resistance suggests possible craniovertebral instability and the need for special care in handling the patient. (Grieve 1981)

**Non-traumatic cases:** In cases without a clear indication of trauma (e.g., repetitive microtrauma, posture loads), interpretation is broader. If the pain with contraction is greater than the pain with passive range of motion, then the muscle tested may be the pain generator. Weakness in a non-traumatic context may simply be due to pain with contraction as opposed to true weakness. The patient may be able to give some guidance. If pain increases just with the initiation of the contraction (the set phase), then the pain may be arthrogenic.

Weakness without pain suggests a possible neurological lesion and should be correlated with other neurological tests. Grade 4 weakness may also be associated with muscle imbalance—either hypertonic (“tight” weakness) or hypotonic and lengthened (“stretch weakness”). Other proposed causes of inhibition include a short tight antagonist (reciprocal inhibition), joint dysfunction, and myofascial trigger points residing in the muscle being tested. The weakness may also result as a reflex inhibition from a more distant muscle harboring trigger points.

**Charting**

Muscle strength must be graded (graded 1-5 as a fraction of 5) and location of pain noted. (See CSPE protocol “Muscle Testing.”) Unusual findings or procedural modifications should be noted (e.g., if pain occurs only with muscle testing at end range, or if the muscles are tested for endurance or repetitively). If muscle tests are sustained, the time it took to produce pain or weakness should be recorded over a baseline of 5 seconds. In the case of multiple repetitions, the number of the repetitions over a baseline of 10 should be recorded (e.g., “grade 3 weakness at 7/10 reps”). For additional charting options, see Appendix E: Charting the results of pain provocation tests.

Sample language that could be used in a narrative report: “Resisted isometric cervical flexion was weak (grade 4/5) and painful. All other cervical muscles were strong (5/5) and pain free.” Another example would be “Resisted isometric cervical extension sustained for 5 seconds reproduced the chief complaint.” In some cases it may be important to be more specific. If the patient’s chief complaint is both headache and neck pain, which portion of the chief complaint was aggravated by the testing procedure?

**Reliability and Validity**

Reliability and validity have not been established, but this test is commonly used in clinical practice.

**Follow-up Testing**

<table>
<thead>
<tr>
<th>Weakness and pain with testing</th>
<th>Palpate and stretch injured muscle; repeat on another day if it is unclear whether the weakness is due to pain alone or tissue damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurological lesion</td>
<td>Neurological exam, possible MRI, electrodiagnostic studies</td>
</tr>
<tr>
<td>Craniovertebral instability</td>
<td>Radiographs (include flexion, extension)</td>
</tr>
<tr>
<td>Arthrogenic lesion</td>
<td>Cervical orthopedic tests (cervical compression, etc.)</td>
</tr>
<tr>
<td>Muscle imbalance</td>
<td>Length test tight muscles; Jull’s test for inhibited deep flexors</td>
</tr>
<tr>
<td>Reflex inhibition</td>
<td>Palpate for trigger points, joint dysfunction in related areas, length test antagonist</td>
</tr>
</tbody>
</table>

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Sources


Indications for Testing
Used to investigate whether midthoracic pain is of cervical origin or if arm symptoms have a neurological component.

Procedure
The patient is seated, examiner standing in front or behind. The examiner carefully tractions the SCM laterally out of the way while slowly applying moderate digital pressure in a posteriomedial direction from about the mid-cervicals down to the clavicle for up to 2-3 seconds.

Mechanism
Irritating tissue deep to the cervical spine may reproduce a somatic referral pattern to the midthoracic area. In addition, the cervical nerve roots, especially C5 and C6, may be irritated by this procedure. Tractioning or compressing these nerve roots may increase peripheral symptoms (“electrical shooting pain”) in patients with existing radicular neuropathy.

Procedural Errors
Compression needs to be directed accurately; if too medial, no nerve tension will occur and the test may be falsely negative. Palpation needs to be gentle. The practitioner should avoid compression of the carotid body and carotid artery, which could lead to syncope or pre-syncope.

Interpretation
Local pain in the neck may occur for a variety of reasons and does not constitute a positive test for radiculopathy. Pain referral patterns include thoracic or interscapular pain, sometimes referred to as cervicogenic dorsalgia (Terrett 2002). Maigne (1996) speculates that up to 70% of common interscapular pain may originate from the lower cervical joints. The cause may be simple mechanical joint dysfunction or irritation of a cervical nerve root.

Reproduction of arm symptoms suggests a radicular syndrome. Occasionally, scalene myofascial trigger points may give a false positive, mimicking nerve root irritation. Sharp electrical radiating pain presumably would be more suggestive of a nerve root problem.

Charting
Document the location and radiation pattern. Document the quality of the pain (dull, sharp, electrical, etc.) and the intensity of the symptom. For other options, see Appendix E: Charting the results of pain provocation tests. Sample language that could be used in a narrative: “Deep palpation over the cervical nerves resulted in dull referred pain between the scapulae [sharp pain radiating down the right arm] (Doorbell sign).”

Reliability and Validity
Unknown. Terret (2002) suggests that the test has poor sensitivity for cervicodorsalgia.

Follow-up Testing
See Appendix A: Summary of exam procedures to perform for suspected cervical radiculopathy.
For cervicogenic dorsalgia, correlate with the following findings:
- reproduction of the dorsal pain with head rotation to the symptomatic side (sometimes requiring some additional extension while rotated) (Terrett 2002)
- palpable joint dysfunction in the lower cervical spine
- a tender point about 2 cm lateral to the spinous process of T5 or T6 (Maigne 1996)
- and symptom relief with cervical manipulation.

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Sources

RUST’S SIGN

Indications for Testing
Rust’s sign is an observation (rather than a test) indicative of cervical instability that may be associated with upper cervical fracture, rheumatoid arthritis, severe sprain or subluxation.

Procedure
Patients support the neck with their hands due to pain and/or to provide stability following trauma. The sign may be observed in a patient who is sitting or standing or may be observed when a recumbent patient attempts to arise.

Mechanism
Significant trauma to the head and neck (e.g., motor vehicle accident, diving injury, falls) may result in odontoid fracture or transverse ligament sprain or rupture. Atlantoaxial instability is also associated with rheumatoid arthritis and other inflammatory arthritis (e.g., ankylosing arthritis, psoriatic arthritis, Reiter’s syndrome). This instability, especially when traumatic, may result in rigidity or painful torticollis, requiring extra support which the patient attempts to supply with his/her hands.

Interpretation
The sign suggests cervical instability, so caution in patient handling and careful history taking are necessary to prevent further injury. In cases of trauma or suspected inflammatory arthritis, manipulation is contraindicated until appropriate radiographs are taken.

Charting
Sample language that may be used in a narrative report: “The patient was observed holding his [her] neck for support (Rust’s sign).”

Reliability and Validity
Statistics regarding validity and reliability are unknown.

Follow-up Testing
Neurological examination including cranial nerves, sensory, reflex and motor examination will provide useful documentation for comparison to clinical progress and outcome. Imaging studies including plain film, CT and MRI will be necessary for a specific diagnosis. For safe transportation to the orthopedic or neurological surgeon, the patient’s neck may require external support (e.g., a rigid cervical collar, backboard and ambulance).

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Sources


Indications for Testing
This test is used when evaluating a patient suffering from neck and arm symptoms, especially if a radicular syndrome is suspected (e.g., dermatomal pain, paresthesia, subjective weakness or numbness).

Procedure
The patient is asked to actively raise (abduct) the symptomatic arm until it is near the head and to report if there are any changes in arm symptoms.

Mechanism
*Nervous tissue*. Alleviation of arm pain or paresthesia with shoulder abduction over the head may occur due to a reduction in nerve root tension, mainly C6-C8 (Fast 1989), or intraforaminal pressure (Farmer 1994).

Procedural Errors
If the arm is not raised high enough, there may be a false negative. Monitoring neck symptoms rather than arm symptoms may lead to a false positive.

Interpretation
If shoulder abduction relieves the patient’s arm pain, this suggests there is a radicular syndrome of the lower nerve roots. A cervical disc herniation (in a younger patient) or spondylotic compression from a spur or osteophyte (in an older patient) would have the highest index of suspicion. Other causes such as nerve root adhesions, stenosis, infection, a traction injury, etc. are also possible. Patients may present in this posture to relieve radicular arm pain (Bakody’s sign). It also suggests that abduction of the arm during cervical joint palpation and manipulation may be helpful.

An increase in symptoms may suggest that pressure is increasing in the scalene triangle. (Evans 1994)

Charting
The *most important feature* to record is whether the arm symptoms are relieved or aggravated. Sample language that can be used in narrative: “Abduction of the right arm decreased arm symptoms.” In cases where arm abduction aides in manipulation, the practitioner should consider charting this, especially in multiple-doctor clinics.

Reliability and Validity
A positive test is strong, supportive evidence of C6-C8 root irritation associated with disc herniation or spondylotic changes. In one retrospective study, a positive test correlated with excellent surgical outcome (Davidson 1981). In another small study, a positive test was 100% specific for correlating with neurological deficits suggestive of root compression and between 80-100% specific for myelographic evidence of root compression. Another preliminary study reported 92% specificity based on patients with mild to moderate EMG findings. (Wainner 2003) **On the other hand, a negative test had poor power in ruling out radicular syndromes.** Sensitivity has been reported to range from 17-50% (Wainner 2003, Viikari-Juntura 1989). In one other study (retrospective) it was 68% (Davidson 1981).
Follow-up Testing
See Appendix A: Summary of exam procedures to perform for suspected cervical radiculopathy.

Correlate with other maneuvers that reduce tension on the nerve roots. The patient may experience relief of arm symptoms when they are holding/cradling and slightly elevating the arm across the abdomen. Gifford (2001) suggests that a small percentage of patients will get relief with postures and movements toward the side of pain. This may be an attempt to reduce root tension. Further correlation can be done with other procedures that increase tension on the nervous system of the whole upper limb (see Upper Limb Tension tests in NMS I course notes).

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Sources


Indications for Testing
Used to indicate possible nerve root or brachial plexus irritation/inflammation in patients with neck and arm symptoms. The upper limb tension test for the median nerve is probably a better test for this purpose.

Procedure
Patient may be seated or supine. Examiner first instructs patient to laterally bend the neck away from the side to be tested. Then examiner maintains the head in that amount of lateral flexion attained by the patient and places the other hand on top of the patient’s shoulder. With gradually increasing pressure, the examiner depresses the affected shoulder. Radicular pain produced on the side being stretched constitutes a positive test. Confirmation of the positive test may be appreciated by reducing downward pressure on the shoulder until symptoms just abate and then have the patient rotate the head away from the affected shoulder. Exacerbation of radicular symptoms confirms a positive test.

Mechanism
**Nervous tissue.** Nerve root and brachial plexus tension is increased both by cervical lateral flexion away from the shoulder and by depression of the shoulder away from the cervical spine. Rotation of the head away from the affected shoulder also increases tension on the brachial plexus. Patients with nerve irritation, IVF encroachment, or dural sleeve adhesions or inflammation may have radicular symptoms exacerbated by this maneuver. In addition, the IVF is closed down on the concave side and may irritate an already compressed nerve root on that side. **Joints and ligaments.** The facets and cervical discs are compressed on the concave side of the neck and ligaments are stretched on the convex side. **Muscles.** The lateral neck flexors as a group can be length tested for tightness.

Procedural Errors
Examiner forcing the neck into lateral flexion may well irritate symptoms beyond that which the shoulder depression test is designed to document. Patients with serious neck immobility may not be able to position themselves for adequate stretch of the brachial plexus resulting in false negative tests. If performing the test primarily for muscle tightness, the movement should be slow and steady, applying pressure through the shoulder. The patient must be relaxed and offer no resistance. Jerky or accelerating movements may be needlessly uncomfortable.

Interpretation

<table>
<thead>
<tr>
<th>Test Result</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reproduction or exacerbation of radicular symptoms on the side tested</td>
<td>Irritation/inflammation of the nerve root, spinal nerve or brachial plexus due to tractioning forces during the test</td>
</tr>
<tr>
<td>Reproduction or exacerbation of radicular symptoms on the opposite side that is tested</td>
<td>Irritation/inflammation of the nerve root, spinal nerve or brachial plexus due to compressive forces during the test</td>
</tr>
<tr>
<td>Reproduction of arm symptoms</td>
<td>May be myofascial pain referral from stretching (e.g., anterior scalenei)</td>
</tr>
<tr>
<td>Local pain on the concave side of the neck</td>
<td>Joint irritation (joint dysfunction, facet, disc derangement)</td>
</tr>
<tr>
<td>Test Result</td>
<td>Interpretation</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Local pain on the convex side of the neck</td>
<td>Ligamentous sprain, capsular stretching, or a painful muscle such as the scaleni or upper trapezius</td>
</tr>
<tr>
<td>Reduced passive ROM and altered end feel</td>
<td>Short, tight lateral flexors (primarily upper traps, levator scapula, and/or scalenei); may be part of an upper cross syndrome</td>
</tr>
</tbody>
</table>

**Charting**

Document side tested and the location of symptom production. Optionally, document the intensity of pain produced. Sample language that could be used in a narrative: “Right shoulder depression with the neck left laterally flexed reproduced the arm symptoms.” In the case of short, tight muscles, indicate which side is tight or has a hard, restricted end feel and whether one side is worse than the other (e.g., “R > L”).

**Reliability and Validity**

Unknown.

**Follow-up Testing**

See Appendix A: Summary of exam procedures to perform for suspected cervical radiculopathy. In addition, neurodynamic testing of the upper limb may provide useful information implicating individual terminal branches of the brachial plexus facilitating further examination and/or treatment in specific areas of the cervical spine or upper extremity.

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**Sources**


Indications for Testing
This test may be useful when suspecting a fracture or lesion of the lower cervical or upper thoracic joints. (Haldeman, Schafer, Evans)

Procedure
With the patient supine, one hand is placed on the patient’s sternum to prevent lumbar and thoracic regions from flexing; the other hand is under the patient’s occiput. The neck is then passively flexed towards the chest while maintaining gentle pressure on the sternum. (Evans 2001, Kleinfield 1993, Cipriano 1991)

Mechanism
This test places traction on the posterior elements of the cervical and upper thoracic spine and compresses the anterior bodies and discs. It also causes traction of the nervous system (see Cervical Flexion). In the case of vertebral fracture, when the supraspinous ligament pulls on the spinous process of the fractured element, acute local pain will result.

Procedural Errors
Common errors include placing too much pressure on the sternum resulting in needless discomfort to the patient, or placing too little pressure and allowing the thorax to rise off of the table.

Interpretation
Localized pain suggests a possible joint or bone injury or pathology (but not lower than the T7 level). Depending on the complete patient presentation, a positive Soto-Hall test could support a cervicothoracic sprain, facet syndrome, disc derangement, joint dysfunction, or vertebral fracture diagnosis. This test may also produce Brudzinki’s, Lindner’s, or Lhermitte’s signs (see Cervical Flexion).

Charting
Document the nature of the test and patient response. See Appendix E: Charting the results of pain provocation tests. Sample language for use in a narrative report: “Passive supine cervical flexion produced a sharp pain at the cervicothoracic junction (positive Soto-Hall test).”

Reliability and Validity
The test is nonspecific and has limited use to localized conditions of the cervical and upper thoracic spine. (Evan 2001, Cipriano 1991) Test reliability and validity is unknown.

Follow-up Testing
Perform other active and passive loading tests to the area of injury (e.g., palpation, Valsalva maneuver, spinal percussion, cervical compression, etc).

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Sources


APPENDIX A: SUMMARY OF EXAM PROCEDURES TO PERFORM FOR SUSPECTED CERVICAL RADICULOPATHY

Orthopedic and palpatory procedures indicating nerve root irritation – may be due to compressive pathologies, such as a disc herniation, or tractional forces resulting in neurapraxis injury.

- Cervical compression (neutral, lateral, maximal, other variations)
- Cervical distraction
- Upper limb tension test (median nerve)
- Shoulder abduction (or observe Bakody's sign)
- Valsalva maneuver
- Provocation of neurological tissue: doorbell sign, brachial compression, Tinel's test/palpation posterior to the SCM.

Neurological exam procedures to screen for loss of nerve root function – due to compressive or tractional forces.

Procedures should be compared bilaterally.

- Deep tendon stretch reflexes (biceps, triceps, brachioradialis)
- Muscle tests in the upper extremity (performed repetitively or sustained if necessary)
- Dynamometer (optional)
- Sensory tests (light touch, sharp-dull discrimination, vibration)
- Measure girth of arm and forearm checking for atrophy.

If a radicular syndrome is present:

1. Perform additional physical exam procedures to rule out cord compression. (See Appendix B: Summary of exam procedures to perform for suspected cord lesion.)
2. Consider plain films – 3 views minimally, but 5-view series (including obliques) is recommended by the WSCC Radiology department.
3. Consider an immediate MRI (preferred) or CT if there are signs of cord compression, profound muscle weakness, or suspicion of a serious disease process.
4. On rare occasions, nerve conduction, EMG or sensory evoked potential may be helpful. Nerve conduction/EMG studies are less likely to yield useful results if performed earlier than 3 months after the injury or longer than 6 months.

If a radicular syndrome is ruled out, but neurological involvement is still suspected, go to Appendix C: Summary of exam procedures to perform for suspected brachial plexus, neurovascular, or other nerve entrapment syndromes.

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APPENDIX B: SUMMARY OF EXAM PROCEDURES TO PERFORM FOR SUSPECTED CORD LESIONS

Orthopedic exam procedures
- Cervical flexion for Lhermitte’s sign

Neurological exam procedures indicating loss of function of the posterior column

Procedures should be compared bilaterally.
- Vibration (middle finger and toe)
- Romberg and/or position sense (middle finger and toe)
- 2 point discrimination (optional)

Neurological exam procedures indicating loss of function of the spinothalamic tract

Procedures should be compared bilaterally.
- Sharp-dull discrimination (upper and lower extremity)
- Hot vs. cold (optional)

Neurological exam procedures indicating UMNL (upper motor neuron lesion)

Procedures should be compared bilaterally.
- Deep tendon stretch reflexes (biceps, triceps, Achilles and patellar)
- Babinski’s reflex
- Hoffman’s reflex (or dynamic Hoffman’s if stenosis is suspected)
- Clonus (performed at ankle and wrist)
- Muscle testing of upper and lower extremity muscles (to include proximal muscle groups such as the deltoid and hip flexors, sustained/repetitive if necessary)
- Superficial abdominal reflex (optional)

Optional neurological procedures for suspected cervical cord compression

Procedures should be compared bilaterally.
- Rapid opening and closing of the hands
- Finger escape sign
- Scapulohumeral reflex

If spinal cord signs are present:
- Perform a cranial nerve exam (to rule out more extensive disease or lesions rostral to the cord).
- Consider plain films (3 views minimally), add flexion-extension if instability is suspected.
- Order an MRI (preferred) or CT or refer for neurological consultation.

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APPENDIX C: SUMMARY OF EXAM PROCEDURES TO PERFORM FOR SUSPECTED BRACHIAL PLEXUS, NEUROVASCULAR, OR OTHER NERVE ENTRAPMENT SYNDROMES

Orthopedic and palpatory procedures indicating tension/irritation in the spinal nerves, brachial plexus, or peripheral nerves

Procedures should be compared bilaterally.
- Upper limb tension test I for the median nerve
- Upper limb tension test II the median nerve
- Upper limb tension test III for the radial nerve
- Upper limb tension test IV for the ulnar nerve
- Provocation of neurological tissue: doorbell sign, brachial compression, Tinel’s test at various locations (e.g., palpation posterior to the SCM, medial elbow, pronator teres, carpal tunnel)

Orthopedic/palpation procedures indicating compression of the brachial plexus, TOS or other neurovascular conditions

Procedures should be compared bilaterally.
- Roos’ test
- Hyperabduction (Wright's test)
- Costoclavicular test (Eden's)
- Adson’s, reverse Adson's (Halstead's)
- Allen’s test
- Palpate/compress forearm (e.g., pronater teres) and wrist (e.g., Phalen’s test, reverse Phalen’s, etc.)
- Length test scalenes and pectoral muscles for hypertonicity

Neurological exam procedures to screen for loss of function

- Deep tendon stretch reflexes (biceps, triceps, brachioradialis)
- Muscle tests in the upper extremity (if necessary, performed repetitively or sustained)
- Dyna mometer (optional)
- Sensory tests (light touch, sharp-dull discrimination, vibration) to include pure patches for peripheral nerves
- Measure girth of arm and forearm, inspect for atrophy (e.g., intrinsic muscles of the hand intrinsic, thenar eminence)

If peripheral nerve damage is suspected:

On rare occasions, nerve conduction, EMG or sensory evoked potential may be helpful. Nerve conduction/EMG studies are less likely to yield useful results if performed earlier than 3 months after the injury or longer than 6 months.

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APPENDIX D: SUMMARY OF EXAM PROCEDURES TO PERFORM FOR SUSPECTED LUMBOSACRAL RADICULOPATHY

Orthopedic and palpatory procedures indicating nerve root irritation – may be due to compressive pathologies such as a disc herniation

- Thoracolumbar AROM
- SLR seated (Bechterew’s test) and supine
- Whichever is appropriate: maximum SLR seated (e.g., slump test) and supine or confirmation tension tests seated (e.g., Deyerle’s test) and supine (e.g., Braggard, bowstring)
- Valsalva maneuver or cough test
- Palpation of pelvic soft tissue over the sciatic notch
- Consider McKenzie protocol to identify centralization maneuvers.

Neurological exam procedures to screen for loss of nerve root function – due to compressive or tractional forces; procedures should be compared bilaterally.

- Deep tendon stretch reflexes (patellar, hamstring, Achilles)
- Muscle tests in the lower extremity (if necessary, performed repetitively or sustained)
- Sensory tests (light touch, sharp-dull discrimination, vibration)
- Measure girth of thigh (2 places) and calf, checking for atrophy.

Major criteria for diagnosis – Three of these criteria support a clinical diagnosis:

- Presence of leg pain in a dermatomal distribution: often dominates, may be sharp, burning, electrical and superficial, worse than back pain.
- Presence of dermatomal paresthesias
- Positive SLR and other tension tests: SLR – pain past the knee between 35-70° of elevation (especially if <45°); confirm with other tension tests; XSLR uncommon but very specific.
- Neurologic deficits: 20% of cases will have no deficits.
- Positive imaging: MRI (preferred) or CT

Supportive evidence

- Decreased sagittal thoracolumbar range of motion is an important finding.
- DeJeurine’s triad is present.
- Valsalva exacerbates leg pain.
- Sitting may be very difficult; lying often offers relief.
- Night pain and pain at rest are nonspecific findings.
- Bowel/bladder/sexual dysfunction

Evaluation steps: Refer to the herniated lumbar disc care pathway.

If a radicular syndrome is present:
1. Perform additional physical exam procedures if indicated by history to rule out cauda equina syndrome.
2. Make emergency referral for consideration of surgical decompression in suspected cauda equina syndrome.
3. Consider plain films.
4. Consider initial MRI (preferred) or CT if there are signs of cauda equina syndrome, cord compression, profound muscle weakness or suspicion of a serious disease process.
5. On rare occasions, nerve conduction, EMG or sensory evoked potential may be helpful.

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APPENDIX E: CHARTING THE RESULTS OF PAIN PROVOCATION TESTS

Recording positive results

When recording the results of orthopedic pain provocation tests, there are a few basic principles that should always be followed and a number of optional notations that can also be made. A test should NEVER be simply noted as being positive!

Basic principles

- Record pain location including any radiation pattern.
- If the procedure reproduces the symptoms exactly, this should be recorded. You may mark this as “CC” for chief complaint. However, there will be situations when it is important to note more specifically which chief complaint or which part of the chief complaint has been aggravated (e.g., if the patient has both headache and neck pain, which portion of the chief complaint was affected?).
- If a procedure is designed to be sustained for a certain length of time (e.g., Roos test), note when the symptoms were reproduced/aggravated.

Optional

- Record the quality of the pain if it is noteworthy (e.g., sharp, burning, electrical).
- Record the intensity of the symptoms (any verbal scale is acceptable as long as the denominator is recorded, e.g., 3/5 or 6/10).
- Record whether the symptoms were aggravated at end range only.

Recording negative results

Sometimes the test is technically negative for what it is primarily designed to test, but yields other useful information. For example, a SLR may be negative as a nerve tension test but may reveal that the hamstrings are tight at 70 degrees. On WSCC exam forms, circle the item and describe the finding. In narrative formats, likewise, describe the finding. For example, “SLR on the right was negative for nerve involvement but aggravated the patient’s back pain.”

All negative tests must be recorded. Do not leave them off an exam form or out of a SOAP note just because they are negative. The fact that the test was performed must be part of the chart.

Record inability to perform a test

Cases in which an attempt is made to perform a pain provocation test, but the patient cannot tolerate it, record "not performed due to pain." This can be abbreviated "NP d/t P." Sometimes procedures are not performed for other reasons. In these cases, line out the procedure on the exam form and write NA (not applicable) or NP (not performed).

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