

As in the fourth edition,¹ *the DRE method is the primary method used to evaluate individuals with an injury. Use the ROM method when the impairment is not caused by an injury or when an individual's condition is not well represented by a DRE category. The ROM method is also now used to evaluate individuals with an injury at more than one level in the same spinal region and in certain individuals with recurrent pathology.* This approach addresses the difficulty of assigning these individuals to an appropriate DRE category. An exception, however, is individuals with corticospinal involvement who have been treated with decompression and multilevel fusions within the same region; they should be rated by the DRE method because assessing ROM in paralyzed individuals is difficult. Finally, the range-of-motion method should be used if statutorily mandated in a particular jurisdiction. A more detailed description of the applications of either method is provided in Section 15.2.

As stated in this edition, an individual with a spinal condition is rated only when the condition is stable (unlikely to change within the next year regardless of treatment), ie, when MMI has been reached (Chapter 1 and Glossary). The individual is evaluated based on medical findings that are present when MMI has been reached.

15.1 Principles of Assessment

Before using the information in this chapter, the *Guides* user should become familiar with Chapters 1 and 2 and the Glossary. Chapters 1 and 2 discuss the *Guides'* purpose, applications, and methods for performing and reporting impairment evaluations. The Glossary provides definitions of common terms used by many specialties in impairment evaluation.

The evaluation should include a comprehensive, accurate medical history; a review of all pertinent records; a comprehensive description of the individual's current symptoms and their relationship to daily activities; a careful and thorough physical examination; and all findings of relevant laboratory, radiologic (imaging), electrodiagnostic, and ancillary tests. It is also essential that the rater include in the report a description of how the impairment was calculated. Because many ratings are reviewed by other physicians and nonmedical personnel, the explanation of the calculation will lead to a better understanding of the method used and the report will be considered more reliable and complete.

15.1a Interpretation of Symptoms and Signs

History

The history should be based primarily on the individual's own statements rather than secondhand information. While the medical history should consider information from others, the physician should be cautious about using subjective information from medical records. It is not appropriate to question the individual's integrity. If information from the individual is inconsistent with what is known about the medical condition, circumstances, or written records, the physician should report and comment on the inconsistencies.

The history must describe in detail the chief complaint and the quality, severity, anatomic location, frequency, and duration of symptoms, including pain, numbness, paresthesias, and weakness. Document exacerbating and alleviating factors and the way in which the condition interferes with daily activities. The physician should elicit the history of when and how the condition started, any precipitating events or factors, and the relationship to any previous spine problems.²⁻⁴

The history should include the individual's description, in his or her own words, of how the symptoms developed and the assumed cause. In addition, the response to treatment and the results of special studies that have been performed should be described. The physician should either review available roentgenograms and other imaging studies personally or report the findings as being those of another reviewer (based on reports). A review of organ systems and of the general medical history can provide potentially helpful information, including complicating medical problems that can affect the diagnosis, treatment plan, prognosis, disability, etc.

Examination

Physical examination of nonmusculoskeletal areas (eg, nervous system) is discussed in other parts of the *Guides*. Since a targeted neurologic assessment is needed for individuals with back or neck problems, the physician must have a good grasp of basic neurologic examination techniques and principles. Guided by the history, the physician should focus on spine-related physical findings, such as range of motion, reflexes, muscle strength and atrophy, sensory deficits, root tension signs, gait, and the need for assistive devices (Table 15-1). Range-of-motion measurements are discussed later in this chapter.

Table 15-1 Physical Examination**Lumbar Spine**

Individual Position	Examination
Standing	Posture Scoliosis Lordosis Kyphosis
	Palpation Muscles Tenderness
	Gait
	Range of motion
	Muscle strength screening Heel-toe walk Squatting
Sitting	Neurologic Reflexes (ankle, knee) Strength Sensation
	Nerve tension Straight leg raising (or similar)
Recumbent Supine	Neurologic Reflexes Strength Sensation Straight leg raising (or similar)
	Other Pulses Hip range of motion
Recumbent Prone	Nerve tension Femoral stretch test
	Palpation Muscles Spinous processes

Thoracic Spine

Individual Position	Examination
Standing	Posture Scoliosis Kyphosis
	Palpation Muscles Tenderness
	Range of motion

Cervical Spine

Individual Position	Examination
Standing or sitting	Posture Scoliosis Kyphosis Lordosis
	Palpation Muscles Tenderness
	Range of motion
	Other Shoulder motion Cervical compression Foraminal compression (Spurling test)
	Neurologic Reflexes (biceps, triceps, brachioradialis, finger)
	Motor Sensory

The physical examination of the spine must be placed in the context of the individual's general health and condition. For findings such as atrophy, consider other possible explanations besides spine impairment, such as previous joint surgery or hypertrophy of the contralateral side from overuse. Other physical conditions may be present that influence motor and sensory function, ranges of motion, and sciatic nerve tension. Examination of associated systems (vascular, nervous) and follow-up of any possibly significant information from the history and physical examination will allow the physician to distinguish between spine-related findings and other abnormalities.²⁻⁴

The physician should record and discuss any physical findings that are inconsistent with the history. Many physical findings are subjective, ie, potentially under the influence of the individual. It is important to appreciate this and not confuse such observations with truly objective findings.

It is not the purpose of this text to discuss in detail how the physical examination is performed; textbooks are available to cover that subject. A few aspects of particular value to the impairment evaluation will be discussed subsequently.

Evaluation of Sciatic Nerve Tension Signs

Sciatic nerve tension signs are important indicators of irritation of the lumbosacral nerve roots. While most commonly seen in individuals with a herniated lumbar disk, this is not always the case. In chronic nerve root compression due to spinal stenosis, tension signs are often absent. A variety of nerve tension signs have been described. The most commonly used is the straight leg raising test (SLR). When performed in the supine position, the hip is flexed with the knee extended. In the sitting position, with the hip flexed 90°, the knee is extended. The test is positive when thigh and/or leg pain along the appropriate dermatomal distribution is reproduced. The degree of elevation at which pain occurs is recorded.

Research indicates that the maximum movement of nerve roots occurs when the leg is at an angle of 20° to 70° relative to the trunk. However, this may vary depending on the individual's anatomy. Further, the L4, L5, and S1 nerve roots are those that primarily change their length when straight leg raising is performed. Thus, pathology at higher levels of the lumbar spine is often associated with a negative SLR. Root tension signs are most reliable when the pain is elicited in a dermatomal distribution. Back pain on

SLR is not a positive test. Hamstring tightness must also be differentiated from posterior thigh pain due to root tension.

With time, spine-related symptoms usually improve, and a positive root tension (SLR) test is elicited only at the extremes of hip flexion (leg raising). While straight leg raising in disk herniation is a relatively sensitive test (72% to 97%), it is nonspecific (11% to 45%).⁵ Straight leg raising of the asymptomatic limb (eg, crossed SLR) that produces *sciatica* in the limb with symptoms (crossed positive) is a specific (85% to 100%) but less sensitive (23% to 42%) test.

Results of supine SLR can be further validated by recording the individual's response to gentle dorsiflexion and plantar flexion of the ankle, and to internal and external rotation of the hip when the straightened leg is raised to the point where symptoms begin. Normally, ankle dorsiflexion and hip internal rotation increase the pain, and ankle plantar flexion and hip external rotation decrease the sciatica. Since sitting knee extension and supine hip flexion culminate in essentially identical positions, symptomatic responses to the two types of SLR should be similar, although the angle at which pain is elicited may vary.

The reverse SLR or femoral stretch test causes root tension of L2, L3, and L4 and may be a sign of disk herniations at the higher levels. This test has low sensitivity and specificity.

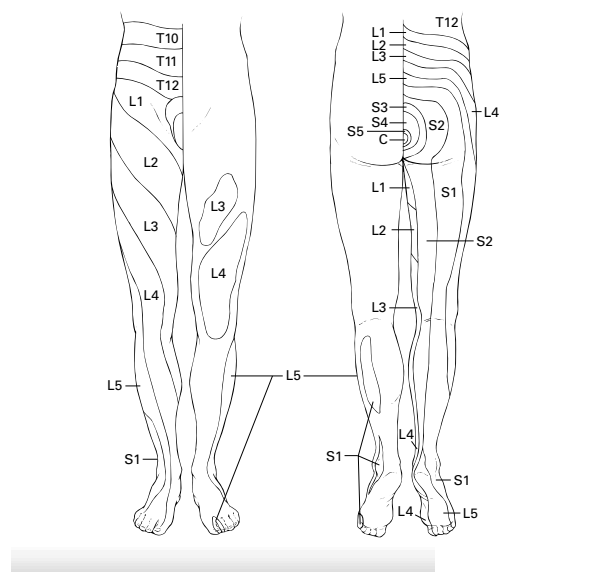
Neurologic Tests

Neurologic examination of the lower extremity should include measurement of knee and ankle reflexes and motor and sensory functions. Because over 90% of all nerve-related pathology in the lumbar spine occurs at the L3-4, L4-5, and L5-S1 levels, it is especially important to recognize the functions of the L4, L5, and S1 nerves (Table 15-2). The knee reflex is primarily a test of L4 nerve root function. Individuals with pathology at the L3-4 level may also have sensory changes in the L4 dermatome (Figure 15-1) and quadriceps weakness. L5 nerve root compression will often influence the strength of the extensor hallucis longus muscle, but other foot and ankle muscles can be affected as well, resulting in weakness in foot dorsiflexion and difficulty walking on the heels. The ankle reflex is primarily mediated by the S1 nerve root. Weakness in foot plantar flexion and difficulty with toe walking can also occur with S1 root compression. The Babinski sign and the presence of clonus and hyperreflexia are important indicators of corticospinal tract involvement.

Table 15-2 Common Radicular Syndromes

Disk Level	Nerve Root	Motor Deficit	Sensory Deficit	Reflex Compromise
Lumbar				
L3-4	L4	Quadriceps	Anterolateral thigh Anterior knee Medial leg and foot	Knee
L4-5	L5	Extensor hallucis longus	Lateral thigh Anterolateral leg Middorsal foot	Medial hamstrings
L5-S1	S1	Ankle plantar flexors	Posterior leg Lateral foot	Ankle
Cervical				
C4-5	C5	Deltoid Biceps	Anterolateral shoulder and arm	Biceps
C5-6	C6	Wrist extensors Biceps	Lateral forearm and hand Thumb	Brachioradialis Pronator teres
C6-7	C7	Wrist flexors Triceps Finger extensors	Middle finger	Triceps
C7-T1	C8	Finger flexors Hand intrinsic	Medial forearm and hand, ring and little fingers	None
T1-T2	T1	Hand intrinsic	Medial forearm	None

Figure 15-1 Skin Areas Innervated by the Thoracic and Lumbosacral Nerve Roots and Showing Autonomic Zones

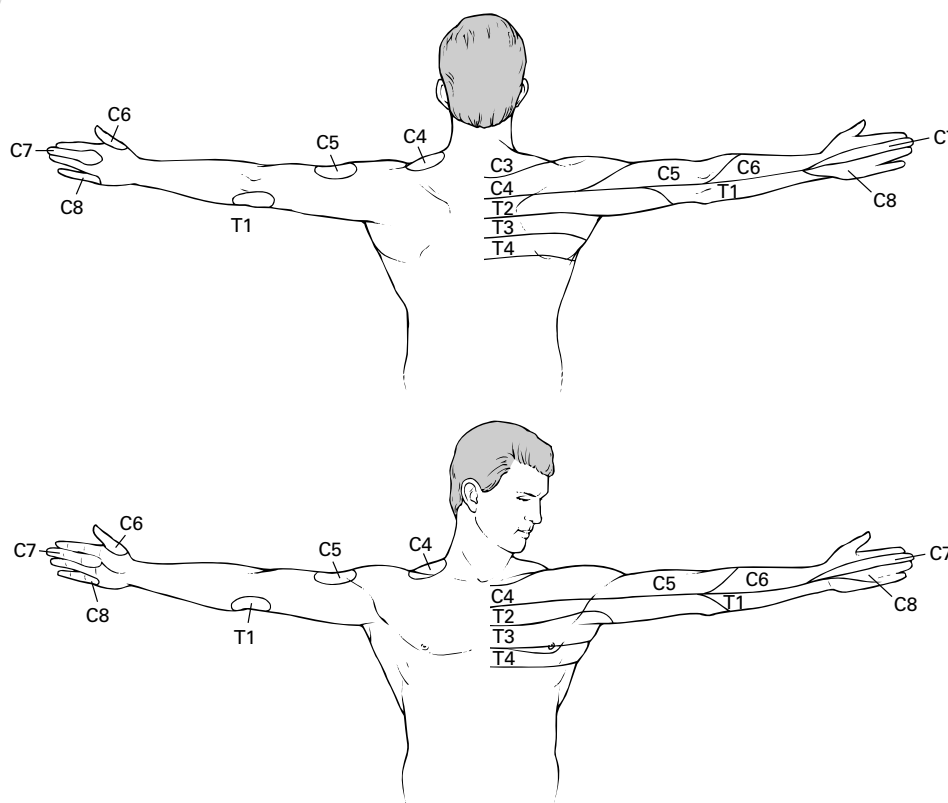


Changes in balance and gait pattern may also signify myelopathy.

A systematic neurologic examination can also localize the affected cervical nerve root (Table 15-2). The upper spine and extremity sensory dermatomes appear in Figure 15-2. The biceps (C5, partially C6), brachioradialis (C6), and triceps (C7) reflexes should be elicited. Weakness of the deltoid and biceps muscles implicates C5; wrist extensors C6; triceps, wrist flexors, and finger extensors C7; finger flexors C8; and intrinsics C8 and T1. Sensation can be grossly evaluated by touch and more precisely determined by pinprick, light touch, and a vibrating fork. Dermatomal overlap is common.

Reflexes should always be compared between extremities and elicited several times to determine reproducibility. Importantly, reflexes once “lost” due to previous injury or disease rarely return. Strength should also be compared between extremities and may need repeat testing to determine effort and reproducibility.

Figure 15-2 Skin Area Innervated by the Cervical and Thoracic Nerve Roots Showing Autonomic Zones



15.1b Description of Clinical Studies

General

The individual may have undergone a variety of special tests including electromyographic, cystometric, roentgenographic studies with or without dye, CT scans, and MRI studies with or without contrast. The physician should determine when, where, and by whom the studies were done, the findings, and who interpreted them. Whenever possible, the physician should personally review the studies and report agreement or disagreement with previous interpretations. A summary of the studies should be included as a separate paragraph or section.

While imaging and other studies may assist physicians in making a diagnosis, it is important to note that a positive imaging study in and of itself does not make the diagnosis. Several reports indicate approximately 30% of persons who have never had back pain will have an imaging study that can be interpreted as positive for a herniated disk, and 50% or more will have bulging disks. Further, the prevalence of degeneration changes, bulges, and herniations increases with advancing age.⁶⁻¹¹ To be of diagnostic value, clinical symptoms and signs must agree with the imaging findings. In other words, an imaging test is useful to confirm a diagnosis, but an imaging result alone is insufficient to qualify for a DRE category. Individuals with electromyography (EMG) studies that are clearly positive support a diagnosis of radiculopathy and therefore qualify for at least DRE category III.¹⁴

Motion Segment Integrity

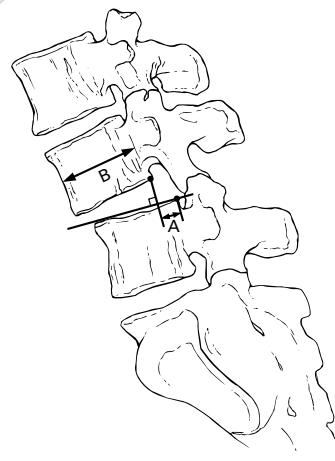
A motion segment of the spine is defined as two adjacent vertebrae, the intervertebral disk, the apophyseal or facet joints, and ligamentous structures between the vertebrae. The range of motion from segment to segment varies. In the upper cervical spine (occiput to C2), there is little flexion-extension, while the lower cervical spine permits increasing flexion-extension movements from about 10° at C2 to C3 to about 20° at C5 to C6 and C6 to C7. Flexion-extension movements are about 4° in the upper thoracic spine, 6° in the midthoracic spine, and 12° in the lower thoracic spine segments. In the lumbar spine there is a gradual increase from about 12° at L1 to L2 to 20° at the L5 to S1 level.¹³

Lateral bending is 5° to 6° in the lower cervical spine and about 6° in the upper thoracic spine. In the lumbar spine, lateral bending is greatest at L3 to L4, where it is about 8° to 9°. Axial rotation is 30° to 40° in each direction in the upper cervical spine, 5° to 6° in the lower cervical and upper thoracic spine, and minimal in the lumbar spine.

Throughout the spine, movements are coupled; this means that the primary motion in one direction always is accompanied by a secondary motion in another direction. For example, rotation is almost always combined with side bending. The dominant motions at both the lower cervical and entire lumbar spine, where most clinical pathology occurs, are flexion-extension.

Alteration of motion segment integrity can be either loss of motion segment integrity (increased translational or angular motion) or decreased motion resulting mainly from developmental changes, fusion, fracture healing, healed infection, or surgical arthrodesis. An attempt at arthrodesis may not necessarily result in a solid fusion, but it may significantly limit motion at a motion segment and qualify for alteration of motion segment integrity.

Figure 15-3a Loss of Motion Segment Integrity, Translation

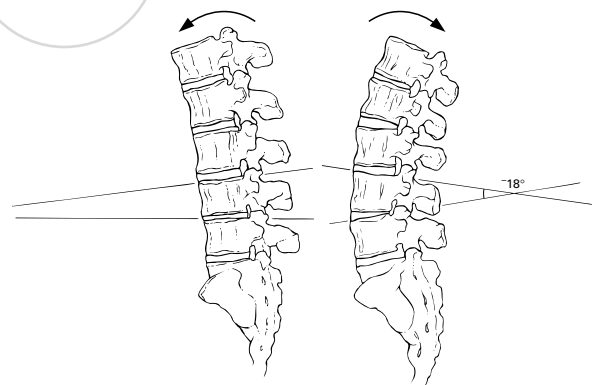


A line is drawn along the posterior bodies of the vertebrae below and above the motion segment in question on dynamic (flexion and extension), lateral roentgenograms of the spine. The distance between lines A and B and the distance between lines B and C at the level of the posteroinferior corner of the upper vertebral body are summed. A value greater than 2.5 mm in the thoracic spine, greater than 4.5 mm in the lumbar spine, and greater than 3.5 mm in the cervical spine qualifies as loss of structural integrity.

Motion of the individual spine segments cannot be determined by a physical examination but is evaluated with flexion and extension roentgenograms (see Figures 15-3a through 15-3c).^{13,14} Loss of motion segment integrity is defined as an anteroposterior motion of one vertebra over another that is greater than 3.5 mm in the cervical spine, greater than 2.5 mm in the thoracic spine, and greater than 4.5 mm in the lumbar spine (Figure 15-3a). Loss of motion segment integrity is also defined as a difference in the angular motion of two adjacent motion segments greater than 15° at L1-2, L2-3, and L3-4 and greater than 20° at L4 to L5. Loss of integrity of the lumbosacral joint is defined as angular motion between L5 and S1 that is greater than 25° . In the cervical spine, loss of motion segment integrity is defined as motion at the level in question that is more than 11° greater than at either adjacent level.

When routine x-rays are normal and severe trauma is absent, motion segment alteration is rare; thus, flexion and extension x-rays are indicated *only* when the physician suspects motion segment alteration from history or findings on routine x-rays.¹⁴

Figure 15-3b Loss of Motion Segment Integrity, Angular Motion (Sagittal Rotation), Lumbar Spine



Lines are drawn along the superior border of the vertebral body of the lower vertebrae and the superior border of the body of the upper vertebrae and the lines extended until they join. The angles are measured and subtracted. Note that lordosis (extension) is represented by a negative angle and kyphosis (flexion) by a positive angle. Loss of motion segment integrity is defined as motion greater than 15° at L1-2, L2-3, and L3-4 and greater than 20° at L4 to L5. Loss of integrity of the lumbosacral joint is defined as angular motion between L5 and S1 that is greater than 25° . The flexion angle is $+8^\circ$ and the extension angle is -18° . Therefore $(+8) - (-18) = +26^\circ$ and would qualify for loss of structural integrity at any lumbar level.

15.2 Determining the Appropriate Method for Assessment

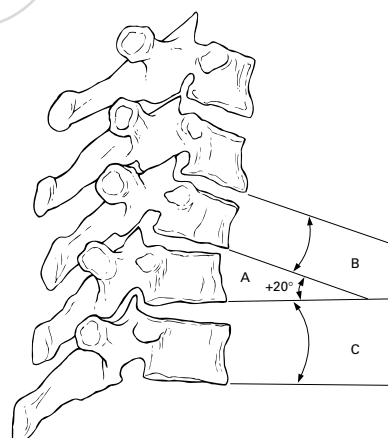
Spinal impairment rating is performed using one of two methods: the diagnosis-related estimate (DRE) or range-of-motion (ROM) method.

The DRE method is the principal methodology used to evaluate an individual who has had a distinct injury. When the cause of the impairment is not easily determined and if the impairment can be well characterized by the DRE method, the evaluator should use the DRE method.

The ROM method is used in several situations:

1. When an impairment is not caused by an injury, if the cause of the condition is uncertain and the DRE method does not apply, or an individual cannot be easily categorized in a DRE class. It is acknowledged that the cause of impairment (injury, illness, or aging) cannot always be determined. The reason for using the ROM method under these circumstances must be carefully supported in writing.

Figure 15-3c Loss of Motion Segment Integrity, Cervical Spine



Lines are drawn along the inferior borders of the two vertebral bodies adjacent to the level in question and of the vertebral bodies above and below those two vertebrae. Angles A, B, and C are measured on both flexion and extension x-rays and the measurements subtracted from one another. Note that lordosis (extension) is represented by a negative angle and kyphosis (flexion) is represented by a positive angle. Loss of motion segment integrity is defined as motion at the level in question that is more than 11° greater than at either adjacent level.

2. When there is multilevel involvement in the same spinal region (eg, fractures at multiple levels, disk herniations, or stenosis with radiculopathy at multiple levels or bilaterally).
3. Where there is alteration of motion segment integrity (eg, fusions) at multiple levels in the same spinal region, unless there is involvement of the corticospinal tract (then use the DRE method for corticospinal tract involvement).
4. Where there is recurrent radiculopathy caused by a new (recurrent) disk herniation or a recurrent injury in the same spinal region.
5. Where there are multiple episodes of other pathology producing alteration of motion segment integrity and/or radiculopathy.

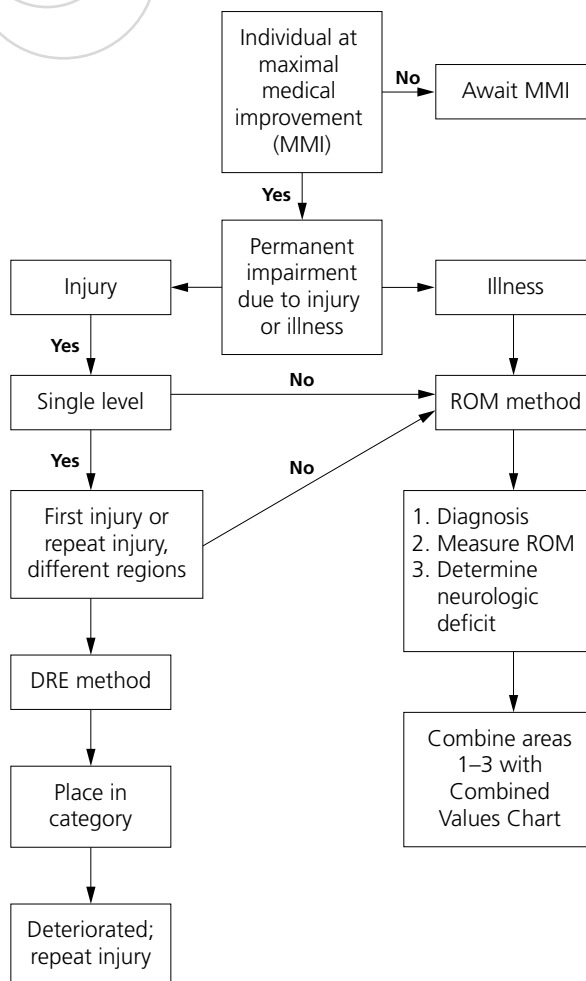
The ROM method can also be used if statutorily mandated in a particular jurisdiction.

In the small number of instances in which the ROM and DRE methods can both be used, evaluate the individual with both methods and award the higher rating.

All spine impairment ratings shown in Tables 15-3 to 15-5 estimate whole person impairment. With both the DRE method and the ROM method, whole person function is regarded as 100%. For converting whole person to regional spine impairments, see Section 15.13. When two or more regions are impaired and rated by either the DRE or ROM method, the ratings should be combined using the Combined Values Chart, p. 604.

A flowchart of the spine impairment evaluation process is provided in Figure 15-4.

Figure 15-4 Spine Impairment Evaluation Process



15.2a Summary of Specific Procedures and Directions

1. Take a careful history, perform a thorough medical examination, and review all pertinent records and studies. This is helpful in determining the presence or absence of structural abnormalities, nerve root or cord involvement, and motion segment integrity.
2. Consider the permanency of the impairment, referring to *Guides* Chapter 1 and the Glossary for definitions as needed. If the impairment is resolving, changing, unstable, or expected to change significantly with or without medical treatment within 12 months, it is not considered a permanent (stable) impairment and should not be rated under the *Guides* criteria.

3. Select the region that is primarily involved (ie, the lumbar, cervical, or thoracic spine) and identify the individual's most serious objective findings.
4. Determine whether the individual has multilevel involvement or multiple recurrences/occasions within the same region of the spine. Use the ROM method if:
 - a. there are fractures at more than one level in a spinal region,
 - b. there is radiculopathy bilaterally or at multiple levels in the same spinal region,
 - c. there is multilevel motion segment alteration (such as a multilevel fusion) in the same spinal region, or
 - d. there is recurrent disk herniation or stenosis with radiculopathy at the same or a different level in the same spinal region; in this case, combine the ratings using the ROM method.

5. If the individual does not have multilevel involvement or multiple recurrences/occasions and an injury occurred, determine the proper DRE category. Most ratings will fall into categories I, II, or III. A corticospinal tract injury is evaluated according to Section 15.7.
6. If the individual has been treated with surgery or another modality, evaluate the results, extent of improvement, and impact on the ability to perform activities of daily living. If residual symptoms or objective findings impact the ability to perform ADL despite treatment, the higher percentage in each range should be assigned. If an individual had a prior condition, was asymptomatic, and now—at MMI—has symptoms that impact the ability to perform activities of daily living, the higher rating within a range may also be used. If ratings are increased, explicit documentation of the reasons for the increase should be included in the report.
7. If more than one spine region is impaired, determine the impairment of the other region(s) with the DRE method. Combine the regional impairments using the Combined Values Chart (p. 604) to express the individual's total spine impairment.
8. From historical information and previously compiled medical data, determine if there was a preexisting impairment. Congenital, developmental, and other preexisting conditions may be differentiated from those attributable to the injury or illness by examining preinjury roentgenograms or by performing a bone scan after the onset of the condition.
9. If requested, apportion findings to the current or prior condition, following jurisdiction practices and assuming adequate information is available on the prior condition. In some instances, to apportion ratings, the percent impairment due to previous findings can simply be subtracted from the percent based on the current findings. Ideally, use the same method to compare the individual's prior and present conditions. If the ROM method has been used previously, it must be used again. If the previous evaluation was based on the DRE method and the individual now is evaluated with the ROM method, and prior ROM measurements do not exist to calculate a ROM impairment rating, the previous DRE percent can be subtracted from the ROM ratings. Because there are two methods and complete data may not exist on an earlier assessment, the apportionment calculation may be a less than ideal estimate.
10. For individuals with corticospinal tract involvement, refer to Table 15-6 for the appropriate impairment rating.

15.3 Diagnosis-Related Estimates Method

The DRE method has eight diagnosis-related categories for each of the three spinal regions. In assigning the individual to the correct DRE category, one of two approaches is used. The first is based on symptoms, signs, and appropriate diagnostic test results. The second is based on the presence of fractures and/or dislocations with or without clinical symptoms. If a fracture is present that places the individual into a DRE category, no other verification is required. The symptoms, signs other than fractures, and tests used to assist correct categorization of an individual are defined in Box 15-1.

Box 15-1 Definitions of Clinical Findings Used to Place an Individual in a DRE Category**Muscle Spasm**

Muscle spasm is a sudden, involuntary contraction of a muscle or group of muscles. Paravertebral muscle spasm is common after acute spinal injury but is rare in chronic back pain. It is occasionally visible as a contracted paraspinal muscle but is more often diagnosed by palpation (a hard muscle). To differentiate true muscle spasm from voluntary muscle contraction, the individual should not be able to relax the contractions. The spasm should be present standing as well as in the supine position and frequently causes a scoliosis. The physician can sometimes differentiate spasm from voluntary contraction by asking the individual to place all his or her weight first on one foot and then the other while the physician gently palpates the paraspinal muscles. With this maneuver, the individual normally relaxes the paraspinal muscles on the weight-bearing side. If the examiner witnesses this relaxation, it usually means that true muscle spasm is not present.

Muscle Guarding

Guarding is a contraction of muscle to minimize motion or agitation of the injured or diseased tissue. It is not true muscle spasm because the contraction can be relaxed. In the lumbar spine, the contraction frequently results in loss of the normal lumbar lordosis, and it may be associated with reproducible loss of spinal motion.

Asymmetry of Spinal Motion

Asymmetric motion of the spine in one of the three principal planes is sometimes caused by muscle spasm or guarding. That is, if an individual attempts to flex the spine, he or she is unable to do so moving symmetrically; rather, the head or trunk leans to one side. To qualify as true asymmetric motion, the finding must be reproducible and consistent and the examiner must be convinced that the individual is cooperative and giving full effort.

Nonverifiable Radicular Root Pain

Nonverifiable pain is pain that is in the distribution of a nerve root but has no identifiable origin; ie, there are no objective physical, imaging, or electromyographic findings. For dermatomal distributions, see Figures 15-1 and 15-2.

Reflexes

Reflexes may be normal, increased, reduced, or absent. For reflex abnormalities to be considered valid, the involved and normal limb(s) should show marked asymmetry between arms or legs on repeated testing. Once lost because of previous radiculopathy, a reflex rarely returns. Abnormal reflexes such as Babinski signs or clonus may be signs of corticospinal tract involvement.

Weakness and Loss of Sensation

To be valid, the sensory findings must be in a strict anatomic distribution, ie, follow dermatomal patterns (see Figures 15-1 and 15-2). Motor findings should also be consistent with the affected nerve structure(s). Significant, long-standing weakness is usually accompanied by atrophy.

Atrophy

Atrophy is measured with a tape measure at identical levels on both limbs. For reasons of reproducibility, the difference in circumference should be 2 cm or greater in the thigh and 1 cm or greater in the arm, forearm, or leg. The evaluator can address asymmetry due to extremity dominance in the report.

Radiculopathy

Radiculopathy for the purposes of the *Guides* is defined as significant alteration in the function of a nerve root or nerve roots and is usually caused by pressure on one or several nerve roots. The diagnosis requires a dermatomal distribution of pain, numbness, and/or paresthesias in a dermatomal distribution. A root tension sign is usually positive. The diagnosis of herniated disk must be substantiated by an appropriate finding on an imaging study. The presence of findings on an imaging study in and of itself does not make the diagnosis of radiculopathy. There must also be clinical evidence as described above.

Electrodiagnostic Verification of Radiculopathy

Unequivocal electrodiagnostic evidence of acute nerve root pathology includes the presence of multiple positive sharp waves or fibrillation potentials in muscles innervated by one nerve root. However, the quality of the person performing and interpreting the study is critical. Electromyography should

be performed only by a licensed physician qualified by reason of education, training, and experience in these procedures. Electromyography does not detect all compressive radiculopathies and cannot determine the cause of the nerve root pathology. On the other hand, electromyography can detect noncompressive radiculopathies, which are not identified by imaging studies.

Alteration of Motion Segment Integrity

Motion segment alteration can be either loss of motion segment integrity (increased translational or angular motion) or decreased motion secondary to developmental fusion, fracture healing, healed infection, or surgical arthrodesis. An attempt at arthrodesis may not necessarily result in a solid fusion but may significantly limit motion at a motion segment. Motion of the individual spine segments cannot be determined by a physical examination but is evaluated with flexion and

extension roentgenograms. The loss of motion segment integrity is defined in Section 15.1b.

Cauda Equina Syndrome

Cauda equina syndrome is manifested by bowel or bladder dysfunction, saddle anesthesia, and variable loss of motor and sensory function in the lower extremities. Individuals with cauda equina syndrome usually have loss of sphincter tone on rectal examination and diminished or absent bladder, bowel, and lower limb reflexes.

Urodynamic Tests

Cystometrograms are useful in individuals where a cauda equina syndrome is possible but not certain. A normal cystometrogram makes the presence of a nerve-related bladder dysfunction unlikely. Occasionally, more extensive urodynamic testing is necessary.

To use the DRE method, obtain an individual's history, examine the individual, review the results of appropriate diagnostic studies, and place the individual in the appropriate category. Although there are eight categories, almost all individuals will fall into one of the first three DRE categories. Altered motion segment integrity (ie, increased motion or loss of motion) qualifies the individual for category IV or V. A fracture and/or dislocation, with or without clinical symptoms, permits placement of the individual into a DRE category with no additional verification. If there are impairments in different spinal regions, rate each spinal region separately using the DRE method; then combine the ratings using the Combined Values Chart on page 604. As stated previously, fractures at more than one level in the same spinal region should be rated using the ROM method.

In most cases, using the definitions provided in Box 15-1, the physician can assign an individual to DRE category I, II, or III. An individual in category I has only subjective findings. In category II, the individual has objective findings but no radiculopathy or alteration of structural integrity, while in category III, radiculopathy with objective verification must be present. Since an individual is evaluated after having reached MMI, a previous history of objective findings may not define the current, ratable condition but is important in determining the course and whether

MMI has been reached. *The impairment rating is based on the condition once MMI is reached, not on prior symptoms or signs.*

If the individual had a radiculopathy caused by a herniated disk or lateral spinal stenosis that responded to conservative treatment and currently has no radicular symptoms or signs, he or she is placed in category II, since at MMI there is no radiculopathy. Category III is for individuals with a symptomatic radiculopathy, either after medical or surgical treatment, or for individuals who have a history of previous radiculopathy caused by disk herniation or lateral spinal stenosis but have improved or become asymptomatic following surgery.

The DRE method recommends that physicians document physiologic and structural impairments relating to injuries or diseases other than common developmental findings, such as (1) spondylolysis, found normally in 7% of adults; (2) spondylolisthesis, found in 3% of adults; (3) herniated disk without radiculopathy, found in approximately 30% of individuals by age 40 years; and (4) aging changes, present in 40% of adults after age 35 years and in almost all individuals after age 50.^{6,12} As previously noted, the presence of these abnormalities on imaging studies does not necessarily mean the individual has an impairment due to an injury.

In cases where the abnormalities discussed above are present on imaging studies and are known or assumed to have preexisted an injury being rated, physicians should acknowledge these antecedent conditions. If requested, physicians may need to assess whether the condition was previously symptomatic and whether any aggravation occurred as a result of the injury. Physicians should be aware of the statutory definition in the involved jurisdiction pertaining to *aggravation* to ensure their use of the term is consistent with their state's legal interpretation.

DRE categories are discussed in the following three sections.

15.4 DRE: Lumbar Spine

The lumbar spine DRE categories are summarized in Table 15-3. Apart from category I, each category includes a range to account for the resolution or continuation of symptoms and their impact on the ability to perform ADL.

Table 15-3 Criteria for Rating Impairment Due to Lumbar Spine Injury

DRE Lumbar Category I 0% Impairment of the Whole Person	DRE Lumbar Category II 5%- 8% Impairment of the Whole Person	DRE Lumbar Category III 10%-13% Impairment of the Whole Person	DRE Lumbar Category IV 20%-23% Impairment of the Whole Person	DRE Lumbar Category V 25%-28% Impairment of the Whole Person
No significant clinical findings, no observed muscle guarding or spasm, no documentable neurologic impairment, no documented alteration in structural integrity, and no other indication of impairment related to injury or illness; no fractures	<p>Clinical history and examination findings are compatible with a specific injury; findings may include significant muscle guarding or spasm observed at the time of the examination, asymmetric loss of range of motion, or nonverifiable radicular complaints, defined as complaints of radicular pain without objective findings; no alteration of the structural integrity and no significant radiculopathy</p> <p>or</p> <p>individual had a clinically significant radiculopathy and has an imaging study that demonstrates a herniated disk at the level and on the side that would be expected based on the previous radiculopathy, but no longer has the radiculopathy following conservative treatment</p> <p>or</p> <p>fractures: (1) less than 25% compression of one vertebral body; (2) posterior element fracture without dislocation (not developmental spondylolysis) that has healed without alteration of motion segment integrity; (3) a spinous or transverse process fracture with displacement without a vertebral body fracture, which does not disrupt the spinal canal</p>	<p>Significant signs of radiculopathy, such as dermatomal pain and/or in a dermatomal distribution, sensory loss, loss of relevant reflex(es), loss of muscle strength or measured unilateral atrophy above or below the knee compared to measurements on the contralateral side at the same location; impairment may be verified by electrodiagnostic findings</p> <p>or</p> <p>history of a herniated disk at the level and on the side that would be expected from objective clinical findings, associated with radiculopathy, or individuals who had surgery for radiculopathy but are now asymptomatic</p> <p>or</p> <p>fractures: (1) 25% to 50% compression of one vertebral body; (2) posterior element fracture with displacement disrupting the spinal canal; in both cases, the fracture has healed without alteration of structural integrity</p>	<p>Loss of motion segment integrity defined from flexion and extension radiographs as at least 4.5 mm of translation of one vertebra on another or angular motion greater than 15° at L1-2, L2-3, and L3-4, greater than 20° at L4-5, and greater than 25° at L5-S1 (Figure 15-3); may have complete or near complete loss of motion of a motion segment due to developmental fusion, or successful or unsuccessful attempt at surgical arthrodesis</p> <p>or</p> <p>fractures: (1) greater than 50% compression of one vertebral body without residual neurologic compromise</p>	<p>Meets the criteria of DRE lumbosacral categories III and IV; that is, both radiculopathy and alteration of motion segment integrity are present; significant lower extremity impairment is present as indicated by atrophy or loss of reflex(es), pain, and/or sensory changes within an anatomic distribution (dermatomal), or electromyographic findings as stated in lumbosacral category III and alteration of spine motion segment integrity as defined in lumbosacral category IV</p> <p>or</p> <p>fractures: (1) greater than 50% compression of one vertebral body with unilateral neurologic compromise</p>

DRE Lumbar Category I
0% Impairment of the Whole Person

No significant clinical findings, no observed muscle guarding or spasm, no documentable neurologic impairment, no documented alteration in structural integrity, and no other indication of impairment related to injury or illness; no fractures

Example 15-1
0% Impairment Due to Lumbar Injury

Subject: 24-year-old man.

History: Hurt his back while lifting a large, heavy box; described the pain as being in the lumbosacral region. Examination shortly after the injury was normal, except for a slight decrease in lumbar motion due to pain. No muscle spasm or weakness. The individual was treated with an analgesic. He was off work for 3 days and then returned and has continued to work.

Current Symptoms: Occasional soreness in the low back with heavy lifting; denies leg pain or numbness.

Physical Exam: No positive finding was present, including a negative SLR, normal strength, range of motion, and normal neurologic examination. No atrophy.

Clinical Studies: None.

Diagnosis: Minor lumbar strain.

Impairment Rating: 0% impairment of the whole person.

Comment: Since there are no objective findings at the time of the impairment evaluation, the individual is assigned to lumbar DRE category I.

DRE Lumbar Category II
5%- 8% Impairment of the Whole Person

Clinical history and examination findings are compatible with a specific injury; findings may include significant muscle guarding or spasm observed at the time of the examination, asymmetric loss of range of motion, or nonverifiable radicular complaints, defined as complaints of radicular pain without objective findings; no alteration of the structural integrity and no significant radiculopathy

or

individual had a clinically significant radiculopathy and has an imaging study that demonstrates a herniated disk at the level and on the side that would be expected based on the previous radiculopathy, but no longer has the radiculopathy following conservative treatment

or

fractures: (1) less than 25% compression of one vertebral body; (2) posterior element fracture without dislocation (not developmental spondylolysis) that has healed without alteration of motion segment integrity; (3) a spinous or transverse process fracture with displacement without a vertebral body fracture, which does not disrupt the spinal canal

Example 15-2
5% to 8% Impairment Due to Lumbar Injury

Subject: 25-year-old man.

History: Onset of low back and left thigh pain while lifting on the job. Examination revealed muscle spasm, a positive SLR on the left at 60°, a positive crossed SLR at 70°, and an absent left Achilles tendon reflex. Treated with physical therapy, improved, and returned to work after 6 weeks.

Current Symptoms: No pain at rest or numbness in the lower extremities 1 year after onset. Able to perform all ADL; some back pain with heavy activity.

Physical Exam: Full range of motion of the lumbar spine. SLR: negative. Motor and sensory functions are normal.

Clinical Studies: MRI: left posterolateral disk herniation L5-S1.

Diagnosis: Left posterolateral disk herniation L5-S1 with left S1 radiculopathy, resolved.

Impairment Rating: 5% impairment of the whole person.

Comment: This individual had a radiographically confirmed herniated disk, at the level and side expected from the physical examination. Most symptoms resolved with conservative treatment. At the time of evaluation, the individual was doing well, with no evidence of residual radiculopathy.

DRE Lumbar Category III
10%-13% Impairment of the Whole Person

Significant signs of radiculopathy, such as dermatomal pain and/or in a dermatomal distribution, sensory loss, loss of relevant reflex(es), loss of muscle strength or measured unilateral atrophy above or below the knee compared to measurements on the contralateral side at the same location; impairment may be verified by electrodiagnostic findings

or

history of a herniated disk at the level and on the side that would be expected from objective clinical findings, associated with radiculopathy, or individuals who had surgery for radiculopathy but are now asymptomatic

or

fractures: (1) 25% to 50% compression of one vertebral body; (2) posterior element fracture with displacement disrupting the spinal canal; in both cases, the fracture has healed without alteration of structural integrity

Example 15-3
10% to 13% Impairment Due to Surgically Treated Herniated Disk

Subject: 25-year-old man.

History: Onset of back and left posterior thigh and leg pain while twisting in a flexed position when lifting a moderately heavy package. Initially presented with muscle spasm, a positive SLR on the side at 60°, a positive crossed SLR at 70°, and an absent left Achilles tendon reflex. Treatment with physical therapy did not produce significant improvement. Underwent surgical discectomy 3 months after the injury. Improved and returned to work without restrictions after 4 months of rehabilitation.

Current Symptoms: No pain at rest or numbness in the lower extremities 8 months after injury. Able to do most ADL but complains of back pain with heavy activity.

Physical Exam: Full range of motion of the lumbar spine. Loss of the Achilles reflex but normal motor and sensory functions. SLR: negative.

Clinical Studies: Original MRI: herniated disk at L5-S1. No additional studies have been done.

Diagnosis: Left posterolateral herniated disk at L5-S1 with left S1 radiculopathy, partially resolved status postdiscectomy.

Impairment Rating: 10% impairment of the whole person.

Comment: Symptoms, physical findings, and imaging studies are all consistent with a symptomatic herniated disk. Most symptoms and signs resolved with surgical treatment.

Example 15-4
10% to 13% Impairment Due to Radiculopathy

Subject: 25-year-old man.

History: New onset of back and left leg pain while lifting on the job. Initially presented with muscle spasm, a positive SLR on the left side at 60°, a positive crossed SLR at 70°, and an absent left Achilles tendon reflex. An MRI revealed a left posterolateral disk herniation at L5-S1. Was treated with analgesics and physical therapy but did not improve. Underwent surgical discectomy 3 months after the injury. Some improvement in the symptoms after 9 months of rehabilitation.

Current Symptoms: Persistent back and thigh pain and numbness along the lateral side of the foot at rest. Unable to do his usual recreational and some household activities.

Physical Exam: Restricted lumbar motion. Loss of the Achilles reflex, numbness in the S1 nerve root distribution, and pain in the posterior thigh and leg on SLR.

Clinical Studies: Original MRI: herniated disk at L5-S1. Postoperative MRI with gadolinium: fibrosis but no residual or recurrent herniation.

Diagnosis: Chronic low back pain and radiculopathy.

Impairment Rating: 13% impairment of the whole person.

Comment: Symptoms, physical findings, and imaging studies are all consistent with a symptomatic herniated disk. Symptoms did not completely resolve after surgical treatment, with subjective and objective signs of persistent radiculopathy. Individual therefore qualifies for DRE lumbar category III. Because of significant persistent symptoms that limit the ability to perform ADL and continued objective findings, the impairment rating is increased to 13%.

DRE Lumbar Category IV
20%-23% Impairment of the Whole Person

Loss of motion segment integrity defined from flexion and extension radiographs as at least 4.5 mm of translation of one vertebra on another or angular motion greater than 15° at L1-2, L2-3, and L3-4, greater than 20° at L4-5, and greater than 25° at L5-S1 (Figure 15-3); may have complete or near complete loss of motion of a motion segment due to developmental fusion, or successful or unsuccessful attempt at surgical arthrodesis

or

fractures: (1) greater than 50% compression of one vertebral body without residual neurologic compromise

DRE Lumbar Category V
25%-28% Impairment of the Whole Person

Meets the criteria of DRE lumbosacral categories III and IV; that is, both radiculopathy and alteration of motion segment integrity are present; significant lower extremity impairment is present as indicated by atrophy or loss of reflex(es), pain, and/or sensory changes within an anatomic distribution (dermatomal), or electromyographic findings as stated in lumbosacral category III and alteration of spine motion segment integrity as defined in lumbosacral category IV

or

fractures: (1) greater than 50% compression of one vertebral body with unilateral neurologic compromise

Example 15-5**20% to 23% Impairment Due to Fracture With Greater Than 50% Compression of Vertebrae**

Subject: 54-year-old woman.

History: Fell from a ladder and sustained a burst fracture of L2 with a 55% loss of height, without neurologic findings. Treated with bracing, the fracture healed; returned to most ADL 6 months after the injury.

Current Symptoms: No neurologic complaints, but has back pain after heavy activity or with weather changes.

Physical Exam: Mild tenderness to palpation at the fracture site. Neurologic examination and SLR: negative. Range of motion is mildly decreased.

Clinical Studies: Radiograph: fracture healed with 60% loss of height.

Diagnosis: Burst fracture L2 > 50%.

Impairment Rating: 20% impairment of the whole person.

Comment: Individual qualifies for lumbar DRE category IV based on the fracture. Neurologic deficit, if present, would warrant category V or Section 15.7. If she had multiple compression fractures in the same or different spinal regions, use the ROM method for rating.

Example 15-6**25% to 28% Impairment Due to Radiculopathy and Alteration of Motion Segment Integrity**

Subject: 25-year-old man.

History: Onset of back and left leg pain after a fall on a concrete surface while carrying a box. Initially presented with muscle spasm, an SLR on the left side at 60°, a positive crossed SLR at 70°, and an absent left Achilles tendon reflex. Treated with physical therapy but did not improve. Underwent surgical discectomy and arthrodesis of L5-S1 3 months after the injury. After 9 months of rehabilitation, leg and back symptoms were diminished but persistent.

Current Symptoms: Back and thigh pain at rest and persistent numbness along the lateral side of the foot 1 year after the onset of symptoms. Pain and numbness prevent individual from maintaining a constant position, prolonged standing or walking, or performing his prior work, recreational, and some household activities.

Physical Exam: Severely restricted range of motion. Loss of the Achilles reflex. Numbness in the S1 nerve root distribution and dermatomal pain in the leg on SLR.

Clinical Studies: Original MRI: a severely degenerated L5-S1 disk with a herniation on the left side. Postoperative MRI with gadolinium: fibrosis, but no residual or recurrent herniation. Fusion appears solid.

Diagnosis: Left posterolateral disk herniation L5-S1 with S1 radiculopathy and severe disk degeneration, unresolved status postdiscectomy and L5-S1 fusion.

Impairment Rating: 28% impairment of the whole person.