

Comment: Symptoms, physical findings, and imaging studies are all consistent with a symptomatic herniated disk. Excision of the offending disk and a single-level fusion did not relieve all symptoms, which are supported by signs of a persistent radiculopathy. Individual qualifies for lumbar DRE category V because he has persistent radiculopathy as well as single-level alteration of motion segment integrity.

15.5 DRE: Thoracic Spine

Thoracic problems are evaluated as follows:

For thoracic spine problems localized to the thoracic region, use Table 15-4. If the thoracic pathology also leads to isolated bowel or bladder dysfunction not due to corticospinal damage, obtain the appropriate estimates for bowel and bladder dysfunction listed in the gastrointestinal and urology chapters and combine these with the thoracic spine DRE category (I-V) listed in Table 15-4. If the thoracic spine problem is due to corticospinal tract involvement, use Section 15.7. If thoracic injury-related bowel or bladder symptoms exist without verifiable lower extremity involvement, then appropriate estimates for bowel and bladder impairments from the *Guides* chapters on the urinary and reproductive and digestive systems should be combined (Combined Values Chart, p. 604) with an impairment percent from one of the thoracic categories II through V.

The thoracic spine impairment DRE categories are summarized in Table 15-4.

Table 15-4 Criteria for Rating Impairment Due to Thoracic Spine Injury

DRE Thoracic Category I 0% Impairment of the Whole Person	DRE Thoracic Category II 5%-8% Impairment of the Whole Person	DRE Thoracic Category III 15%-18% Impairment of the Whole Person	DRE Thoracic Category IV 20%-23% Impairment of the Whole Person	DRE Thoracic Category V 25%-28% Impairment of the Whole Person
No significant clinical findings, no observed muscle guarding, no documentable neurologic impairment, no documented changes in structural integrity, and no other indication of impairment related to injury or illness; no fractures	History and examination findings are compatible with a specific injury or illness; findings may include significant muscle guarding or spasm observed at the time of the examination, asymmetric loss of range of motion (dysmetria), or nonverifiable radicular complaints, defined as complaints of radicular pain without objective findings; no alteration of motion segment integrity or herniated disk at the level and on the side that would be expected from objective clinical findings, but without radicular signs following conservative treatment or fractures: (1) less than 25% compression of one vertebral body; (2) posterior element fracture without dislocation that has healed without alteration of motion segment integrity or radiculopathy; (3) a spinous or transverse process fracture with displacement, but without a vertebral body fracture	Ongoing neurologic impairment of the lower extremity related to a thoracolumbar injury, documented by examination of motor and sensory functions, reflexes, or findings of unilateral atrophy above or below the knee related to no other condition; impairment may be verified by electrodiagnostic testing or clinically significant radiculopathy, verified by an imaging study that demonstrates a herniated disk at the level and on the side that would be expected from objective clinical findings; history of radiculopathy, which has improved following surgical treatment or fractures: (1) 25% to 50% compression fracture of one vertebral body; (2) posterior element fracture with mild displacement disrupting the canal; in both cases the fracture has healed without alteration of structural integrity; differentiation from a congenital or developmental condition should be accomplished, if possible, by examining preinjury roentgenograms, if available, or by a bone scan performed after the onset of the condition	Alteration of motion segment integrity or bilateral or multilevel radiculopathy; alteration of motion segment integrity is defined from flexion and extension radiographs as translation of one vertebra on another of more than 2.5 mm; radiculopathy as defined in thoracic category III need not be present if there is alteration of motion segment integrity; if an individual is to be placed in DRE thoracic category IV due to radiculopathy, the latter must be bilateral or involve more than one level or fractures: (1) more than 50% compression of one vertebral body without residual neural compromise	Impairment of the lower extremity as defined in thoracolumbar category III and loss of structural integrity as defined in thoracic category IV or fractures: (1) greater than 50% compression of one vertebral body with neural motor compromise but not bilateral involvement that would qualify the individual for corticospinal tract evaluation

**DRE Thoracic Category I
0% Impairment of the Whole Person**

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

**Example 15-7
0% Impairment Due to Thoracic Injury**

Subject: 44-year-old man.

History: Working from home spending many hours on the phone and computer.

Current Symptoms: Chronic, bilateral, upper back discomfort under the scapula area worsened 3 to 4 months ago, but unchanged since. Feels better when not working at the computer.

Physical Exam: Hunched posture. Minimal tenderness to deep palpation over the descending trapezius muscles and the periscapular area, right side more pronounced. Otherwise normal examination.

Clinical Studies: None.

Diagnosis: Upper back pain.

Impairment Rating: 0% impairment of the whole person.

Comment: The individual was educated concerning the importance of proper posture, an appropriate workstation, and the need for stretching and strengthening exercises to alleviate the temporary discomfort.

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

History and examination findings are compatible with a specific injury or illness; findings may include significant muscle guarding or spasm observed at the time of the examination, asymmetric loss of range of motion (dysmetria), or nonverifiable radicular complaints, defined as complaints of radicular pain without objective findings; no alteration of motion segment integrity

or

herniated disk at the level and on the side that would be expected from objective clinical findings, but without radicular signs following conservative treatment

or

fractures: (1) less than 25% compression of one vertebral body; (2) posterior element fracture without dislocation that has healed without alteration of motion segment integrity or radiculopathy; (3) a spinous or transverse process fracture with displacement, but without a vertebral body fracture

Example 15-8

5% to 8% Impairment Due to Thoracic Injury

Subject: 56-year-old man.

History: Laborer with prior history of multiple musculoskeletal injuries during college football, from which he had fully recovered. Developed severe right-sided, radiating arm pain with tingling along the chest and the underside of the right arm while moving a refrigerator. Most of the pain has disappeared, but individual still has some discomfort when lifting the right arm above shoulder level.

Current Symptoms: Persistent numbness along the medial right arm.

Physical Exam: Numbness along a T1-3 dermatomal area in chest, not clearly defined.

Clinical Studies: MRI: degenerative disk changes at T1-2. Radiographs: osteophyte T1, T2 levels.

Diagnosis: Degenerative disk disease T1.

Impairment Rating: 5% impairment of the whole person.

Comment: Impairment rating would increase by up to 3% if individual was unable to do ADL as indicated in Table 1-2.

DRE Thoracic Category III
15%-18% Impairment of the Whole Person

Ongoing neurologic impairment of the lower extremity related to a thoracolumbar injury, documented by examination of motor and sensory functions, reflexes, or findings of unilateral atrophy above or below the knee related to no other condition; impairment may be verified by electrodiagnostic testing

or

clinically significant radiculopathy, verified by an imaging study that demonstrates a herniated disk at the level and on the side that would be expected from objective clinical findings; history of radiculopathy, which has improved following surgical treatment

or

fractures: (1) 25% to 50% compression fracture of one vertebral body; (2) posterior element fracture with mild displacement disrupting the canal; in both cases the fracture has healed without alteration of structural integrity; differentiation from a congenital or developmental condition should be accomplished, if possible, by examining preinjury roentgenograms, if available, or by a bone scan performed after the onset of the condition

Example 15-9

15% to 18% Impairment Due to Thoracic Injury

Subject: 35-year-old man.

History: Individual fell from the second floor of a building on which he was working and sustained a compression fracture of T8. After conservative treatment, able to perform most ADL and walk without braces or crutches.

Current Symptoms: Minor back pain with heavy physical activity. Left lower extremity weakness and numbness in the left leg.

Physical Exam: Spotty numbness in the left leg and grade 4/5 left leg weakness. Measurable atrophy of left thigh and leg. Left leg reflexes are slightly hypoactive.

Clinical Studies: Compression fracture of T8 with loss of height of the vertebral body of about 30%.

Diagnosis: Compression fracture T8 with residual left lower extremity neurologic involvement.

Impairment Rating: 15% impairment of the whole person.

Comment: This individual qualifies for DRE thoracic category III because of his ongoing neurologic deficits and structural inclusion of a compression fracture with 25% to 50% loss of height.

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

Alteration of motion segment integrity or bilateral or multilevel radiculopathy; alteration of motion segment integrity is defined from flexion and extension radiographs as translation of one vertebra on another of more than 2.5 mm; radiculopathy as defined in thoracic category III need not be present if there is alteration of motion segment integrity; if an individual is to be placed in DRE thoracic category IV due to radiculopathy, the latter must be bilateral or involve more than one level

or

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

Example 15-10**20% to 23% Impairment Due to Compression Fracture of T1**

Subject: 56-year-old-man.

History: Truck driver in motor vehicle accident was unconscious and had a seizure. Improved with physical therapy. Able to drive again and do usual ADL. No further seizures; off medication.

Current Symptoms: Bilateral upper extremity heaviness and weakness.

Physical Exam: Numbness over T1 distribution bilaterally; weakness of the intrinsic hand muscles.

Clinical Studies: 65% compression fracture of T1.

Diagnosis: Compression fracture of T1 with bilateral radiculopathy. New onset seizure disorder.

Impairment Rating: 20% impairment due to musculoskeletal disorder; combine with appropriate rating due to the seizure disorder to determine whole person impairment (see Combined Values Chart, p. 604).

Comment: No additional impairment since he is doing well.

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

Impairment of the lower extremity as defined in thoracolumbar category III and loss of structural integrity as defined in thoracic category IV

or

fractures: (1) greater than 50% compression of one vertebral body with neural motor compromise but not bilateral involvement that would qualify the individual for corticospinal tract evaluation

Example 15-11**25% to 28% Impairment Due to Radiculopathy and Alteration of Motion Segment Integrity**

Subject: 35-year-old man.

History: Individual fell from the second floor of a building on which he was working and sustained a compression fracture of T8. He had minor right lower extremity weakness and numbness. After anterior surgical decompression and instrumented fusion from T7 through T9 he improved and was able to return to most ADL and walk without braces or crutches, but he still had weakness and patchy numbness in the right lower extremity.

Current Symptoms: Minor pain on heavy activity.

Physical Exam: Neurologically, spotty numbness in the right lower extremity with 4/5 weakness and mild atrophy of the right thigh and leg muscles. Right lower extremity reflexes are slightly hyperactive.

Clinical Studies: MRI: compression fracture T8 without canal compromise. Radiograph: treated fracture with fusion.

Diagnosis: Compression fracture T8 treated surgically with mild residual right lower extremity neurologic involvement.

Impairment Rating: 25% impairment of the whole person by DRE method; another option is to use the ROM method.

Comment: This individual qualifies for DRE thoracic category V because he has mild right lower extremity neurologic deficits (category III) and alteration of motion segment integrity given the fusion (category IV). A combination of categories III and IV in the thoracic region means that the individual qualifies for category V. Because he has alteration of motion segment integrity of more than one level (multilevel fusion), he could also be rated by the ROM method. The best approach would be to rate the individual by both methods and award the higher rating.

15.6 DRE: Cervical Spine

15.6a Criteria for Rating Impairment Due to Cervical Disorders

For cervical problems localized to the cervical or cervicothoracic region, use Table 15-5. If the cervical spine problem also leads to isolated bowel and/or bladder dysfunction not due to corticospinal damage, obtain the appropriate estimates for bowel and

bladder dysfunction from the gastrointestinal and urology chapters (Chapters 6 and 7) and combine these with the appropriate cervical spine DRE category from DRE I to V, listed in Table 15-5. If the cervical spine problem is due to corticospinal tract involvement, use Table 15-6 alone.

The DRE cervical categories are summarized in Table 15-5.

Table 15-5 Criteria for Rating Impairment Due to Cervical Disorders

DRE Cervical Category I 0% Impairment of the Whole Person	DRE Cervical Category II 5%-8% Impairment of the Whole Person	DRE Cervical Category III 15%-18% Impairment of the Whole Person	DRE Cervical Category IV 25%-28% Impairment of the Whole Person	DRE Cervical Category V 35%-38% Impairment of the Whole Person
No significant clinical findings, no muscular guarding, no documentable neurologic impairment, no significant loss of motion segment 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 muscle guarding or spasm observed at the time of the examination by a physician, 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</p> <p>or</p> <p>individual had clinically significant radiculopathy and an imaging study that demonstrated a herniated disk at the level and on the side that would be expected based on the radiculopathy, but has improved following nonoperative treatment</p> <p>or</p> <p>fractures: (1) less than 25% compression of one vertebral body; (2) posterior element fracture without dislocation that has healed without loss of structural integrity or radiculopathy; (3) a spinous or transverse process fracture with displacement</p>	<p>Significant signs of radiculopathy, such as pain and/or sensory loss in a dermatomal distribution, loss of relevant reflex(es), loss of muscle strength, or unilateral atrophy compared with the unaffected side, measured at the same distance above or below the elbow; the neurologic impairment may be verified by electrodiagnostic findings</p> <p>or</p> <p>individual had clinically significant radiculopathy, verified by an imaging study that demonstrates a herniated disk at the level and on the side expected from objective clinical findings with radiculopathy or with improvement of radiculopathy following surgery</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 is healed without loss of structural integrity; radiculopathy may or may not be present; differentiation from congenital and developmental conditions may be accomplished, if possible, by examining preinjury roentgenograms or a bone scan performed after the onset of the condition</p>	<p>Alteration of motion segment integrity or bilateral or multilevel radiculopathy; alteration of motion segment integrity is defined from flexion and extension radiographs as at least 3.5 mm of translation of one vertebra on another, or angular motion of more than 11° greater than at each adjacent level (Figures 15-3a and 15-3b); alternatively, the individual may have loss of motion of a motion segment due to a developmental fusion or successful or unsuccessful attempt at surgical arthrodesis; radiculopathy as defined in cervical category III need not be present if there is alteration of motion segment integrity</p> <p>or</p> <p>fractures: (1) more than 50% compression of one vertebral body without residual neural compromise</p>	<p>Significant upper extremity impairment requiring the use of upper extremity external functional or adaptive device(s); there may be total neurologic loss at a single level or severe, multilevel neurologic dysfunction</p> <p>or</p> <p>fractures: structural compromise of the spinal canal is present with severe upper extremity motor and sensory deficits but without lower extremity involvement</p>

DRE Cervical Category I
0% Impairment of the Whole Person

No significant clinical findings, no muscular guarding, no documentable neurologic impairment, no significant loss of motion segment integrity, and no other indication of impairment related to injury or illness; no fractures

Example 15-12
0% Impairment Due to Cervical Injury

Subject: 37-year-old man.

History: Complaints of neck discomfort when painting.

Current Symptoms: Intermittent neck pain, occasionally extending into upper back bilaterally, moreso on the left side.

Physical Exam: Full neck motion, but pain at the extremes; some tenderness over the trapezius muscles; no spasm; no neurologic findings.

Clinical Studies: Radiographs: normal cervical spine.

Diagnosis: Intermittent cervical neck strain.

Impairment Rating: 0% impairment of the whole person.

Comment: No evidence of permanent impairment, without objective signs. Advised to do appropriate stretching and neck exercises regularly, before and after vigorous activity.

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

Clinical history and examination findings are compatible with a specific injury; findings may include muscle guarding or spasm observed at the time of the examination by a physician, 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

or

individual had clinically significant radiculopathy and an imaging study that demonstrated a herniated disk at the level and on the side that would be expected based on the radiculopathy, but has improved following nonoperative treatment

or

fractures: (1) less than 25% compression of one vertebral body; (2) posterior element fracture without dislocation that has healed without loss of structural integrity or radiculopathy; (3) a spinous or transverse process fracture with displacement

Example 15-13
5% to 8% Impairment Due to Cervical Injury

Subject: 37-year-old woman.

History: Pain in the neck and lateral right upper extremity extending to the thumb following a rear-end auto collision. An MRI showed a herniated disk at C6. She elected nonoperative treatment and recovered after 18 months.

Current Symptoms: Some residual neck pain with physical activity; upper limb symptoms have resolved.

Physical Exam: Slight loss of motion of the cervical spine. Neurologic examination is normal.

Clinical Studies: Initial MRI: right posterolateral disk herniation at C5. No additional imaging studies were done.

Diagnosis: Herniated disk C5-6 with resolved right C6 radiculopathy.

Impairment Rating: 5% impairment of the whole person.

Comment: The individual qualifies for DRE cervical category II because she had a radiculopathy caused by a herniated disk that responded to treatment. She has no significant residual signs.

DRE Cervical Category III**15%-18% Impairment of the Whole Person**

Significant signs of radiculopathy, such as pain and/or sensory loss in a dermatomal distribution, loss of relevant reflex(es), loss of muscle strength, or unilateral atrophy compared with the unaffected side, measured at the same distance above or below the elbow; the neurologic impairment may be verified by electrodiagnostic findings

or

individual had clinically significant radiculopathy, verified by an imaging study that demonstrates a herniated disk at the level and on the side expected from objective clinical findings with radiculopathy or with improvement of radiculopathy following surgery

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 is healed without loss of structural integrity; radiculopathy may or may not be present; differentiation from congenital and developmental conditions may be accomplished, if possible, by examining preinjury roentgenograms or by bone scans performed after the onset of the condition

Example 15-14**15% to 18% Impairment Due to Radiculopathy**

Subject: 44-year-old man.

History: Sustained a blow to his posterior neck from a machine support that slipped. Unable to use his dominant left hand for ADL without considerable pain in neck, left upper back, and ulnar left upper limb. No discomfort in the lower extremities. Refuses surgery.

Current Symptoms: Neck pain, radiating to the ulnar hand with numbness of the ring and little fingers.

Physical Exam: Decreased range of motion in the neck with severe radiating pain to the left arm in a C6 distribution.

Clinical Studies: MRI: left posterolateral disk herniation C7-8.

Diagnosis: Radiculopathy due to disk herniation C6.

Impairment Rating: 18% impairment of the whole person.

Comment: Residual symptoms and functional limitations to perform ADL.

DRE Cervical Category IV**25%-28% Impairment of the Whole Person**

Alteration of motion segment integrity or bilateral or multilevel radiculopathy; alteration of motion segment integrity is defined from flexion and extension radiographs as at least 3.5 mm of translation of one vertebra on another, or angular motion of more than 11° greater than at each adjacent level (Figures 15-3a and 15-3b); alternatively, the individual may have loss of motion of a motion segment due to a developmental fusion or successful or unsuccessful attempt at surgical arthrodesis; radiculopathy as defined in cervical category III need not be present if there is alteration of motion segment integrity

or

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

Example 15-15**25% to 28% Impairment Due to Alterations of Motion Segment Integrity**

Subject: 37-year-old woman.

History: Onset of pain in the neck and right arm along the radial aspect and into the thumb following a medium-speed rear-end auto collision. Individual failed conservative treatment, and an MRI showed a herniated disk at C6-7. Underwent a disectomy of the sixth cervical disk and fusion of C6 to C7. Healed uneventfully and returned to work 4 months after the injury.

Current Symptoms: Occasional neck pain with physical activity. Upper extremity pain resolved.

Physical Exam: Slight loss of cervical spine motion. Neurologic examination is normal.

Clinical Studies: Radiographs: healed C6-7 fusion.

Diagnosis: Herniated disk C6-7 with C7 radiculopathy resolved following anterior cervical disectomy and C6-7 fusion.

Impairment Rating: 25% impairment of the whole person.

Comment: This individual meets criteria for DRE cervical category IV because of alteration of motion segment integrity due to fusion.

DRE Cervical Category V
35%-38% Impairment of the Whole Person

Significant upper extremity impairment requiring the use of upper extremity external functional or adaptive device(s); there may be total neurologic loss at a single level or severe, multilevel neurologic dysfunction

or

fractures: structural compromise of the spinal canal is present with severe upper extremity motor and sensory deficits but without lower extremity involvement

Example 15-16

35% to 38% Impairment Due to Herniated Cervical Disk Postdiscectomy and Fusion

Subject: 37-year-old woman.

History: Individual fell and struck her posterior head and neck on a conveyor machine while working on an assembly line. She had severe and persistent pain in the neck and lateral right upper limb extending into the thumb. An MRI showed a herniated disk at C5-6. She failed nonoperative treatment and underwent a discectomy of the sixth cervical disk and fusion of C6 to C7. She has continued neck and bilateral upper extremity pain. Unable to perform most ADL and uses assistive devices for gripping and turning objects.

Current Symptoms: Severe neck and bilateral upper extremity pain aggravated by movements of the neck and use of the upper extremities. Persistent numbness in the radial forearm, hand, and digits on both sides.

Physical Exam: Slight loss of cervical motion. Neurologic examination reveals decreased sensation in the thumb and index finger and weakness of the biceps and wrist extensors bilaterally. Diminished brachioradialis reflexes, right worse than left.

Clinical Studies: Radiographs: healed fusion.

Diagnosis: Herniated C5-6 disk treated with residual bilateral C6 radiculopathy.

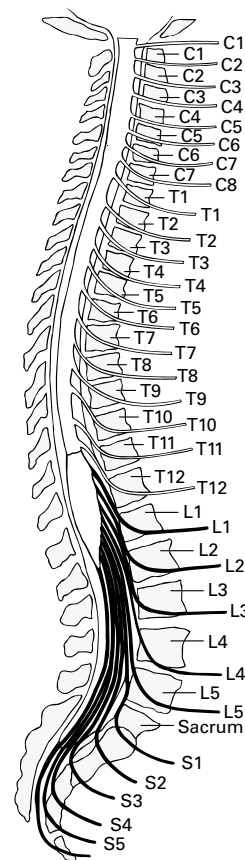
Impairment Rating: 38% impairment of the whole person.

Comment: This individual meets criteria for both DRE cervical category III, with a surgically treated radiculopathy, and DRE cervical category IV, because of alteration of motion segment integrity due to the fusion, and is placed in DRE category V because of objective findings supportive of significant upper extremity impairment requiring the use of adaptive devices.

15.7 Rating Corticospinal Tract Damage

The neurologic level of involvement is determined by identifying the level of cord involvement, not necessarily the same level as a fracture, because the root function at the fracture level frequently returns with time. The level of cord involvement is determined by identifying the lowest normally functioning nerve root. Identifying the level of nerve root function helps to determine the degree of residual function. Figure 15-5 illustrates the relationship of nerve roots to the vertebral level.

Figure 15-5 Relationship of Spinal Nerves to Vertebrae



The level at which nerve roots exit the spine relative to the vertebrae. The neurologic level of involvement is determined by identifying the lowest normally functioning nerve root.

Table 15-6 Rating Corticospinal Tract Impairment

a. Impairment of One Upper Extremity Due to Corticospinal Tract Impairment							
Class 1		Class 2		Class 3		Class 4	
Dominant Extremity 1%-9% Impairment of the Whole Person	Nondominant Extremity 1%-4% Impairment of the Whole Person	Dominant Extremity 10%-24% Impairment of the Whole Person	Nondominant Extremity 5%-14% Impairment of the Whole Person	Dominant Extremity 25%-39% Impairment of the Whole Person	Nondominant Extremity 15%-29% Impairment of the Whole Person	Dominant Extremity 40%-60% Impairment of the Whole Person	Nondominant Extremity 30%-45% Impairment of the Whole Person
Individual can use the involved extremity for self-care, daily activities, and holding, but has difficulty with digital dexterity		Individual can use the involved extremity for self-care, can grasp and hold objects with difficulty, but has no digital dexterity		Individual can use the involved extremity but has difficulty with self-care activities		Individual cannot use the involved extremity for self-care or daily activities	
b. Criteria for Rating Impairments of Two Upper Extremities							
Class 1 1%-19% Impairment of the Whole Person		Class 2 20%-39% Impairment of the Whole Person		Class 3 40%-79% Impairment of the Whole Person		Class 4 80%+ Impairment of the Whole Person	
Individual can use both upper extremities for self-care, grasping, and holding, but has difficulty with digital dexterity		Individual can use both upper extremities for self-care, can grasp and hold objects with difficulty, but has no digital dexterity		Individual can use both upper extremities but has difficulty with self-care activities		Individual cannot use upper extremities	
c. Criteria for Rating Impairments Due to Station and Gait Disorders							
Class 1 1%-9% Impairment of the Whole Person		Class 2 10%-19% Impairment of the Whole Person		Class 3 20%-39% Impairment of the Whole Person		Class 4 40%-60% Impairment of the Whole Person	
Rises to standing position; walks, but has difficulty with elevations, grades, stairs, deep chairs, and long distances		Rises to standing position; walks some distance with difficulty and without assistance, but is limited to level surfaces		Rises and maintains standing position with difficulty; cannot walk without assistance		Cannot stand without help, mechanical support, and/or an assistive device	

In prior editions of the *Guides*, rating spinal cord injury was done either through a combination of DRE categories or in the nervous system chapter. It was decided in this edition to evaluate spinal cord injuries based on the criteria in the nervous system chapter (Chapter 13). These criteria are repeated in this section. For bilateral neurologic or corticospinal tract damage, consultation with a spinal cord injury specialist and review of Chapter 13, The Central and Peripheral Nervous System, is recommended. Thus, for an individual with a spinal cord injury affecting the upper extremities, use Table 15-6 and the appropriate impairment rating for impairment of one or both upper extremities. For impairments involving loss of use of the lower extremities, use the section in Table 15-6 pertaining to station and gait impairment. If there is additional bowel or bladder dysfunction, combine the upper extremity or lower extremity loss with impairments in bladder, anorectal, and/or neurologic sexual impairment as warranted.

Once a class has been selected, the exact value is obtained by combining the value with the corresponding additional impairment from DRE categories II through V for cervical and lumbar impairment and DRE categories II through IV for thoracic impairment. An exact value is determined based on the degree of impairment of ADL. Table 15-6 and the following examples illustrate the method for impairment rating of spinal cord injury.

Example 15-17
**69% Impairment Due to Compression Fracture With
 Corticospinal Tract Damage**

Subject: 28-year-old man.

History: Sustained a C6 vertebral body fracture with almost 40% compression after a fall from a scaffold. Had loss of bladder control and weakness of both lower extremities. He also had numbness and

d. Criteria for Rating Neurologic Impairment of the Bladder

Class 1 1%-9% Impairment of the Whole Person	Class 2 10%-24% Impairment of the Whole Person	Class 3 25%-39% Impairment of the Whole Person	Class 4 40%-60% Impairment of the Whole Person
Individual has some degree of voluntary control but is impaired by urgency or intermittent incontinence	Individual has good bladder reflex activity, limited capacity, and intermittent emptying without voluntary control	Individual has poor bladder reflex activity, intermittent dribbling, and no voluntary control	Individual has no reflex or voluntary control of bladder

e. Criteria for Rating Neurologic Anorectal Impairment

Class 1 1%-19% Impairment of the Whole Person	Class 2 20%-39% Impairment of the Whole Person	Class 3 40%-50% Impairment of the Whole Person
Individual has reflex regulation but only limited voluntary control	Individual has reflex regulation but no voluntary control	Individual has no reflex regulation or voluntary control

f. Criteria for Rating Neurologic Sexual Impairment

Class 1 1%-9% Impairment of the Whole Person	Class 2 10%-19% Impairment of the Whole Person	Class 3 20% Impairment of the Whole Person
Sexual functioning is possible, but with difficulty of erection or ejaculation in men or lack of awareness, excitement, or lubrication in either sex	Reflex sexual functioning is possible, but there is no awareness	No sexual functioning

g. Criteria for Rating Neurologic Impairment of Respiration

Class 1 5%-19% Impairment of the Whole Person	Class 2 20%-49% Impairment of the Whole Person	Class 3 50%-89% Impairment of the Whole Person	Class 4 90%+ Impairment of the Whole Person
Individual can breathe spontaneously but has difficulty performing activities of daily living that require exertion	Individual is capable of spontaneous respiration but is restricted to sitting, standing, or limited ambulation	Individual is capable of spontaneous respiration but to such a limited degree that he or she is confined to bed	Individual has no capacity for spontaneous respiration

weakness of both upper extremities, which was verified as a C7-level radiculopathy by positive sharp waves on the electromyogram in three arm muscles 4 weeks after the injury. Underwent corpectomy of C6 and a fusion from C5 to C7.

Current Symptoms: Pain free with numbness and weakness of upper extremities; no remaining bladder symptoms. Unable to walk without leg braces (orthoses).

Physical Exam: Mild sensory changes from C7 distally. C6-innervated muscles function normally, but he had weakness of muscles innervated by C7 and lower nerve roots.

Clinical Studies: Neurodiagnostic studies: see above; radiographs show a solid fusion from C5 through C7.

Diagnosis: C6 compression fracture with corticospinal tract damage.

Impairment Rating: 69% impairment of the whole person.

Comment: Although this man has a vertebral fracture, his corticospinal tract involvement indicates he should be rated using the neurology tables. His numbness, weakness, and difficulty with dexterity movements of both upper extremities warrant a 39% WPI. He is unable to walk without braces, indicating a class 3 WPI of 39%. He has no bowel or bladder dysfunction. His vertebral fracture results in a DRE III, or 15% impairment. Combining 39%, 39%, and 15% WPI using the Combined Values Chart results in a 69% WPI.

Example 15-18**78% Impairment Due to Burst Fracture With Cauda Equina Syndrome**

Subject: 54-year-old woman.

History: Fell from a ladder and sustained a burst fracture of L2 with a loss of height of 35%. In addition to numbness and weakness of both lower extremities, she was unable to empty her bladder and required catheterization. Following anterior decompression of the cauda equina and fusion from L1 to L3, the fractures healed, and she regained partial function in the muscles innervated by the L2 and lower nerve roots.

Current Symptoms: Persistent weakness of both lower extremities requiring the use of ankle-foot orthoses. Walks using two crutches. Requires intermittent catheterization of her bladder. She has occasional bowel incontinence.

Physical Exam: Mild tenderness to palpation at the fracture site. Neurologic examination reveals weakness of L2 to S1 innervated muscle and numbness and atrophy of both lower extremities. Decreased rectal tone. Knee and ankle reflexes are absent.

Clinical Studies: Repeat x-rays of the region: solid fusion from L1 to L3.

Diagnosis: Burst fracture L2 with cauda equina syndrome.

Impairment Rating: 78% impairment of the whole person.

Comment: Her lower extremity weakness and use of orthoses and crutches indicate a class 3, or 39%, WPI. The bladder impairment, requiring intermittent catheterization, indicates a class 4, or 50%, WPI. Her rectal tone is decreased, with occasional bowel incontinence, indicating a class 2 anorectal impairment of 20%. The burst fracture receives a DRE lumbar category III rating of 10%. Combining 50%, 39%, 20%, and 10% results in a combined whole person impairment of 78%.

15.8 Range-of-Motion Method

Although called the range-of-motion method, this evaluation method actually consists of three elements that need to be assessed: (1) the range of motion of the impaired spine region; (2) accompanying diagnoses (Table 15-7); and (3) any spinal nerve deficit, which is described in this chapter and in Chapter 13 (The Central and Peripheral Nervous System). Mobility, diagnoses, and nerve root deficits all provide important clinical information about function of an individual's spine.¹⁵⁻²¹ An impairment rating based on loss of motion is valid only if there is medical evidence of a documented injury or illness with a permanent anatomic and/or physiologic residual dysfunction. The whole person impairment rating is obtained by combining ratings from all three components, using the Combined Values Chart (p. 604).

All impairment estimates shown in the tables of this section are expressed as whole person impairments. Section 15.13 explains how to express a whole person spine impairment as a regional spine impairment. Tables 15-8 through 15-14 provide estimates for rating ankylosis and range of motion, while neurologic impairments are rated based on Tables 15-15 through 15-18. The data on standards and normal functioning described in this section are based on both medical studies and consensus judgments.^{15,18-27}

As previously stated (Section 15.2) the ROM method should be used only (1) if the DRE method is not applicable (no verifiable injury); (2) if, after obtaining the history and performing the examination, the physician cannot place the individual within a multilevel DRE category; (3) if multilevel involvement and/or alteration of motion segment integrity has occurred in the same spinal region; (4) if there is recurrent radiculopathy caused by a new (recurrent) disk herniation or a recurrent injury in the same spinal region; (5) if there are multiple episodes of other pathology producing alteration of motion segment integrity and/or radiculopathy; or (6) if statutorily mandated by the involved jurisdiction.

Concerns have been raised by users of the *Guides* regarding perceived age- and gender-related variations in the normal population, which may bias impairments in favor of males or older individuals, both of whom are perceived to be less flexible and therefore may be judged “impaired” even under normal circumstances. Since preparation of the fourth edition, some scientific evidence has accumulated and several relevant articles have been identified.²⁷⁻⁴⁵

Regarding gender, the scientific evidence is inconsistent. The majority of studies actually show a non-significant trend toward greater motion for male normal individuals in each age group. The only movement showing any statistically significant gender difference is cervical extension, and then only in younger women. This finding is inconsistent among various studies, however, and the difference disappears with advancing age.^{35,41}

There is a decrease in normal motion with advancing age, but the effect is not linear. Most studies examining a wide spectrum of age groups find greater alterations in mobility below 20 and above 60 years of age. Several studies suggest that lifestyle factors may influence flexibility far more than inherent factors, as the variability of overall motion between individuals increases with advancing years. However, the evidence is inconsistent, and the changes in normative data too small for the most relevant age groups 20 to 59, to warrant age adjustment in this edition of the *Guides*.

15.8a General ROM Method Measurement Principles

Impairment should be evaluated when the condition has stabilized after completion of all necessary medical, surgical, and rehabilitative treatment. This principle precludes rating an acute illness or injury. For example, if acute muscle spasm is present, this should be noted in the examiner's report; however, the mobility measurements would not be valid for estimating permanent impairment. Because the *Guides* only considers permanent impairment, rating should be deferred until after any acute exacerbation of the chronic condition has subsided, ie, when the individual is at MMI (see Chapter 1 and the Glossary).

Pain, fear of injury, disuse, or neuromuscular inhibition may limit mobility by diminishing the individual's effort, leading to inaccurately low and inconsistent measurements. *The physician should seek consistency when testing active motion, strength, and sensation. Tests with inconsistent results should be repeated. Results that remain inconsistent should be disregarded. When the physiologic measurements fail to match known pathology, they should be repeated and, if still inconsistent, disallowed until documented evidence is provided for the abnormalities noted on the physical examination.*

The reproducibility (precision) of an individual's performance is one (but not the sole) indicator of optimum effort. When measuring range of motion, the examiner should obtain at least three consecutive measurements and calculate the mean (average) of the three. Measurements should not change substantially with repeated efforts. If the average is less than 50°, three consecutive measurements must fall within 5° of the mean; if the average is greater than 50°, three consecutive measurements must fall within 10% of the mean. Motion testing may be repeated up to six times to obtain three consecutive measurements that meet these criteria. If after six measurements inconsistency persists, the spinal motions are considered invalid. The measurements and accompanying impairment estimates may then be disallowed, in part or in their entirety.

There are multiple potential *sources of error* in a quantitative physical examination.^{17,20,21} The greatest source of error that occurs is due to test administrator inexperience or lack of knowledge. The evaluator should also ensure adequate warm-up movements have been performed.¹⁶ When possible, the individual being evaluated should warm up prior to the ROM measurements: flexion and extension twice, left and right rotation twice, left and right lateral bending twice, and one additional flexion and extension. The warm-up movements do not need to be repeated before each subsequent test of motions of the same spinal region.

The physician also needs to ensure the anatomical landmarks are accurate, the body part is stabilized, the measurement device is properly stabilized on the spine, and appropriate instructions are provided to the individual.^{17,20,21} If these principles are followed, errors due to examination technique, the measurement device itself, or normal human variability will be minimized.

15.8b Principles of Inclination and Spine Motion Measurement

Since spinal motion is compound, it is essential to measure simultaneously motion of both the upper and lower extremes of the spine region being examined. Because the small joints of the spine do not lend themselves readily to two-arm goniometric measurements and measuring a spine segment's mobility is confounded by motion above and below the assessed points, an inclinometer is the preferred device for obtaining accurate, reproducible measurements in a simple, practical, and inexpensive way. The subcutaneous bony structures that mark the upper and lower ends of the three spine regions can be palpated readily.

Inclinometers, also called angle finders or level indicators, are small angle-measuring devices traditionally used by carpenters, mechanics, and tradespeople. Recently, physicians, therapists, and veterinarians have used them to measure angles and ranges of motion in humans and animals. Inclinometers work like a plumb line, operating on the principle of gravity, which is a constant. An inclinometer used by a physician should be marked off in 2° increments or less and in good operating condition (Figure 15-6). A mechanical inclinometer has a starting or 0° position indicated by a weighted needle or pendulum. A fluid level can cause errors in reading the meniscus. A fluid-filled inclinometer should allow rotation of its inclinometer face so any number on the face can be set as the initial position. Electronic inclinometers use gravity sensors to determine an angle from the vertical, and then perform internal calculations.²¹

Figure 15-6 Inclinometer



Features of a properly designed inclinometer for medical use include a dial large enough to allow easy reading of 2° increments but small enough to enable application on the spine and all joints of the body; features to enable repeated, accurate application and stabilization of the instrument on the body; and a dial that can both display the 0° gravity position and be set by the examiner to a 0° starting position when the body part cannot be placed in a 0° gravity or neutral position.

Box 15-2 offers a partial list of companies that produce or distribute inclinometers. The American Medical Association does not endorse or recommend any particular type or brand of inclinometer.

Box 15-2 Inclinometer Distributors

The following companies distribute inclinometers. To receive information about their products, *Guides* users should contact the company.

Acumar Technology
1314 SW 57th Ave
Portland, OR 97221
503 292-7137
www.acumar.com

ISOMED, Inc
975 SE Sandy Blvd
Portland, OR 97214
503 233-0051
503 233-5128 (fax)
www.isomedinc.com
isomedinc@heaven.com (e-mail)

McMaster Carr
600 County Line Rd
Elmhurst, IL 60126
630 834-9600
www.mcmaster.com

The Saunders Group, Inc
4250 Norex Dr
Chaska, MN 55318
612 944-1656; 800 654-8357 (toll-free)
www.thesaundersgroup.com

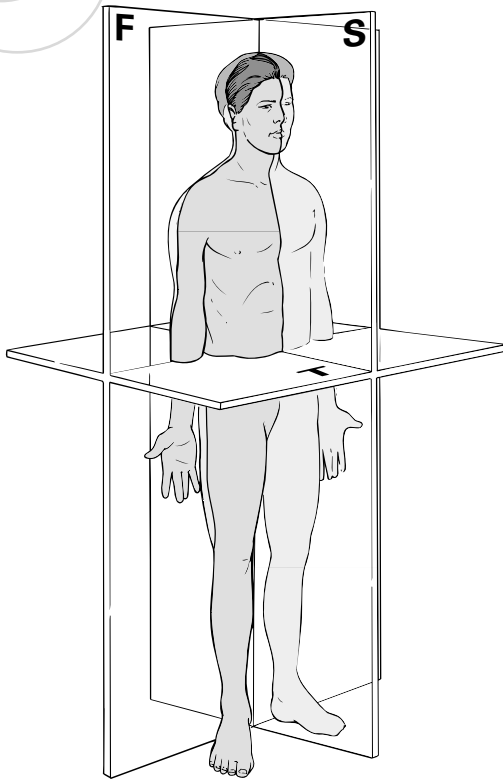
Techmaster
11855 SW Ridge Crest Dr
Beaverton, OR 97008
503 671-9317
503 671-0168 (fax)
techmaster@transport.com (e-mail)

The following principles, discussed in greater detail by Mayer,¹⁷ by Gerhardt et al,^{20,21} and in forthcoming AMA educational material, are important to follow to obtain accurate measurements.

Gravitational plane. An inclinometer works only in the vertical position because only that plane allows the pointer or sensor to move freely in response to gravity. An inclinometer will not operate properly if tilted or at all when horizontal. Therefore, the individual being examined must be in a position that permits motion of the part being tested in a vertical plane. For spinal measurements in the sagittal and frontal (coronal) planes the individual should be standing or sitting, with the spine vertical (Figure 15-7). Measurements in the transverse or axial plane must be made with the individual in the supine, prone, or flexed hip position.

Measure spinal ROM in three principal planes: sagittal (extension-flexion), frontal or coronal, and transverse or axial (rotation) (Figure 15-7). If a spinal region has two or more impaired motions, the ratings for each range of motion impairment are *added*. Impairments of two or more regions of the spine are *combined* using the Combined Values Chart (p. 604).

Stabilization. If the caudad (superior), or lower, part of a spine region can be stabilized so it does not move when the superior, or upper, part moves, a single mechanical inclinometer may be used, as with measuring cervical rotation (see Figure 15-17). However, two inclinometers are usually needed to measure most movements of the spine. Single electronic inclinometers use microprocessors to duplicate functions of mechanical inclinometers. Their use will not be described in detail here as information is available from the manufacturer. The user should ensure that the features described above are addressed.

Figure 15-7 Body Planes for Measuring Motion

S: sagittal plane, T: transverse plane, F: frontal or coronal plane.

Manual pressure during use. The inclinometer should be held so it remains firmly applied to the subcutaneous skeletal structure while the spine is moving through the entire range of motion. It must not deviate from the original position because of skin movement or uneven pressure on the skin overlying the bony landmark, which might occur with an obese individual. The inclinometer design is important to allow proper application and avoid slippage on subcutaneous bony prominences. Firm contact of two points of the instrument with the structure is essential, especially if a convex surface such as the sacrum or calvarium (top of the head) is involved.

Recording ROM Measurements

ROM measurements can be recorded on the summary sheets (Figures 15-10, 15-15, and 15-18).

15.8c Ankylosis and Motion With Ankylosis

Ankylosis is defined as the complete absence of joint motion and is expressed as a fixed position. In the spine, which has multiple motion segments in each region with vertebrae moving together and separately, complete absence of regional motion is rare. For spine impairment evaluation only, when an individual cannot reach the neutral (0°) position, the position or angle of restriction closest to neutral is considered the position of ankylosis or end-restricted movement.

If the individual has end-restricted movement, this value, taken as the ankylosis value, is used to determine impairment instead of the ROM. If the motion crosses the neutral position in any plane, the examiner should use the abnormal motion section of the appropriate table to determine the impairment for that plane.

In determining ankylosis impairments, the examiner should *add* the ankylosis impairments in several planes within a single region or *combine* the ankylosis impairments of two or more regions (Combined Values Chart, p. 604). If a spinal region has several range-of-motion impairments and an ankylosis impairment, the ROM impairments are added and the total is combined with the ankylosis impairment. Impairments of two or more regions are always combined (Combined Values Chart).

15.8d Estimating Whole Person Impairment Using the ROM Method

1. Determine whether the individual has reached MMI and the impairment is stable. If the condition is changing or likely to improve substantially with medical treatment, the impairment is not permanent and should not be rated. If it is permanent, proceed to step 2.
2. Select the impaired region: cervical, thoracic, or lumbar.
3. Use Table 15-7 to determine the percentage impairment for the part of the ROM diagnosis-based method. If there are two or more diagnoses within a spinal region, use that which is most significant. This percent will be combined with those for the impaired range(s) of motion and the whole person neurologic deficit (steps 7-9 below).