4. Measure the range of motion in the relevant sagittal, frontal (coronal), and transverse planes (Figure 15-7), and determine any angle of ankylosis or any restricted motion that is present.
5. Perform at least three measurements of each motion. Determine which measurements meet reproducibility criteria described under general measurement principles described in Section 15.8b. Calculate the average of each set of three measurements and determine whether the three measurements in each set fall within 5° or 10% of the mean, whichever is larger.
6. If the measurements do not meet the consistency requirements described in step 5, perform additional tests until the reproducibility criteria are satisfied, up to a maximum of six. If the test results remain inconsistent after six measurements, repeat the tests at a later date or disallow impairment related to that motion.
7. Use the maximum motion from a reproducible set of measurements to determine any impairment rating from the appropriate tables, based on the spinal region and type of movement. Refer to Section 15.8c, Ankylosis and Motion With Ankylosis, if there are several range-of-motion or ankylosis impairments in a region. For example, an individual who can flex the cervical spine from 30° to 60° but who lacks 30° of motion in reaching the neutral 0° position has restricted end motion and the same estimated impairment as if he or she had fixed ankylosis at 30° of cervical flexion. According to Table 15-12, the individual's impairment is 30% of the whole person. If there are impairments due to loss of motion in more than one plane in the same spinal region (extension, flexion, or rotation), the impairments are added to determine total impairment due to loss of motion in a spinal region.
8. Determine any impairments due to neurologic deficits, such as radiculopathy or spinal nerve injury. Refer to Table 15-15 for the procedure to evaluate the sensory deficit. Use Table 15-16 to determine the procedure for estimating loss of strength. Apply these tables to Table 15-17 (cervical and thoracic nerve roots) or Table 15-18 (lumbar and sacral nerve roots) as needed. Convert the neurologic impairments, initially calculated as upper or lower extremity, into a whole person impairment.
9. Combine the diagnosis-based (Table 15-7) and physical examination–based (mobility and neurologic) impairment percents using the Combined Values Chart (p. 604).
10. Repeat steps 1 through 9 for either of the other two spinal regions with significant involvement related to the primary diagnosis.
11. Combine the regional impairments into a single whole person impairment using the Combined Values Chart (p. 604).
12. Combine the whole person spine impairment with whole person ratings for any other organ system using the Combined Values Chart, if indicated.
13. Record the results of the evaluation on the Spine Impairment Summary form (see Table 15-20).

Instructions for Using Table 15-7

1. Use this table only when the ROM method is used.
2. Identify the most significant (impairing) diagnosis of the primarily involved region (lumbar, thoracic, or cervical).
3. The diagnosis-based impairment percent should be combined with range-of-motion impairment estimates and whole person impairment estimates involving sensation, weakness, and other conditions of the musculoskeletal, nervous, or other organ systems.
4. Combine the diagnosis-based, range-of-motion, and other whole person impairment estimates using the Spine Impairment Summary form (Table 15-20).
5. Repeat for other involved spine regions and combined regional impairments if those exist.

Table 15-7 Criteria for Rating Whole Person Impairment Percent Due to Specific Spine Disorders to Be Used as Part of the ROM Method*

Disorder	% Impairment of the Whole Person		
	Cervical	Thoracic	Lumbar
I. Fractures			
A. Compression of one vertebral body.			
0%-25%	4	2	5
26%-50%	6	3	7
> 50%	10	5	12
B. Fracture of posterior element (pedicle, lamina, articular process, transverse process).	4	2	5
Note: An impairment due to compression of a vertebra and one due to fracture of a posterior element are combined using the Combined Values Chart (p. 604). Fractures or compressions of several vertebrae are combined using the Combined Values Chart.			
C. Reduced dislocation of one vertebra.	5	3	6
If two or more vertebrae are dislocated and reduced, combine the estimates using the Combined Values Chart.			
An unreduced dislocation causes impairment until it is reduced; the physician should then evaluate the impairment on the basis of the individual's condition with the dislocation reduced.			
If no reduction is possible, the physician should evaluate the impairment on the basis of the range-of-motion and neurologic findings according to criteria in this chapter and Chapter 13, The Central and Peripheral Nervous System.			
II. Intervertebral disk or other soft-tissue lesion			
Diagnosis must be based on clinical symptoms and signs and imaging information.			
A. Unoperated on, with no residual signs or symptoms.	0	0	0
B. Unoperated on, with medically documented injury, pain, and rigidity* associated with none to minimal degenerative changes on structural tests.†	4	2	5
C. Unoperated on, stable, with medically documented injury, pain, and rigidity* associated with moderate to severe degenerative changes on structural tests;† includes herniated nucleus pulposus with or without radiculopathy.	6	3	7
D. Surgically treated disk lesion without residual signs or symptoms; includes disk injection.	7	4	8
E. Surgically treated disk lesion with residual, medically documented pain and rigidity.	9	5	10
F. Multiple levels, with or without operations and with or without residual signs or symptoms.	Add 1% per level		
G. Multiple operations *with* or without residual signs or symptoms			
1. Second operation	Add 2%		
2. Third or subsequent operation	Add 1% per operation		
III. Spondylolysis and spondylolisthesis, not operated on			
A. Spondylolysis or grade I (1%-25% slippage) or grade II (26%-50% slippage) spondylolisthesis, accompanied by medically documented injury that is stable, and medically documented pain and rigidity with or without muscle spasm.	6	3	7
B. Grade III (51%-75% slippage) or grade IV (76%-100% slippage) spondylolisthesis, accompanied by medically documented injury that is stable, and medically documented pain and rigidity with or without muscle spasm.	8	4	9
IV. Spinal stenosis, segmental instability, spondylolisthesis, fracture, or dislocation, operated on			
A. Single-level decompression without spinal fusion and without residual signs or symptoms	7	4	8
B. Single-level decompression without spinal fusion with residual signs or symptoms	9	5	10
C. Single-level spinal fusion with or without decompression without residual signs or symptoms	8	4	9
D. Single-level spinal fusion with or without decompression with residual signs and symptoms	10	5	12
E. Multiple levels, operated on, with residual, medically documented pain and rigidity.	Add 1% per level		
1. Second operation	Add 2%		
2. Third or subsequent operation	Add 1% per operation		

* The phrase "medically documented injury, pain, and rigidity" implies not only that an injury or illness has occurred but also that the condition is stable, as shown by the evaluator's history, examination, and other diagnostic data, and that a permanent impairment exists, which is at least partially due to the condition being evaluated.

† Structural tests include radiographs, myelograms with and without CT scan, CT scan and MRI with and without contrast, and diskogram with and without CT scan.

15.9 ROM: Lumbar Spine

15.9a Flexion and Extension

Two-Inclinometer Technique

1. Provide information about the test and allow warm-up within pain tolerance. Warm-up exercises, as described in Section 15.8a, are done as tolerated by the individual, based on physician judgment.
2. The individual should be standing with knees extended and weight balanced on both feet, ideally with hands on hips for support to permit greater motion. The spine should be in the neutral position while the inclinometers are set at 0° (See Figure 15-8a). Locate and place horizontal skin marks over the T12 spinous process and the sacrum. Center the first inclinometer aligned in the sagittal plane, over the mark for the T12 spinous process. Center the second inclinometer over the sacral horizontal mark. It is generally best to place the sacral mark at the midpoint of the posterior superior iliac spine because if the mark is placed too high on the sacral convexity, the inclinometer may be displaced during extension. Be certain of the bony landmarks.
3. Instruct the individual to flex the trunk as far as possible (Figure 15-8b), again recording both inclinometer angles and subtracting the sacral (hip) from the T12 inclinometer angle to obtain true lumbar flexion angle. Ask the individual to return the trunk to the neutral position.

Figure 15-8 Two-Inclinometer Technique for Measuring Lumbar Flexion and Extension

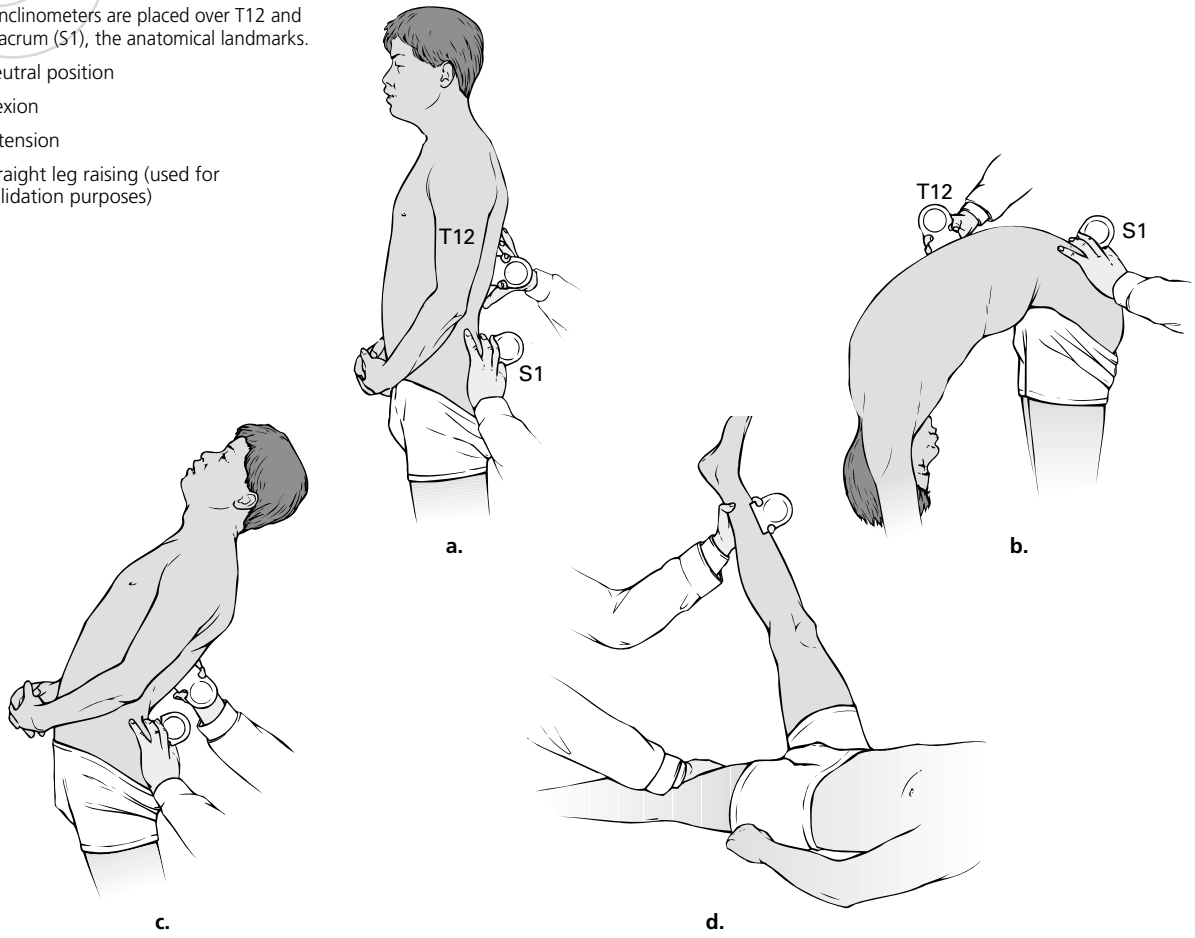
The inclinometers are placed over T12 and the sacrum (S1), the anatomical landmarks.

a. neutral position

b. flexion

c. extension

d. straight leg raising (used for validation purposes)



4. Ask the individual to extend maximally while holding the inclinometers firmly, and record both angles (Figure 15-8c). Subtract the sacral (hip) inclination from the T12 inclinometer angle to obtain the true lumbar extension angle. Return the trunk to the neutral position (verify that the inclinometers are still at 0°).
5. Repeat the procedure at least three times and at most six times for flexion and extension to obtain a valid measurement set (three consecutive, reproducible measurements). Only the true lumbar spine flexion and extension angles need to be consistently measured within 5° if the average is less than 50°, or within 10° if the average is greater than 50°. The impairment is based on the maximum true extension and flexion angles from within the three measurements. The average of the three is only used to determine consistency.
6. An accessory validity test can be performed for lumbosacral flexion and extension.[35] In this test, record the straight-leg-raising angle of the supine individual by placing an inclinometer on each tibial crest with the knees extended and the hip flexed (Figure 15-8d). Compare the straight-leg-raising angle to the sum of the sacral flexion and extension (sacral or hip motion) angles (Figures 15-9a and 15-9c). If the straight-leg-raising angle exceeds the sum of sacral flexion and extension angles by more than 15°, the lumbosacral flexion test is invalid. Normally, the straight-leg-raising angle is about the same as the sum of the sacral flexion-extension angle. If the individual resists passive SLR without other evidence of radiculopathy, the accessory test is also invalid. If invalid, the examiner should either repeat the flexion-extension test or disallow impairment for lumbosacral spine flexion and extension.

   Tightest SLR – [sacral flexion + sacral extension] ≤ 15° for validity (assumes sacral flexion and extension are less than normal).

   Note: This accessory validity test is useful only when sacral flexion plus extension is less than the average for normal individuals (ie, 65° for women and 55° for men). At these levels or above, the difference between sacral motion and supine straight leg raising will usually exceed 15° because the hamstring and gluteal muscles are contracted in the standing flexed position and relaxed in the supine position. However, below the threshold of 65° for women and 55° for men, the tightest supine straight-leg-raising angle should not be more than 15° greater than the combined sacral (hip) flexion and extension angle in the standing position.

   Example of the accessory validity test: A 40-year-old man has a lumbar extension and flexion of 10° and 60°, respectively, with a sacral extension angle of 10° and sacral flexion measurement of 20°. Total sacral motion is 20° + 10°, or 30°. The straight-leg-raising angle is 70°. The measured left straight-leg-raising angle is the tighter one, 70°. The difference between 70° and 30° is greater than 15°, which indicates the results are invalid. The validity test is applicable because the individual's total sacral motion, 30°, is less than the normal 55°. The examiner has the choice of either encouraging the individual to repeat the test with greater effort or invalidating (disallowing) any finding of lumbar spine ROM impairment in the sagittal plane.
7. Once obtaining the lumbar flexion and extension, use Table 15-8 to determine impairment of the whole person. Notice that when interpreting Table 15-8, the physician must take into account the sacral (hip) flexion angle when assessing impairment due to limited lumbar spine flexion because individuals with limited hip flexion have increased impairment with limited lumbar flexion.

Table 15-8 Impairment Due to Abnormal Motion of the Lumbar Region: Flexion and Extension*

The proportion of flexion and extension of total lumbosacral motion is 75%.		
Sacral (Hip) Flexion Angle (°)	**True Lumbar Spine Flexion Angle (°)**	**% Impairment of the Whole Person**
45+	60+	0
	45	2
	30	4
	15	7
	0	10
30-45	40+	4
	20	7
	0	10
0-29	30+	5
	15	8
	0	11

True Lumbar Spine Extension From Neutral Position (0°) to:	**Degrees of Lumbosacral Spine Motion**		**% Impairment of the Whole Person**
	Lost	**Retained**	
0	25	0	7
10	15	10	5
15	10	15	3
20	5	20	2
25	0	25	0

* Use this table only if the sum of sacral (hip) flexion and sacral (hip) extension is within 15° of the straight-leg-raising test on the tighter side; see text.

Ankylosis

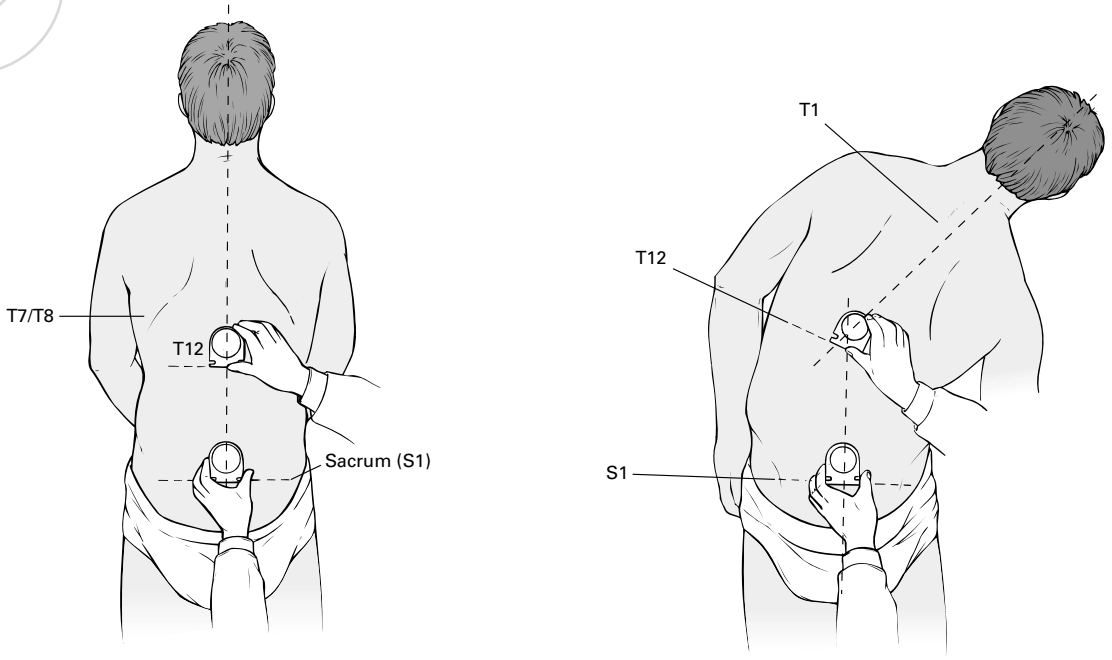
Ankylosis in the lumbosacral spine is rare. It is important mainly if immobility occurs in both the hips and lumbar spine, so the neutral position cannot be attained in the sagittal plane.

Isolated fusion of either a hip or two or more lumbar vertebrae places larger stresses on adjacent segments but does not lead to mechanical failure of the lumbosacral region. Ankylosis impairments related to fusion of the hip or part of the hip motion complex should be evaluated according to Table 15-8 on abnormal motion of the lumbosacral region.

Lateral Bending (Flexion): Two-Inclinometer Technique

1. Provide information to the individual about the procedure and allow for the appropriate warm-up exercises.
2. With the individual standing erect with knees extended, locate and place horizontal skin marks over the T12 spinous process and the sacrum. Verify with the inclinometer that the skin marks are truly horizontal; do not rely solely on visual assessment. Place the first inclinometer aligned in the frontal (coronal) plane over the T12 spinous process and hold the second over the sacrum (Figure 15-9a). The trunk should be in the neutral position while the inclinometers show gravity at 0°.
3. Instruct the individual to bend the trunk laterally to the left and record both angles. Subtract the sacral (hip) inclination angle from the T12 inclination angle to determine the lumbar left lateral angle. Ask the individual to return to the neutral position.

Figure 15-9 Two-Inclinometer Technique for Measuring Lumbosacral Lateral Bend



a. neutral position **b.** lateral bending

4. Instruct the individual to bend the trunk to the right as far as possible (Figure 15-9b), again recording both inclinometer angles and subtracting the sacral (hip) angle from the T12 inclinometer angle to obtain the lumbar right lateral bending angle. Ask the individual to return to the neutral position.
5. Repeat the procedure at least three times per side. To be valid, three of six consecutive measurements must lie within 5° or 10% of the mean, whichever is greater. The impairment estimate is based on the highest (least impairing) angle of a valid set. The mean is used only for a test of reproducibility.

With measurements for left and right lateral bending and any ankylosis, use Table 15-9 to determine the whole person impairment.

Add the impairments within the lumbar region. If other regions are impaired, the lumbar impairment should be *combined* with the other region impairment using the Combined Values Chart (p. 604).

Table 15-9 Impairment Due to Abnormal Motion and Ankylosis of the Lumbar Region: Lateral Bending

Abnormal Motion **Average range of left and right lateral bending is 50°; the proportion of total lumbosacral motion is 40% of the total spine.**				
a.	**Left Lateral Bending From Neutral Position (0°) to:**	**Degrees of Lumbosacral Motion**		**% Impairment of the Whole Person**
		Lost	**Retained**	
	0	25	0	5
	10	15	10	3
	15	10	15	2
	20	5	20	1
	25	0	25	0
b.	**Right Lateral Bending From Neutral Position (°) to:**	**Degrees of Lumbosacral Motion**		**% Impairment of the Whole Person**
		Lost	**Retained**	
	0	25	0	5
	10	15	10	3
	15	10	15	2
	20	5	20	1
	25	0	25	0
c.	**Ankylosis** **Region Ankylosed at (°):**			
	0 (neutral position)			10
	30			20
	45			30
	60			40
	75 (full flexion)			50

Example 15-19
1% Impairment Due to Loss of Left Lateral Bending

Subject: 55-year-old man.

History: Persisting back pain, worse over the last year; no specific injury identified.

Current Symptoms: Lumbar pain increases with standing or walking for more than 1 hour.

Physical Exam: Measured T12 angles for left lateral bending are 20°, 20°, 30°, and 25°. Corresponding sacral (hip) lateral flexion measurements to the right are 15°, 5°, 10°, and 10°. Subtracting the sacral bending measurements, the true lumbosacral left lateral flexion angles are 5°, 15°, 20°, and 15°, respectively. The first measurement is discarded, being more than 5° less than the mean of 13.75°, but the next three measurements fulfill reproducibility criteria. The best left lateral bending angle is 20°.

Diagnosis: Chronic low back pain.

Impairment Rating: 1% impairment due to loss of left lateral bending (Table 15-9). Obtain the other ROM measurements for the lumbar spine and add the ROM impairments.

Ankylosis

Ankylosis in lumbar spine lateral bending (flexion) is generally associated with a scoliosis and usually produces only limited impairment. Mark the T12 and spinous process and sacrum, and ask the individual to stand in the most erect position possible that corrects the deformity. Using measurements made in the frontal (coronal) plane, subtract the sacral (hip) inclination from the T12 inclination and record the ankylosis angle or the angle of restriction (closest to the 0° neutral position). Consult Table 15-9 for the impairment rating.

Figure 15-10 provides a measurement template for lumbar impairment evaluation using the ROM method.

Figure 15-10 Lumbar Range of Motion (ROM)*

Name _____ Soc. Sec. No. _____ Date _____

Movement	Description	Range					
Lumbar flexion	T12 ROM						
	Sacral ROM						
	True lumbar flexion angle						
	±10% or 5°	Yes	No				
	Maximum true lumbar flexion angle						
	% Impairment						
Lumbar extension	T12 ROM						
	Sacral ROM						
	True lumbar extension angle						
	±10% or 5°	Yes	No				
	Maximum true lumbar extension angle			(Add sacral flexion and extension ROM and compare to tightest straight-leg-raising angle)			
	% Impairment						
Straight leg raising (SLR), left	Left SLR						
	±10% or 5°	Yes	No	(If tightest SLR ROM exceeds sum of sacral flexion and extension by more than 15%, lumbar ROM test is invalid)			
	Maximum SLR Left						
Straight leg raising (SLR), right	Right SLR						
	±10% or 5°	Yes	No	(If tightest SLR ROM exceeds sum of sacral flexion and extension by more than 15%, lumbar ROM test is invalid)			
	Maximum SLR right						
Lumbar left lateral bending	T12 ROM						
	Sacral ROM						
	Lumbar left lateral bending angle						
	±10% or 5°	Yes	No				
	Maximum lumbar left lateral bending angle						
	% Impairment						
Lumbar right lateral bending	T12 ROM						
	Sacral ROM						
	Lumbar right lateral bending angle						
	±10% or 5°	Yes	No				
	Maximum lumbar right lateral bending angle						
	% Impairment						
Lumbar ankylosis in lateral bending	Position						
	% Impairment			(Excludes any impairment for abnormal flexion or extension motion)			
Total lumbar range-of-motion and ankylosis* impairment _____ %							

* If ankylosis is present, combine the ankylosis impairment with the range-of-motion impairment (Combined Values Chart, p. 604).

If ankyloses in several planes are present, combine the ankylosis estimates (Combined Values Chart), then combine the result with the range-of-motion impairment.

Example 15-20
15% Impairment Due to Limitation (Ankylosis) of Lateral Bending

Subject: 40-year-old man.

History: Fell from a ladder, landed on his buttocks, and fractured L3 and L4 vertebrae with wedging toward the left side.

Current Symptoms: Low back pain after heavy lifting, with radiating pain to the knee.

Physical Exam: Leaning to the left; cannot straighten his back to a neutral position.

Clinical Studies: Inclinometric measurements show his starting position is at 20° of left lateral bending with further motion to 30°. The 20° is closest to the neutral position and is considered an ankylosis of 20° for rating purposes. Use the Ankylosis section of Table 15-9.

Diagnosis: Compression fractures of L3 and L4 with apex left lateral wedging.

Impairment Rating: 15% impairment of the whole person due to limitation (ankylosis) of lateral bending.

Comment: Add to this any impairments for other ROM deficits in the lumbar spine, then combine the total ROM impairment with those for the compression fractures (Table 15-7) and neurologic deficits, if any.

15.10 ROM: Thoracic Spine

15.10a Flexion and Extension

Thoracic flexion and extension are relatively limited motions. The amount of extension is determined mainly by the individual's posture and the degree of fixed kyphosis or curvature of the thoracic spine. To determine the ranges of motion of this region, the individual is measured in the military brace posture to obtain the angle of extension or minimum kyphosis. Then, with the individual fully flexing the thoracic spine, the flexion angle is determined. The angle of minimum kyphosis is actually a measure of ankylosis, and impairment resulting from deformity corresponding to this angle is found in the Ankylosis part of Table 15-10.

Table 15-10 Impairment Due to Abnormal Motion (Flexion) and Ankylosis of the Thoracic Region

Average range of flexion and extension is 50°; the proportion of all thoracic motion is 60% of the total spine.			
Abnormal Motion			
Flexion From Erect Position (Angle of Thoracic Flexion) to:	**Degrees of Thoracic Motion**		**% Impairment of the Whole Person**
	Lost	**Retained**	
0	50	0	4
15	35	15	2
30	20	30	1
60	0	50	0
Ankylosis **Angle of Minimum Kyphosis (°)**			
–30 (Extension thoracic lordosis)			20
0 (neutral)			0
60			5
80			20
100			40

Two-Inclinometer Technique

1. Provide information to the individual, and allow for the appropriate warm-up exercises. Measurements are obtained with the individual standing or sitting.
2. Locate and place horizontal skin marks over the T1 and T12 spinous processes. Place both inclinometers, which do not show gravity 0 automatically against a true vertical surface, such as a wall, and set the neutral 0° positions. Place the inclinometers over the T1 and T12 spinous processes while instructing the individual to maintain the maximally extended military brace posture position (Figures 15-11a and 15-11c). Subtract the T12 inclinometer reading from the T1 inclinometer reading (if both are inclined in the same direction from the vertical) to obtain the angle of minimum kyphosis. If T12 and T1 are inclined in opposite directions from the vertical, add the angles. Find the impairment percent in the Ankylosis part of Table 15-10.
3. Set the inclinometers to 0° with the individual standing in the erect military brace posture. Then ask the individual to fully flex the thoracic spine. Flexing at the hips is permitted. Subtract the T12 inclinometer reading from the T1 reading obtained in step 1 above to obtain the angle of thoracic flexion (Figures 15-11b and 15-11d).
4. Repeat either the sitting or the standing test up to six times to obtain three measurements within 5° of the mean or 10%, whichever is greater.
5. A reproducibility test is done after a positional change, having the standing individual sit or vice versa. If the initial measurements were made standing, seat the individual on a stool, record the neutral 0° position, and ask him or her to flex the thoracic spine maximally from the military brace position. The thoracic flexion sitting angle should be nearly identical to the flexion angle obtained in the erect position.
6. Consult the Abnormal Motion part of Table 15-10 to determine the whole person impairment.

Figure 15-11 Two-Inclinometer Technique for Measuring Angles of Minimum Kyphosis and Thoracic Flexion

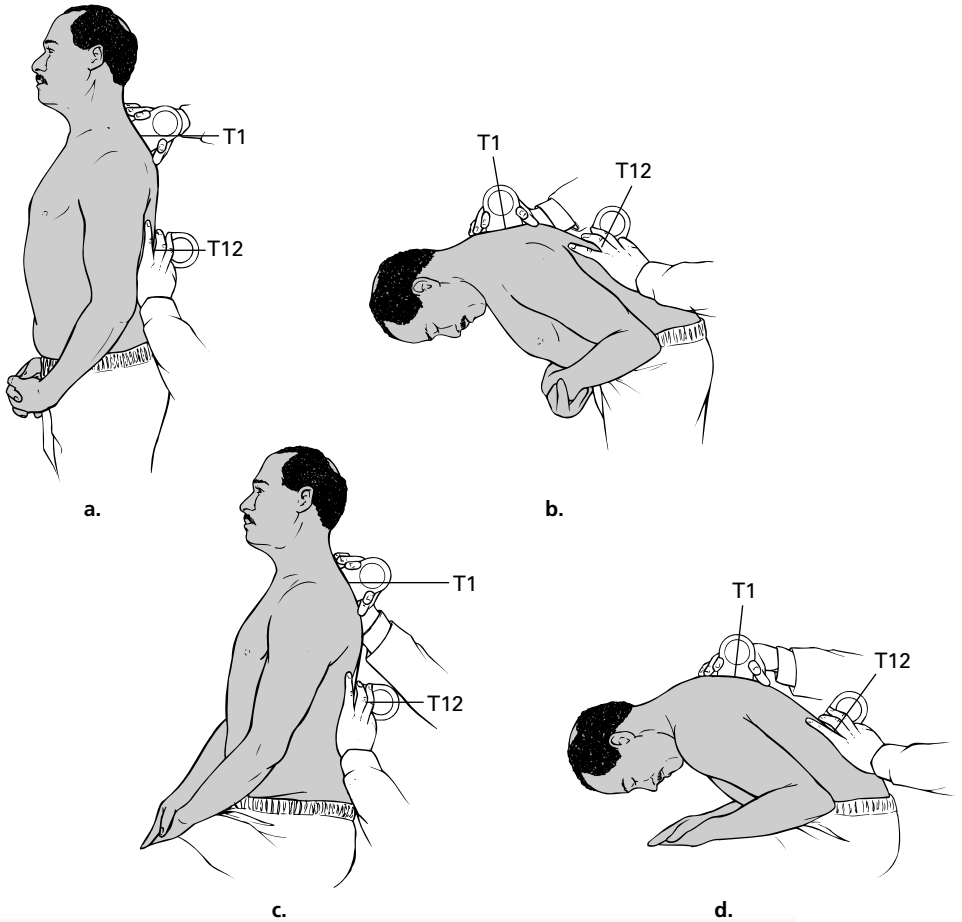
The inclinometers are placed over T1 and T12.

a. standing technique for measuring minimum kyphosis

b. standing technique for measuring flexion

c. sitting technique for measuring minimum kyphosis

d. sitting technique for measuring flexion



Ankylosis

The angle of minimum kyphosis of the thoracic spine may be considered equal to the angle of ankylosis. Excessive kyphosis or thoracic lordosis is evaluated as an impairment according to Table 15-10.

Example 15-21
5% Impairment Due to Ankylosing Spondylitis and Low Back Pain

Subject: 47-year-old man.

History: Ankylosing spondylitis.

Current Symptoms: Chronic low back pain.

Physical Examination: Attempts to extend his thoracic spine fully demonstrate an angle of minimum kyphosis of 60°. With maximum flexion, T1 readings of 35°, 45°, and 55° are recorded, which are matched with T12 flexion angles of 25°, 30°, and 40°, respectively. The angles of thoracic flexion, derived by subtracting the T12 from the T1 angles, are 10°, 15°, and 15°. These three measurements meet validity criteria.

Clinical Studies: Radiographs: consistent with ankylosing spondylitis.

Diagnosis: Ankylosing spondylitis and low back pain.

Impairment Rating: According to Table 15-10, the impairment due to a 60° ankylosis (angle of minimum kyphosis) is 5% whole person impairment. The maximum flexion of 15° is 2% whole person impairment. The total impairment is the greater of the ankylosis and abnormal motion percentages, in this instance, 5%.

Comment: Combine this with impairments from the diagnosis table (Table 15-7).

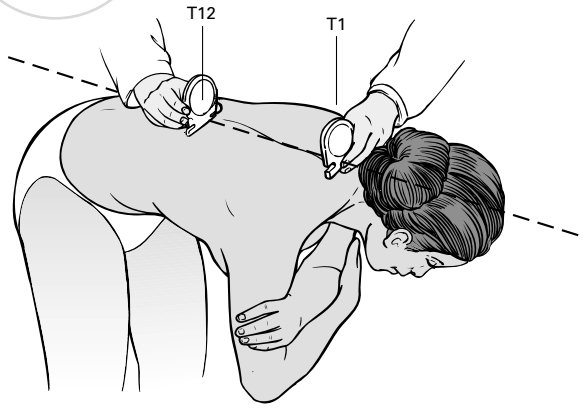
15.10b Rotation

Two-Inclinometer Technique

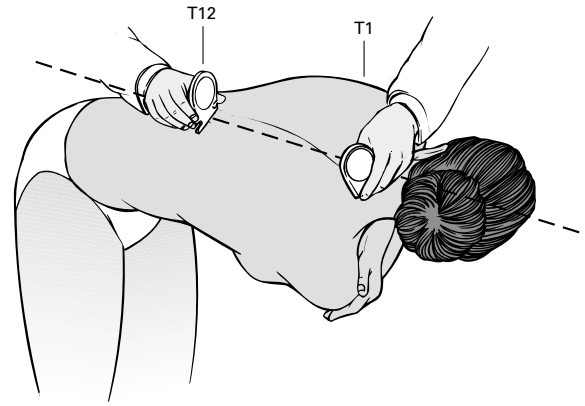
1. Provide information to the individual about the procedure and allow for appropriate warm-up exercises.
2. The individual should be seated or standing, whichever is more comfortable, and in a forward flexed position, with the thoracic spine in as horizontal a position as can be achieved (Figure 15-12a). Locate and place horizontal skin marks over the T1 and T12 spinous processes. The trunk should be in the neutral position for rotation. The inclinometers are set to 0 by placement against a flat, horizontal table or floor if they do not automatically indicate gravity 0°. Place the first inclinometer aligned vertically in the transverse (axial) plane over the T1 spinous process while holding the second over the T12 spinous process.
3. Ask the individual to rotate the trunk maximally to the left and record both angles (Figure 15-12b). Subtract the T12 angle from the T1 angle to obtain the thoracic left rotation angle. Return the trunk to the neutral position (Figure 15-12a).
4. Instruct the individual to rotate the trunk maximally to the right, again recording both inclinometer angles; subtract the T12 angle from the T1 angle to obtain the thoracic right rotation angle.
5. Repeat the procedure three to six times per side to obtain a valid set of three consecutive measurements. The angles of a valid set should be within 5°or 10% of the mean of the set, whichever is greater. The final impairment percent is based on the best (least impairing) angle measured.

Using the best angle of rotation and Table 15-11, determine the whole person impairment.

Figure 15-12 Two-Inclinometer Technique for Measuring Left Thoracic Rotation



a. neutral position



b. rotation

The figure shows the individual standing. The inclinometers are placed at T1 and T12 and aligned in the vertical plane.

Table 15-11 Impairment Due to Abnormal Motion and Ankylosis of the Thoracic Region: Rotation

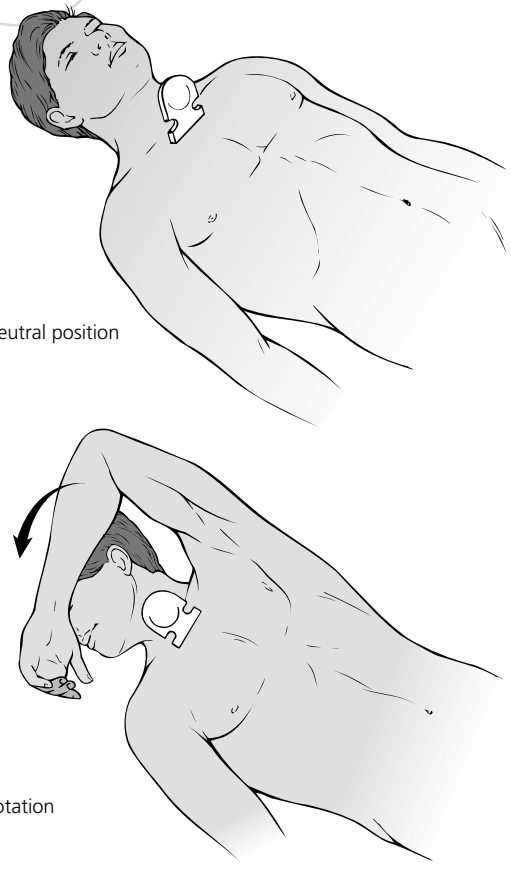
Abnormal Motion **Average range of rotation is 60°;** **the proportion of all thoracic spine motion is 40%.**				
a.	**Left Rotation From Neutral Position (0°) to (°):**	**Degrees of Thoracic Motion**		**% Impairment of the Whole Person**
		Lost	**Retained**	
	0	30	0	3
	10	20	10	2
	20	10	20	1
	30	0	30	0
b.	**Right Rotation From Neutral Position (0°) to (°):**			
	0	30	0	3
	10	20	10	2
	20	10	20	1
	30	0	30	0
c.	**Ankylosis** **Region Ankylosed at (°):**			
	0 (neutral position)			6
	5			10
	25			20
	35 (full left or right rotation)			30

Example: An individual's T1 rotation to the left measures 15°, 20°, and 15°. Corresponding T12 rotation angles are 5°, 10°, and 5°. The measurements are valid, and the left rotation angle is 10°. The whole person impairment is 2% due to loss of rotation (Table 15-11).

15.10c Alternative Thoracic Rotation Technique

1. The individual lies supine on the exam table. Stabilize the hips and pelvis. Place the inclinometer across the manubrium, just below the sternal notch. The trunk should be in the neutral position and the inclinometer set at 0° gravity if it is not automatically set to 0 (Figure 15-13a).
2. Ask the individual to rotate the trunk maximally to the left and record the angle on the sternum inclinometer, making certain an assistant holds the pelvis to the table without permitting rotation. Because the angle actually measures left thoracolumbar rotation, subtract 5°, the average lumbar rotation, to obtain the estimated thoracic rotation.
3. Instruct the individual to rotate the trunk maximally to the right (Figure 15-13b), again maintaining pelvic stabilization. Read the sternal inclinometer angle and subtract 5° to obtain the right thoracic rotation angle.

Figure 15-13 Alternative Technique for Measuring Thoracic Spine Rotation



a. neutral position

b. rotation

Only one inclinometer is used. The individual is supine on the exam table with the thoracolumbar spine and pelvis in neutral position. The inclinometer is placed on the manubrium, just below the sternal notch. Stabilize the pelvis.

Ankylosis

Rotational ankylosis of the thoracic spine is generally a component of a scoliosis deformity and by itself creates only limited impairment. To evaluate this type of ankylosis, use the same posture as for measuring abnormal motion in the thoracic spine, and ask the individual to achieve maximum correction of the rotation deformity. Then subtract the T12 rotation angle from the T1 rotation angle and determine the ankylosis angle or angle of restricted motion. Refer to the Ankylosis part of Table 15-11 to determine the impairment percent.

Figure 15-14 provides a measurement template for thoracic impairment evaluation using the ROM method.

Figure 15-14 Thoracic Range of Motion (ROM)*

Name _____ Soc. Sec. No. _____ Date _____

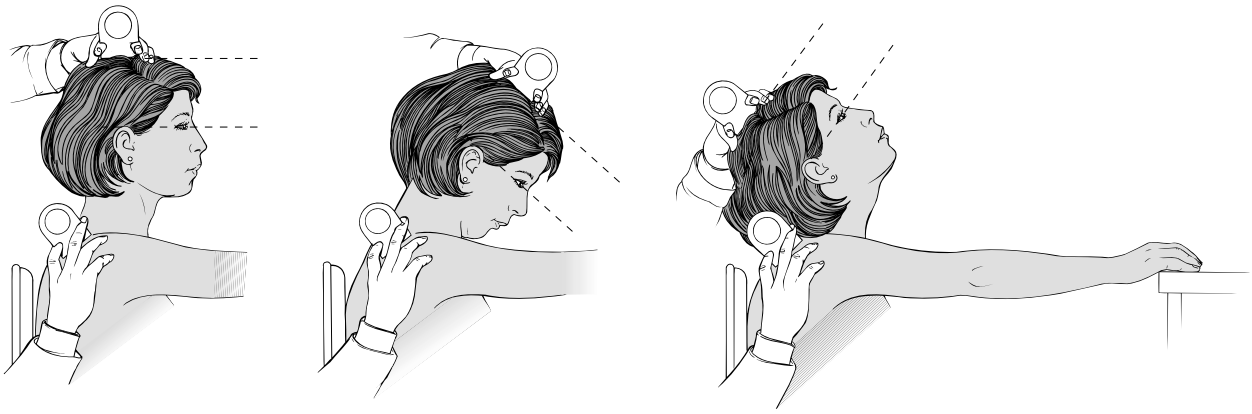
Movement	Description	Range					
Angle of minimum kyphosis (thoracic ankylosis in extension)	T1 reading		XXXX	XXXX	XXXX	XXXX	XXXX
	T12 reading		XXXX	XXXX	XXXX	XXXX	XXXX
	Angle of minimum kyphosis		XXXX	XXXX	XXXX	XXXX	XXXX
	% Impairment due to thoracic ankylosis	(Use larger of either ankylosis or flexion impairment)					
Thoracic flexion	T1 ROM						
	T12 ROM						
	Thoracic flexion angle						
	10% or 5°	Yes	No				
	Maximum thoracic flexion angle						
	% Impairment						
Thoracic left rotation	T1 ROM						
	T12 ROM						
	Thoracic left rotation angle						
	10% or 5°	Yes	No				
	Maximum thoracic left rotation angle						
	% Impairment						
Thoracic right rotation	T1 ROM						
	T12 ROM						
	Thoracic right rotation angle						
	10% or 5°	Yes	No				
	Maximum thoracic right rotation angle						
	% Impairment						
Thoracic ankylosis in rotation	Position			(Excludes any impairment for abnormal flexion or extension motion)			
	% Impairment						
Total thoracic range of motion and ankylosis* impairment _____%							

*If ankylosis is present, combine the ankylosis impairment with the range-of-motion impairment (Combined Values Chart, p. 604).

If ankyloses in several planes are present, combine the ankylosis estimates (Combined Values Chart), then combine the result with the range-of-motion impairment.

Figure 15-15 Two-Inclinometer Technique for Measuring Cervical Flexion and Extension

The individual is sitting and the inclinometers placed over the calvarium and at T1.



a. neutral position **b.** flexion **c.** extension

15.11 ROM: Cervical Spine

15.11a Flexion and Extension

Two-Inclinometer Technique

1. Provide information to the individual about the procedure, and allow for appropriate warm-up exercises.
2. Locate and place a horizontal skin mark over the T1 spinous process. With the individual seated, place the first inclinometer, aligned in the sagittal plane, over the T1 spinous process. Place the second inclinometer at the side of the face, from the corner of the eye to the ear, along a parallel line where the temple of eyeglasses would sit (Figure 15-15a). From this position, set the inclinometer to 0. This represents the 0° true neutral position. Move the second inclinometer to the calvarium, and set the head to the neutral position in both the sagittal and frontal planes, where the inclinometer again reads 0 (Figure 15-15a).
3. Ask the individual to flex maximally and record both angles. Subtract the T1 angle from the calvarium angle to obtain the cervical flexion angle (Figure 15-15b) and record it. Return the head to the neutral position so both inclinometers read 0° again.
4. Instruct the individual to extend the neck as far as possible, keeping the chin close to the sternum, again recording both inclinometer angles. Subtract the T1 angle from the calvarium angle to obtain the cervical extension angle (Figure 15-15c). Ask the individual to return the head to the neutral position.
5. Repeat the procedure three times. The cervical flexion and extension angles should be consistently measured within 5° or 10%, whichever is greater. The impairment rating is based on the greatest angle of a valid set of three consecutive measurements.
6. Using the largest valid cervical flexion and extension measurements, obtain the whole person impairment rating for cervical flexion and extension using Table 15-12.
7. *Add* the cervical flexion and extension impairment ratings and *combine* the sum with any ratings for diagnostic criteria (Table 15-7) and/or neural impairment.

Ankylosis

1. Note whether there is motion of the cervical spine in the sagittal plane or whether the spine is unable either to flex or extend beyond the neutral point. Determine if the ankylosis or restricted motion is in flexion or extension. If some motion is possible in the sagittal plane, ask the individual to hold the position closest to the neutral point.
2. Place the inclinometer's base against a vertical surface to set the inclinometer to the neutral 0 position. Then place it at the side of the face, from the corner of the eye to the ear, along a parallel line where eyeglass temples would lie (Figure 15-15b). Move the inclinometer to the calvarium and set the head to the neutral position in both the sagittal and frontal planes, where the inclinometer again reads 0 (Figure 15-15b).
3. Place the second inclinometer at T1 and record the angle. Subtract or add the T1 angle from the first-read angle to obtain the angle of ankylosis in either flexion or extension.
4. Consult the Ankylosis section of Table 15-12 to determine the whole person impairment.
5. Add the impairment percent for left rotation and right rotation. Their sum is the whole person impairment contributed by abnormal rotation of the cervical region.

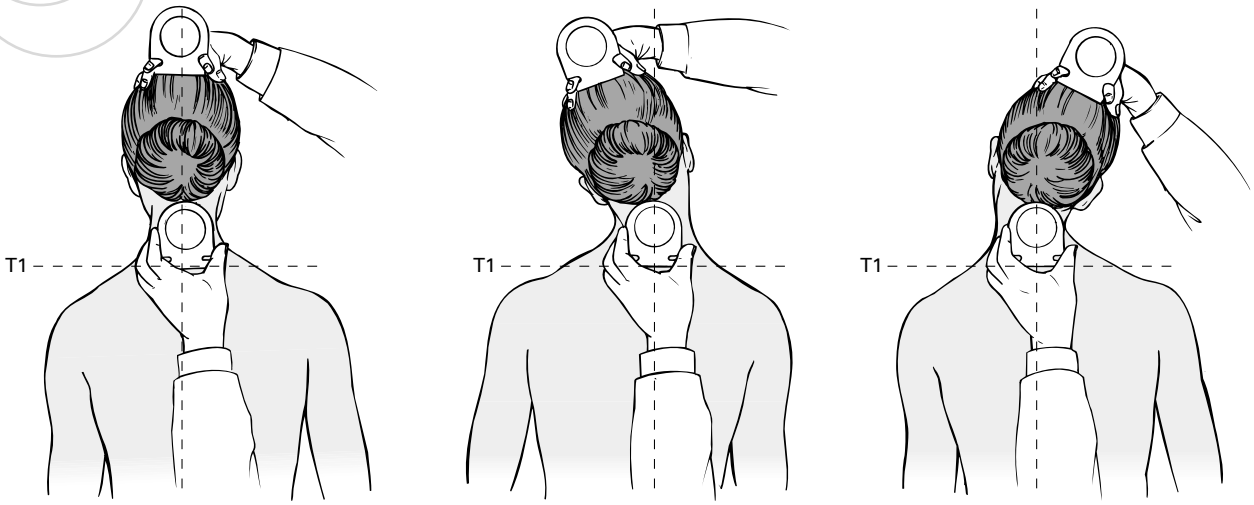
Table 15-12 Cervical Region Impairment From Abnormal Flexion or Extension or Ankylosis

Abnormal Motion
Average range of flexion and extension is 110°; the proportion of all cervical motions is 40%.

a.	Flexion From Neutral Position (0°) to (°):	Degrees of Cervical Motion		% Impairment of the Whole Person
		Lost	Retained	
	0	50	0	5
	15	35	15	4
	30	30	20	2
	50	0	50	0
b.	**Extension From Neutral Position (0°) to (°):**	**Degrees of Cervical Motion**		**% Impairment of the Whole Person**
		Lost	**Retained**	
	0	60	0	6
	20	40	20	4
	40	20	40	2
	60	0	60+	0
c.	**Region Ankylosed at (°):**			
	0 (neutral position)			12
	15			20
	30			30
	50 (full flexion)			40
d.	**Region Ankylosed at (°):**			
	0 (neutral position)			12
	20			20
	40			30
	60 (full extension)			40

Example: A 55-year-old man has an extension deformity on attempted flexion. Inclinometer reading from the calvarium is 15° extension from the neutral 0° position. The T1 angle is 5° of flexion from neutral 0°. In this case, because the angles are in different directions from the neutral position, they are *added*, and the cervical spine thus is ankylosed at 20° extension. This is considered a 20% whole person impairment (Table 15-12).

Figure 15-16 Two-Inclinometer Technique for Measuring Cervical Lateral Flexion



a. neutral position **b.** left lateral bending **c.** right lateral bending

The individual is sitting, and the inclinometers are set to 0, with the eye-ear line as the 0 reference (see text for description) and placed over the calvarium and T1.

15.11b Lateral Bending

Two-Inclinometer Technique

1. Provide information to the individual about the procedure and allow for appropriate warm-up exercises.
2. Place a skin mark over the T1 spinous process. With the individual in the seated position, place the first inclinometer aligned in the coronal plane over the T1 spinous process while holding the second inclinometer over the calvarium (Figure 15-16a). The head should be in the neutral position while the inclinometers are set at 0°.
3. Ask the individual to tilt the head maximally to the left and record both angles (Figure 15-16b). Subtract the T1 angle from the calvarium angle to determine the degrees of left lateral bending. Return the head to the neutral position.
4. Instruct the individual to tilt the head maximally to the right as far as possible, recording both inclinometer angles. Subtract the T1 angle from the calvarium angle to determine cervical right lateral bending (Figure 15-16c).
5. Repeat the above procedure at least three times. The angles measured should be within 5° or 10% of the mean of the three measurements, whichever is greater. The measurement used for impairment rating is the greatest angle of a valid set of three consecutive measurements.
6. Consult Table 15-13 to determine the whole person impairment related to abnormal lateral flexion of the cervical region.

Add the impairment percent from left lateral bending and right lateral bending. Their sum represents the whole person impairment related to abnormal lateral bending of the cervical region.

Table 15-13 Impairment Due to Abnormal Motion and Ankylosis of the Cervical Region: Lateral Bending

Abnormal Motion **The average range of lateral bending is 90°; the proportion of all cervical motions is 25%.**				
a.	**Left Lateral Bending From Neutral Position (0°) to (°):**	**Degrees of Cervical Motion**		**% Impairment of the Whole Person**
		Lost	**Retained**	
	0	45	0	4
	15	30	15	2
	30	15	30	1
	45	0	45	0
b.	**Right Lateral Bending From Neutral Position (0°) to (°):**	**Degrees of Cervical Motion**		**% Impairment of the Whole Person**
		Lost	**Retained**	
	0	45	0	4
	15	30	15	2
	30	15	30	1
	45	0	45	0
c.	**Ankylosis** **Region Ankylosed at (°):**			
	0 (neutral position)			8
	15			20
	30			30
	45 (full left or right rotation)			40

Example: The left bending flexion angles measured from the calvarium are 20°, 35°, 35,° and 40°. The corresponding T1 measurements are 5°, 5°, 10°, and 10°. The true left lateral degrees of bending are 15°, 20°, 25°, and 30°. The 15° is discarded. The other three measurements fulfill the validation criteria, being more than 5° from the mean of 25°. The greatest left lateral bending angle of the three trials is 30°, and the impairment rating due to left lateral bending limitation is 1% (Table 15-13).

Ankylosis

1. Place both inclinometer bases against a desk or tabletop and adjust until they read 0°, or the neutral position.

2. Place one inclinometer in the frontal plane at T1 (Figure 15-16b) and the second inclinometer over the calvarium.

3. Determine whether the individual has cervical lateral motion or is unable to attain the neutral position. If there is motion and the individual cannot reach the neutral position, read the angle closest to neutral 0. This is the angle of ankylosis used for rating (Figure 15-16b).

Consult the Ankylosis section of Table 15-13 to determine the whole person impairment.

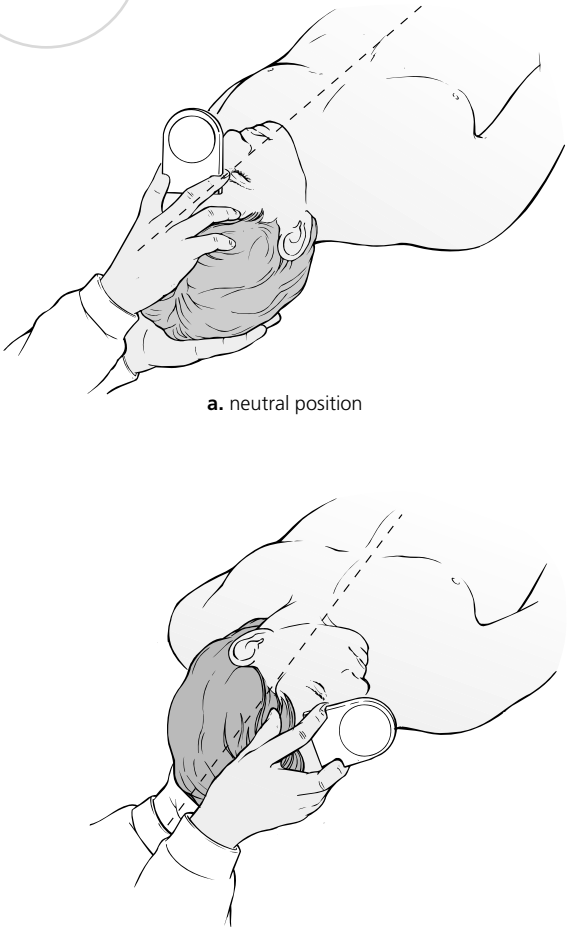
15.11c Cervical Rotation

Because the technique for cervical evaluation stabilizes the trunk in the supine position, with the shoulders on the table, only one inclinometer is required for measurement of rotation.

1. Provide information to the individual about the procedure, and allow for appropriate warm-up exercises. Set the inclinometer to 0° or the gravity position.
2. Have the individual lie supine on a flat exam table with shoulders exposed to permit observation of any truncal (thoracolumbar) rotation. Stand at the head of the table and place the inclinometer in the transverse plane with the base applied to the forehead (Figure 15-17a). Record the neutral 0° position with the individual's nose pointing to the ceiling.
3. Ask the individual to rotate the head maximally to the left, and record the cervical left rotation angle.
4. Ask the individual to rotate the head maximally to the right, and record the cervical right rotation angle (Figure 15-17b).
5. Repeat the procedure three to six times to obtain a valid set of three consecutive measurements. The left and right cervical rotation angles should be within 5° or 10% of the mean of a valid set, whichever is greater. The impairment rating is based on the greatest angle of a valid set.

Example: Left cervical rotation is 15°, 35°, 55°, 60°, and 55°. The initial two measurements are discarded, while the others are close enough to be valid. The largest measurement, 60°, is used and corresponds to a whole person impairment estimate for abnormal left cervical rotation of 1% (Table 15-14).

Figure 15-17 Measuring Cervical Rotation



a. neutral position

b. right rotation

Table 15-14 Impairment Due to Abnormal Motion and Ankylosis of the Cervical Region: Rotation

Abnormal Motion **Average range of rotation is 160°;** **the proportion of all cervical motion is 35%.**				
a.	**Left Rotation From Neutral Position (0°) to (°):**	**Degrees of Cervical Motion**		**% Impairment of the Whole Person**
		Lost	**Retained**	
	0	80	0	6
	20	60	20	4
	40	40	40	2
	60	20	60	1
	80	0	80+	0
b.	**Right Rotation From Neutral Position (0°) to (°):**	**Degrees of Cervical Motion**		**% Impairment of the Whole Person**
		Lost	**Retained**	
	0	80	0	6
	20	60	20	4
	40	40	40	2
	60	20	60	1
	80	0	80+	0
c.	**Ankylosis** **Region Ankylosed at (°):**			
	0 (neutral position)			12
	20			20
	40			30
	60			40
	80 (full right or left rotation)			50

Ankylosis

1. Determine whether the individual has cervical axial motion and is unable to attain the neutral position. If the individual has some motion, ask him or her to maintain the position closest to neutral and record the ankylosis angle closest to neutral (Figure 15-17).
2. Place the inclinometer on the calvarium with the cervical region in the ankylosis position, and record the ankylosis angle.
3. Consult the Ankylosis part of Table 15-14 to determine the whole person impairment.

Figure 15-18 provides a template for evaluating cervical impairment using the ROM method.

Figure 15-18 Cervical Range of Motion (ROM)*

Name _____ Soc. Sec. No. _____ Date _____

Movement	Description	Range					
Cervical flexion	Calvarium angle						
	T1 ROM						
	Cervical flexion angle						
	±10% or 5°	Yes	No				
	Maximum cervical flexion angle						
	% Impairment						
Cervical extension	Calvarium angle						
	T1 ROM						
	Cervical extension angle						
	±10% or 5°	Yes	No				
	Maximum cervical extension angle						
	% Impairment						
Cervical ankylosis in flexion/extension	Position						
	% Impairment			(Excludes any impairment for abnormal flexion or extension motion)			
Cervical left lateral bending	Calvarium angle						
	T1 ROM						
	Cervical left lateral flexion angle						
	±10% or 5°	Yes	No				
	Maximum cervical right lateral flexion angle						
	% Impairment						
Cervical right lateral bending	Calvarium angle						
	T1 ROM						
	Cervical right lateral flexion angle						
	±10% or 5°	Yes	No				
	Maximum cervical right lateral flexion angle						
	% Impairment						
Cervical ankylosis in lateral bending	Position						
	% Impairment			(Excludes any impairment for abnormal lateral flexion or extension motion)			
Cervical left rotation	Cervical left rotation angle						
	±10% or 5°	Yes	No				
	Maximum cervical left rotation angle						
	% Impairment						
Cervical right rotation	Cervical right rotation angle						
	±10% or 5°	Yes	No				
	Maximum cervical right rotation angle						
	% Impairment						
Cervical ankylosis in rotation	Position						
	% Impairment			(Excludes any impairment for abnormal rotation)			
Total cervical range of motion and ankylosis* impairment _____ %							
Total cervical range of motion = % impairments of flexion + extension + left lateral bending + right lateral bending + left rotation + right rotation							

* If ankylosis is present, combine the ankylosis impairment with the range-of-motion impairment (Combined Values Chart, p. 604). If ankyloses in several planes are present, combine the estimates (Combined Values Chart), then combine the result with the range-of-motion impairment.

15.12 Nerve Root and/or Spinal Cord

When using the ROM method, it is important to consider any nerve root or spinal cord impairment. Injury or illness to the cervical spine may produce nerve root compression manifested by sensory or motor loss in the upper extremities, as well as long tract signs from spinal cord compression. In the thoracic spine, spinal cord compression or injury may produce long tract signs, but nerve roots are uncommonly compressed. In the lumbosacral spine, spinal cord involvement is rare because the cord typically ends at L1, although nerve root compression (cauda equina or isolated root[s]) affecting the lower extremities is common. If any neural impairment is identified, proceed with the following evaluation:

1. Identify the nerve(s) involved, based on the clinical evaluation and the dermatome distribution charts for the lower (Figure 15-1) and upper extremity (Figure 15-2).
2. Determine the extent of any sensory and motor loss due to nerve impairment, based on Tables 15-15 and 15-16.
3. Find the maximum impairment due to nerve dysfunction in Table 15-17 for the upper extremity and Table 15-18 for the lower extremity.
4. Multiply the severity of the sensory or motor deficit by the maximum value of the relevant nerve (Tables 15-17, 15-18). If there is both sensory and motor impairment of a nerve root, the impairment percents are combined (Combined Values Chart, p. 604) to determine the extremity impairment. If both extremities are impaired, the impairment percent for each extremity is determined, converted to whole person impairment, and the two impairment ratings combined using the Combined Values Chart.
5. Convert to whole person impairment by multiplying the upper extremity impairment by 0.6 and the lower extremity impairment by 0.4. To convert any regional ROM spine impairment to whole person impairment, multiply the specific spinal nerve impairment by the regional weight: 0.80 for the cervical spine, 0.40 for the thoracic spine, and 0.90 for the lumbosacral spine. Impairment ratings above 100% are rounded down to 100% since a whole person impairment rating cannot exceed 100%. This is described further in Section 15.14.

If there is bilateral spinal nerve impairment or spinal cord involvement, especially if in conjunction with head injury, consultation with a neurologist and/or neurosurgeon and review of the diagnostic criteria in the neurology chapter (Chapter 13) is advisable. The physician should decide whether evaluation by the spine or neurology chapter criteria is most appropriate.

Table 15-15 Determining Impairment Due to Sensory Loss

a. Classification		
Grade	**Description of Sensory Deficit**	**% Sensory Deficit**
5	No loss of sensibility, abnormal sensation, or pain	0
4	Distorted superficial tactile sensibility (diminished light touch), with or without minimal abnormal sensations or pain, that is forgotten during activity	1-25
3	Distorted superficial tactile sensibility (diminished light touch and two-point discrimination), with some abnormal sensations or slight pain, that interferes with some activities	26-60
2	Decreased superficial cutaneous pain and tactile sensibility (decreased protective sensibility), with abnormal sensations or moderate pain, that may prevent some activities	61-80
1	Deep cutaneous pain sensibility present; absent superficial pain and tactile sensibility (absent protective sensibility), with abnormal sensations or severe pain, that prevents most activity	81-99
0	Absent sensibility, abnormal sensations, or severe pain that prevents all activity	100

b. Procedure	
1.	Identify the area of involvement using the dermatome charts (Figures 15-1 and 15-2).
2.	Identify the nerve(s) that innervate the area(s) (Table 16-12 and Figure 16-48).
3.	Grade the severity of the sensory deficit or pain according to the classification above.
4.	Find the maximum impairment of the extremity(ies) due to sensory deficit or pain for each: spinal nerves (Table 15-8) and brachial plexus (Table 16-14).
5.	Multiply the severity of the sensory deficit by the maximum impairment value to obtain the extremity impairment for each spinal nerve involved.

Table 15-16 Determining Impairment Due to Loss of Power and Motor Deficits

a. Classification		
Grade	**Description of Muscle Function**	**% Motor Deficit**
5	Active movement against gravity with full resistance	0
4	Active movement against gravity with some resistance	1–25
3	Active movement against gravity only, without resistance	26–50
2	Active movement with gravity eliminated	51–75
1	Slight contraction and no movement	76–99
0	No contraction	100

b. Procedure	
1.	Identify the motion involved, such as flexion, extension, etc.
2.	Identify the muscle(s) performing the motion and the spinal nerve(s) involved.
3.	Grade the severity of motor deficit of individual muscles according to the classification given above.
4.	Find the maximum impairment of the extremity due to motor deficit for each spinal nerve structure involved (Tables 15-18, 16-11, 16-13, and 17-37).
5.	Multiply the severity of the motor deficit by the maximum impairment value to obtain the extremity impairment for each spinal nerve involved.

* Adapted from Medical Research Council.[16]

Table 15-17 Unilateral Spinal Nerve Root Impairment Affecting the Upper Extremity*

Nerve Root Impaired	Maximum % Loss of Function Due to Sensory Deficit or Pain	Maximum % Loss of Function Due to Strength
C5	5	30
C6	8	35
C7	5	35
C8	5	45
T1	5	20

* For description of the process of determining impairment percent, see text.

Table 15-18 Unilateral Spinal Nerve Root Impairment Affecting the Lower Extremity*

Nerve Root Impaired	Maximum % Loss of Function Due to Sensory Deficit or Pain	Maximum % Loss of Function Due to Strength
L3	5	20
L4	5	34
L5	5	37
S1	5	20

* For description of the process of determining impairment percent, see text.

15.12a Examples Using the ROM Method

Example 15-22
23% Impairment Due to Herniated Disk With Radiculopathy

Subject: 55-year-old man.

History: Developed low back pain and right sciatica after lifting furniture at home. A herniated lumbar disk was treated surgically, with near complete relief of pain. About 15 months ago postoperatively, he reinjured his lumbar spine while lifting on the job. An MRI showed a recurrent herniated disk at the same level and side as before. He underwent a second diskectomy, but this time was unrelieved of pain.

Current Symptoms: Back and unilateral, radiating right leg pain, unchanged for many months.

Physical Exam: Healed scar on the back. Straight leg raising caused pain along the lateral leg and foot at 30°. The right Achilles reflex was absent. Numbness in the right S1 nerve root distribution range of motion and straight-leg-raising testing using the double-inclinometer technique resulted in the following measurements: true lumbar extension 20°; true lumbar flexion 30°; left lateral flexion 25°; right lateral flexion 20°.

The sensory changes in S1 nerve distribution were judged to be grade 4 according to Table 15-15, and weakness in the S1-innervated muscles was judged to be grade 4 according to Table 15-16.

Clinical Studies: MRI after the second injury: recurrent herniated disk. Repeat MRI with gadolinium after surgery and failure to improve: only perineural scarring. Repeat routine x-rays: slight disk space narrowing at the involved level.

Diagnosis: Recurrent herniated disk with radiculopathy.

Impairment Rating: 23% impairment of the whole person.

Comment: Individual has a 12% whole person impairment according to Table 15-7, 10% due to "surgically treated disk lesion with residual, medically documented pain and rigidity," added to 2% for the second operation. He has an impairment of 2% impairment due to loss of lumbar extension and 4% due to loss of flexion, with at least 45° of sacral (hip) motion (Table 15-8) and 6% loss due to extension and flexion. He has 0% impairment due to loss of left lateral lumbar flexion, 1% loss of right lateral flexion (Table 15-9), and 1% loss of lateral movement. He therefore has 7% impairment due to loss of lumbar motion. From Table 15-15 we see that he has a grade 4 sensory loss of S1. Multiplying 25% (the maximum percentage in this case) by the 5% for maximum loss of S1 sensation from Table 15-18 results in a rating of 1% due to sensory loss. We also see that he has a grade 4 motor loss according to Table 15-16. Multiplying 25% (the maximum in this case) by the 20% from Table 15-18 for S1 motor loss results in 5% impairment due to motor loss of S1. Combining the 1% for sensory loss and the 5% for motor loss results in a 6% impairment due to neurologic loss. Using the Combined Values Chart to combine the impairment from Table 15-7, (12%) with the impairments due to loss of motion (7%) and neurologic involvement (6%) results in a whole person impairment of 23%. In some cases, the physician may be asked to apportion the findings. One approach is to subtract 10% from the latest impairment rating due to the first injury, assuming it was a DRE III without ROM data after the first operation and the radiculopathy had resolved after the first surgery.

Example 15-23
7% Impairment Due to Ankylosing Spondylitis

Subject: 56-year-old man.

History: Individual with known ankylosing spondylitis has become unable to work because of pain and is considering retirement, depending on his impairment rating.

Current Symptoms: Moderate pain; cannot straighten up completely.

Physical Exam: Measurement of the motion and ankylosis in the thoracic spine demonstrates an angle of minimum kyphosis of 60°. With maximum flexion, T1 readings of 35°, 45°, and 55° are recorded, which are matched with T12 flexion angles of 25°, 30°, and 40°, respectively. The angles of thoracic flexion, which are derived by subtracting the T1 angles from the T12 angles, are 10°, 15°, and 15°. These meet validity criteria. T1 rotation to the right measures 15°, 20°, and 15°. Corresponding T12 rotation angles measure 5°, 10°, and 5°. The measurements are valid, and the left rotation angle is 10°. The right thoracic rotation angles are the same as the right.

Diagnosis: Ankylosing spondylitis.

Impairment Rating: 7% impairment of the whole person.

Comment: According to Table 15-10, the impairment due to ankylosis (angle of minimum kyphosis) of 60° is 5% of the whole person and, considering maximum flexion, the impairment due to abnormal motion of 15° is 2%. The total impairment is the greater of the ankylosis and abnormal motion percentages, in this instance, 5%. The impairment due to loss of right thoracic rotation is, according to Table 15-11, 1%. Impairment due to loss of left thoracic rotation is the same. Adding these impairments results in a whole person impairment of 7%. Because there has been no injury or surgery, the individual does not meet any of the other diagnostic criteria in Table 15-7, and there is no neurologic involvement, the whole person impairment is derived solely from the loss of motion and is 7%. If there was loss of motion in any other spinal region, each region would be rated separately and the ratings combined using the Combined Values Chart (p. 604).

Example 15-24
23% Impairment Due to Compression Fractures

Subject: 54-year-old woman.

History: Fell from a ladder and sustained burst fractures of L2 with loss of height of 55% and L3 with loss of height of 20%. Treated with bracing and the fractures healed. Returned to work as a customer service agent 6 months after the injury.

Current Symptoms: No neurologic findings, but she has back pain after heavy activity.

Physical Exam: Mild tenderness to palpation at the fracture site. Neurologic examination is negative. Straight leg raising is negative. True lumbar extension is 10°, flexion is 30°, and left and right lateral bending are each 10°. There is normal hip motion.

Clinical Studies: Repeat x-rays of the area: healed fractures with persistent loss of height of greater than 50% at L2 and 20% at L3.

Diagnosis: Compression fractures L2 and L3.

Impairment Rating: 23% impairment of the whole person.

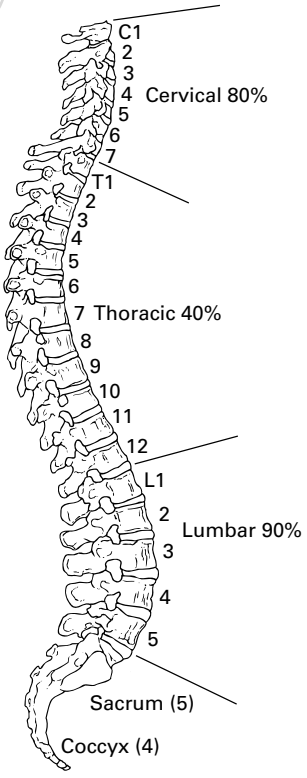
Comment: Injuries at two vertebrae within the same region, with a 55% compression of L2, according to Table 15-7, results in an impairment of 7%. The compression fracture of L3 results in an impairment of 5%, according to Table 15-7. The instructions are to combine these two impairment ratings; doing so results in an impairment rating of 12%.

The woman has true lumbar extension of 10° which, according to Table 15-8, results in an impairment of 5%, a lumbar flexion of 30°, which results in an impairment of 4% (Table 15-8), and left and right lateral bending of 10°, which results in an impairment of 2% for each (Table 15-9). Adding these four impairments due to loss of motion results in an impairment of 13%. Combining the impairment of 12% from Table 15-7 and the 13% from Tables 15-8 and 15-9 results in a whole person impairment of 23%.

15.13 Criteria for Converting Whole Person Impairment to Regional Spine Impairment

In some instances, the evaluator may be asked to express an impairment rating in terms of the involved spine region rather than the whole person. This is done by dividing the whole person impairment estimate by the percent of spine function that has been assigned to that region. Under the DRE method, a whole person estimate being converted to a regional estimate would be divided by 0.35 for the cervical spine, 0.20 for the thoracic spine, and 0.75 for the lumbar and sacral spines. Under the ROM method, a whole person estimate being converted to a regional estimate should be divided by 0.80 for the cervical spine, 0.40 for the thoracic spine, or 0.90 for the lumbosacral spine (Figure 15-19). For example, a 24-year-old female office worker sustained a cervical injury that, after it was healed and stable, resulted in a whole body impairment, estimated by the DRE method, of 20%. Dividing the 20% by 0.35 results in 57% impairment of the cervical spine. An individual with multiple lumbar compression fractures was rated 25% whole body impairment by the ROM method. To obtain an estimate of lumbar spine impairment, the physician should divide the 25% by 0.9, resulting in a 27.7% rounded up to 28% lumbar spine impairment. Any values that exceed 100% are rounded down to 100% regional impairment.

Figure 15-19 Side View of Spinal Column



The whole spine divided into regions indicating the maximum whole person impairment represented by a total impairment of one region of the spine. Lumbar 90%, thoracic 40%, cervical 80%.

15.14 The Pelvis

Criteria for Rating Impairment Due to Pelvic Injury

The pelvis is composed bilaterally of three bones: the ilium, the ischium, and the pubis, forming a ringlike structure. Each ilium is attached to the sacrum via the sacroiliac synchondrosis. The pelvis, including the symphysis pubis, assists in transfer of body weight to the lower extremities. In females, the pelvic structure and function are also of paramount importance in pregnancy and delivery.

Pelvic disorders are evaluated using Table 15-19. When necessary, these disorders may be combined with impairment ratings from either the DRE or ROM methods for spine impairment.

Table 15-19 Whole Person Impairment Due to Selected Disorders of the Pelvis

Disorder	% Impairment of the Whole Person
1. Healed fracture without displacement or residual sign(s)	0
2. Healed fracture with displacement and without residual sign(s) involving:	
a. Single ramus	0
b. Rami, bilateral	0
c. Ilium	0
d. Ischium	0
e. Symphysis pubis, without separation	5
f. Sacrum	5
g. Coccyx	0
3. Healed fracture(s) with displacement, deformity, and residual sign(s) involving:	
a. Single ramus	0
b. Rami, bilateral	5
c. Ilium	2
d. Ischium, displaced 1 inch or more	10
e. Symphysis pubis, displaced or separated	15
f. Sacrum, into sacroiliac joint	10
g. Coccyx, nonunion or excision	5
h. Fracture into acetabulum	Evaluate on basis of restricted motion of hip joint

The impairment estimate for hemipelvectomy is 50% of the whole person (Table 17-32).

Example 15-25
5% Impairment Due to Pelvic Stress Fracture

Subject: 22-year-old man.

History: Military intensive training involving running with a backpack of 40 lbs over extended time and distance. Difficulty standing up because of pain in the pelvis and in the right upper thigh. Pain was enhanced by walking and running. Felt challenged not to report the pain, which he felt while jumping over a boulder 2 weeks prior to the time of the medical exam. The pain was intensified with further running.

Current Symptoms: Pain in the right groin and medial upper thigh aggravated by standing and walking; improved in the supine position.

Physical Exam: Acute tenderness to palpation and pressure on the right pubic bone and the right adductor and hamstrings origin at the inferior ischiopubic junction.

Clinical Studies: Pelvic x-rays: transverse fissure in the upper border of the obturator foramen; there is already a callus development in the area.

Diagnosis: Stress fracture at the right ischiopubic junction.

Impairment Rating: 5% whole person impairment due to delayed union with deformity and residual signs after achieving MMI.

Comment: The callus formation continued and grew, producing a delayed union. He continued to have right groin and medial upper thigh pain, increasing with walking and running, and stabilizing after 9 months. Stress fractures of the pelvis, especially of the inferior branch of the pubic bone, need to be investigated and treated in a timely manner. Delay in investigation and diagnosis may result in massive callus formation and abnormal union, as well as continued pain, especially with standing and running.