

CHAPTER 5

Testing the Muscles of the Lower Extremity



Hip Flexion	Ankle Plantar Flexion
Hip Flexion, Abduction, and External Rotation with Knee Flexion	Foot Dorsiflexion and Inversion
Hip Extension	Foot Inversion
Hip Abduction	Foot Eversion with Plantar Flexion
Hip Abduction from Flexed Position	Hallux and Toe MP Flexion
Hip Adduction	Toe MP Flexion
Hip External Rotation	Hallux and Toe DIP and PIP Flexion
Hip Internal Rotation	Hallux and Toe MP and IP Extension
Knee Flexion	
Knee Extension	

HIP FLEXION

(*Psoas major* and *Iliacus*)

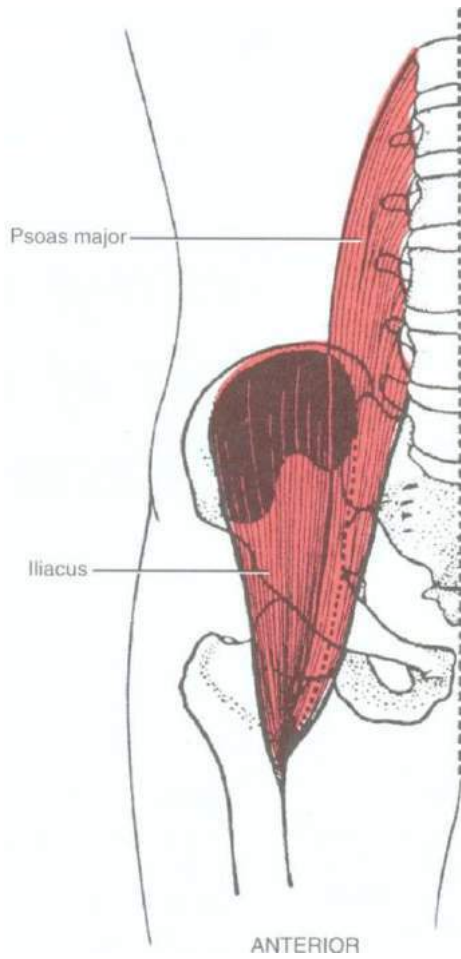


FIGURE 5-1

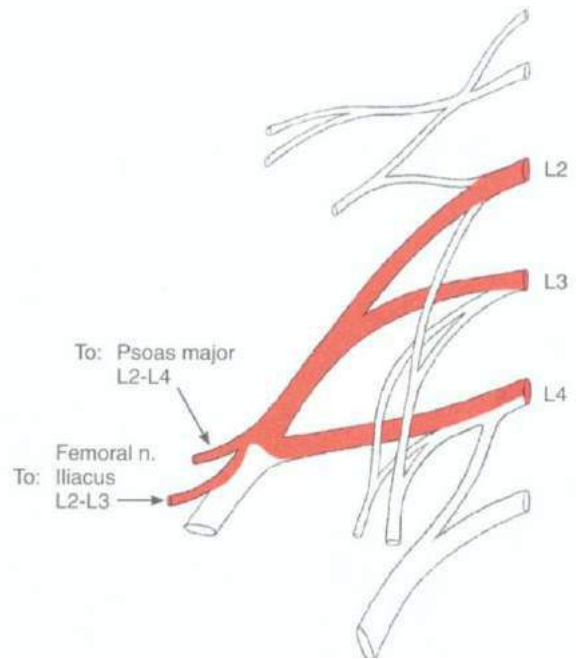


FIGURE 5-2

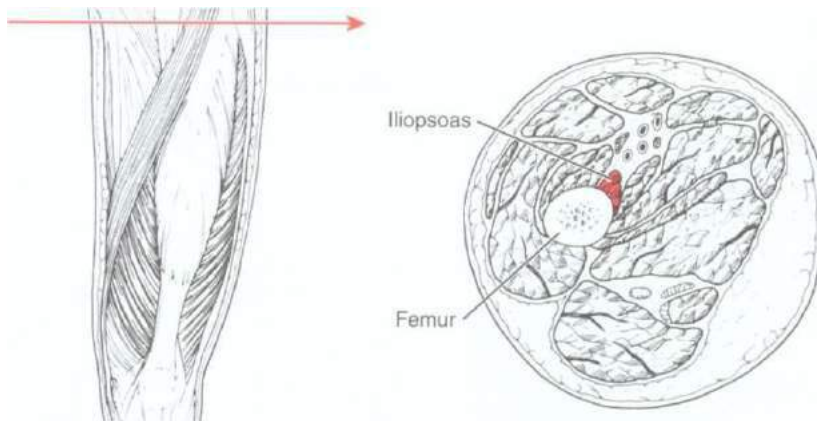


FIGURE 5-3

HIP FLEXION

(*Psoas major* and *Iliacus*)

Range of Motion

0° to 120°

Table 5-1 HIP FLEXION

I.D.	Muscle	Origin	Insertion
174	Psoas major	L1-L5 vertebrae (transverse processes) T12-L5 vertebral bodies (sides) and their intervertebral disks	Femur (lesser trochanter)
176	Iliacus	Iliac fossa (upper 2/3) Iliac crest (inner lip) Sacroiliac and iliolumbar ligaments Sacrum (upper lateral surface)	Femur (lesser trochanter; joins tendon of psoas major) Femoral shaft below lesser trochanter
Others			
196	Rectus femoris		
195	Sartorius		
185	Tensor fasciae latae		
177	Pectineus		
180	Adductor brevis		
179	Adductor longus		
181	Adductor magnus (superior fibers)		
183	Gluteus medius (anterior)		

HIP FLEXION

(*Psoas major* and *Iliacus*)

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

Position of Patient: Short sitting with thighs fully supported on table and legs hanging over the edge. Patient may use arms to provide trunk stability by grasping table edge or with hands on table at each side (Figure 5-4).

Position of Therapist: Standing next to limb to be tested. Contoured hand to give resistance over distal thigh just proximal to the knee joint (see Figure 5-4).

Test: Patient flexes hip to end of range, clearing the table and maintaining neutral rotation, holding that position against the examiner's resistance, which is given in a downward direction toward the floor.

Instructions to Patient: "Lift your leg off the table and don't let me push it down."

Grading

Grade 5 (Normal): Thigh clears table. Patient tolerates maximal resistance.

Grade 4 (Good): Hip flexion holds against strong to moderate resistance. There may be some "give" at the end position.

Grade 3 (Fair): Patient completes test range and holds the position without resistance (Figure 5-5).



FIGURE 5-4



FIGURE 5-5

Helpful Hint

Knowledge of the ranges of motion of the hip is imperative before manual tests of hip strength are conducted. If the examiner does not have a clear idea of hip joint ranges, especially tightness in the hip flexor muscles, test results will be contaminated. For example, in the presence of a hip flexion contracture, the patient must be standing and leaning over the

edge of the table to test hip extension strength. This position (described on page 194) will decrease the influence of the flexion contracture and will allow the patient to move against gravity through the available range.

HIP FLEXION

(*Psoas major* and *Iliacus*)

Grade 2 (Poor)

Position of Patient: Side-lying with limb to be tested uppermost and supported by examiner (Figure 5-6). Trunk in neutral alignment. Lowermost limb may be flexed for stability.

Position of Therapist: Standing behind patient. Cradle test limb in one arm with hand support under the knee. Opposite hand maintains trunk alignment at hip (see Figure 5-6).

Test: Patient flexes supported hip. Knee is permitted to flex to prevent hamstring tension.

Instructions to Patient: "Bring your knee up toward your chest."

Grading

Grade 2 (Poor): Patient completes the range of motion in side-lying position.



FIGURE 5-6

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Supine. Test limb supported by examiner under calf with hand behind knee (Figure 5-7).

Position of Therapist: Standing at side of limb to be tested. Test limb is supported under calf with hand behind knee. Free hand palpates the muscle just distal to the inguinal ligament on the medial side of the sartorius (see Figure 5-7).

Test: Patient attempts to flex hip.

Instructions to Patient: "Try to bring your knee up to your nose."

Grading

Grade 1 (Trace): Palpable contraction but no visible movement.

Grade 0 (Zero): No palpable contraction of muscle.



FIGURE 5-7

HIP FLEXION

(*Psoas major* and *Iliacus*)

Substitutions

- Use of the sartorius will result in external rotation and abduction of the hip. The sartorius, because it is superficial, will be seen and can be palpated in most limbs (Figure 5-8).
- If the tensor fasciae latae substitutes for the hip flexors, internal rotation and abduction of the hip will result. If, however, the patient is tested in the supine position, gravity will cause the limb to externally rotate. The tensor may be seen and palpated at its origin on the anterior superior iliac spine (ASIS).



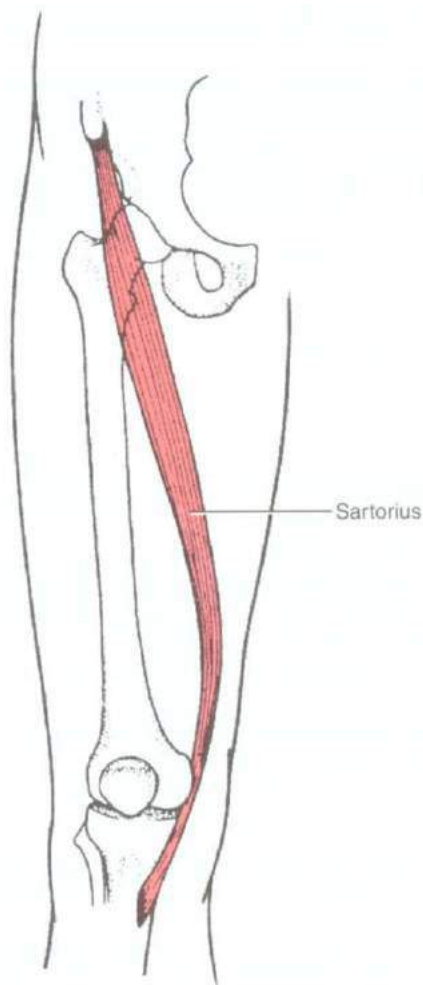
FIGURE 5-8

Helpful Hints

- When the trunk is weak the test will be more accurate from a supine position.
- Hip flexion is not a strong motion, so experience is necessary to appreciate what constitutes a normal level of resistance.

HIP FLEXION, ABDUCTION, AND EXTERNAL ROTATION WITH KNEE FLEXION

(Sartorius)



ANTERIOR

FIGURE 5-9

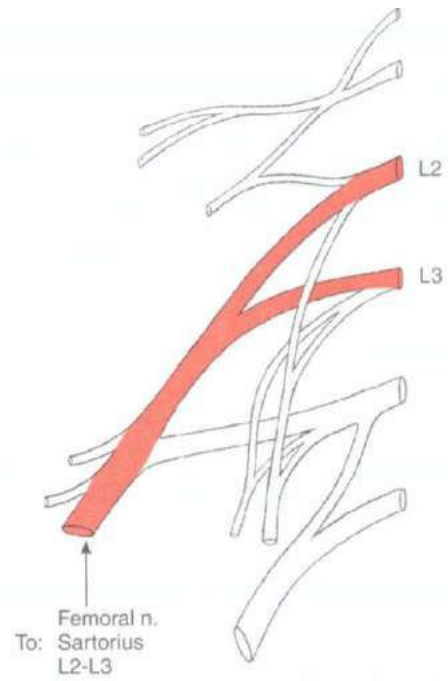


FIGURE 5-10

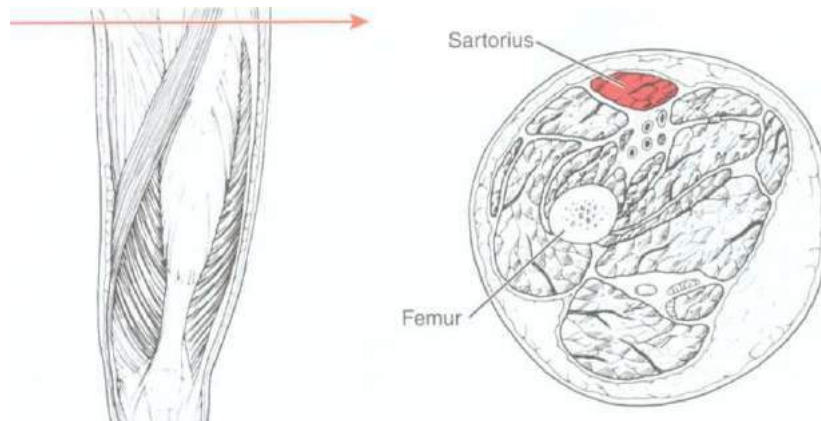


FIGURE 5-11

HIP FLEXION, ABDUCTION, AND EXTERNAL ROTATION WITH KNEE FLEXION

(Sartorius)

Range of Motion

Because this is a two-joint muscle, no specific range-of-motion value can be assigned solely to the sartorius.

Table 5-2 HIP FLEXION, ABDUCTION, AND EXTERNAL ROTATION

I.D.	Muscle	Origin	Insertion
195	Sartorius	Ilium (anterior superior iliac spine (ASIS)) Iliac notch below ASIS	Tibia (shaft, proximal medial surface) Capsule of knee joint (via slip) Medial side fascia of leg

Others

Hip and knee flexors
Hip external rotators
Hip abductors

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

Position of Patient: Short sitting with thighs supported on table and legs hanging over side. Arms may be used for support.

Position of Therapist: Standing lateral to the leg to be tested. Place one hand on the lateral side of knee; the other hand grasps the medial-anterior surface of the distal leg (Figure 5-12).

Hand at knee resists hip flexion and abduction (down and inward direction) in the Grade 5 and 4 tests. Hand at the ankle resists hip external rotation and knee flexion (up and outward) in Grade 5 and 4 tests. No resistance for Grade 3 test.

Test: Patient flexes, abducts, and externally rotates the hip and flexes the knee (Figure 5-12).

Instructions to Patient: Therapist may demonstrate the required motion passively and then ask the patient to repeat the motion, or the therapist may place the limb in the desired end position.

"Hold it! Don't let me move your leg or straighten your knee."

Alternate instruction: "Slide your heel up the shin of your other leg."

Grading

Grade 5 (Normal): Holds end point against maximal resistance.

Grade 4 (Good): Tolerates moderate to heavy resistance.

Grade 3 (Fair): Completes movement and holds end position but takes no resistance (Figure 5-13).



FIGURE 5-12



FIGURE 5-13

HIP FLEXION, ABDUCTION, AND EXTERNAL ROTATION WITH KNEE FLEXION

(Sartorius)

Grade 2 (Poor)

Position of Patient: Supine. Heel of limb to be tested is placed on contralateral shin (Figure 5-14).

Position of Therapist: Standing at side of limb to be tested. Support limb as necessary to maintain alignment.

Test: Patient slides test heel upward along shin to knee.

Instructions to Patient: "Slide your heel up to your knee."

Grading

Grade 2 (Poor): Completes desired movement.



FIGURE 5-14

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Supine.

Position of Therapist: Standing on side to be tested. Cradle test limb under calf with hand supporting limb behind knee. Opposite hand palpates sartorius on medial side of thigh where the muscle crosses the femur (Figure 5-15). Examiner may prefer to palpate near the muscle origin just below the ASIS.

Test: Patient attempts to slide heel up shin toward knee.

Instructions to Patient: "Try to slide your heel up to your knee."

Grading

Grade 1 (Trace): Therapist can detect slight contraction of muscle; no visible movement.

Grade 0 (Zero): No palpable contraction.



FIGURE 5-15

Helpful Hints

- The therapist is reminded that failure of the patient to complete the full range of motion in the Grade 3 test is not an automatic Grade 2. The patient should be tested in the supine

Substitution

Substitution by the iliopsoas or the rectus femoris results in pure hip flexion without abduction and external rotation.

- position to ascertain whether the correct grade is Grade 2 or less.
- Never grasp the belly of a muscle (the calf in this instance) during Poor and Trace tests.

HIP EXTENSION

(*Gluteus maximus* and *Hamstrings*)

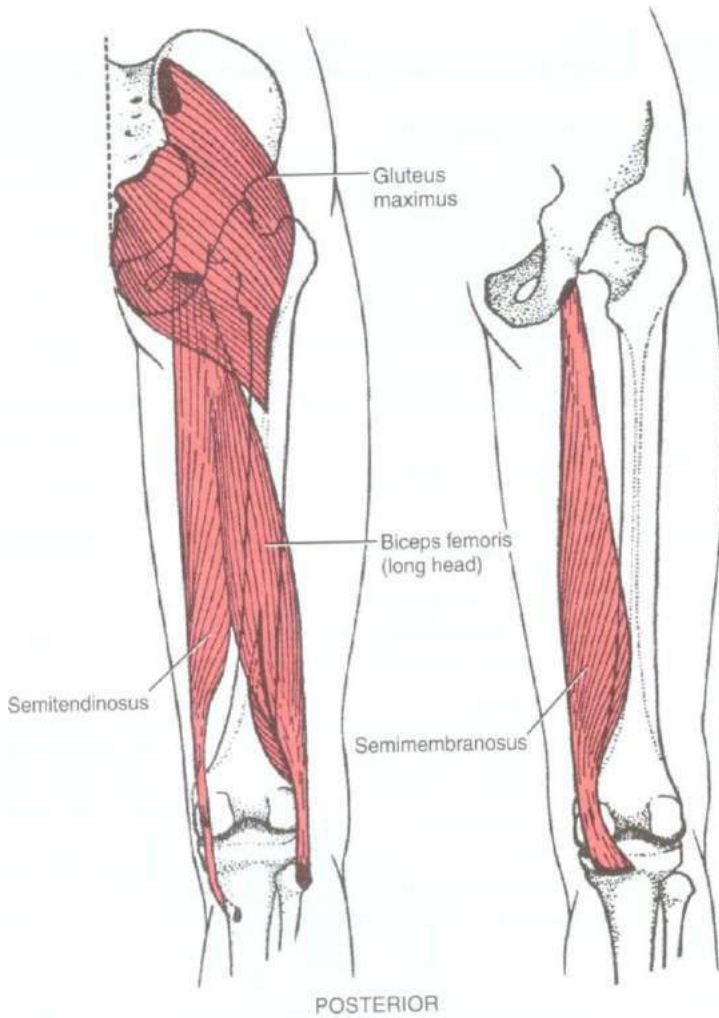


FIGURE 5-16

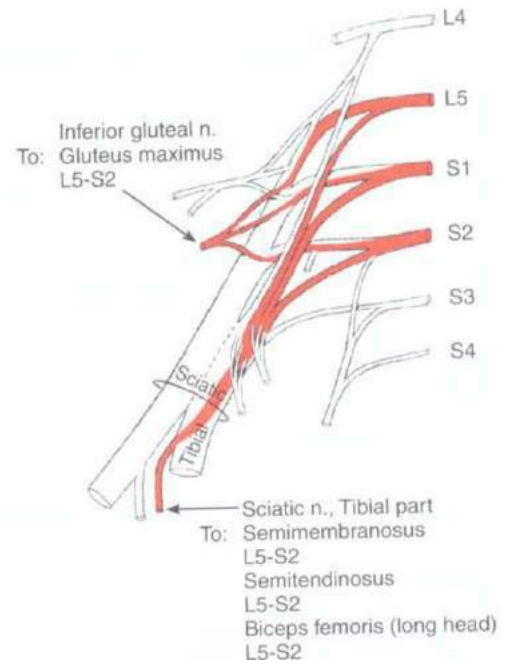


FIGURE 5-18

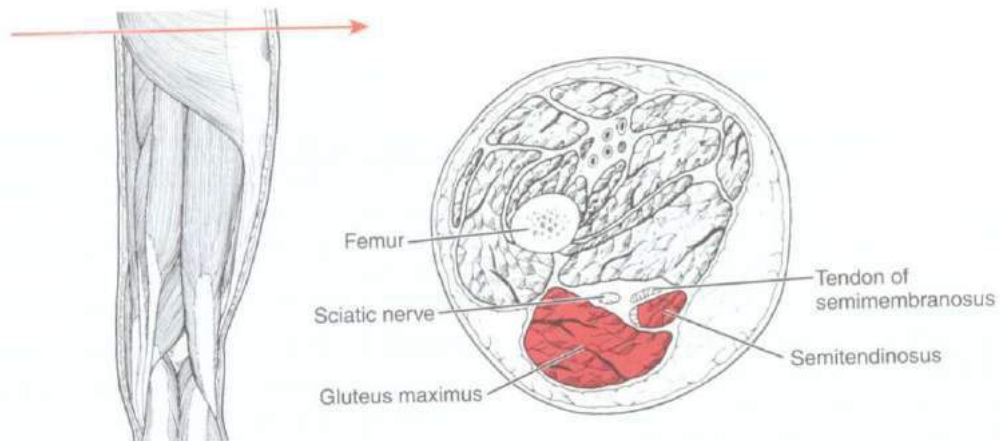


FIGURE 5-19

HIP EXTENSION

(*Gluteus maximus and Hamstrings*)

Range of Motion
0° to 20°
Some authors say as low as 0° to 5°.

Table 5-3 HIP EXTENSION

I.D.	Muscle	Origin	Insertion
182	Gluteus maximus	Ilium (posterior gluteal line) Iliac crest (posterior medial) Sacrum (dorsal surface of lower part) Coccyx (side) Sacrotuberous ligament Aponeurosis over gluteus medius	Femur (gluteal tuberosity) Iliotibial tract of fascia lata
193	Semitendinosus	Ischial tuberosity (upper area, inferomedial impression via tendon shared with biceps femoris) Aponeurosis (between the two muscles)	Tibia (proximal medial shaft) Pes anserina
194	Semimembranosus	Ischial tuberosity (superolateral impression)	Tibia (medial condyle, posterior aspect) Oblique popliteal ligament of knee joint Aponeurosis over distal muscle (variable)
192	Biceps femoris (long head)	Ischial tuberosity (inferomedial impression via tendon shared with semitendinosus) Sacrotuberous ligament	Fibula (head) Tibia (lateral condyle) Aponeurosis
Others			
181	Adductor magnus (inferior)		
183	Gluteus medius (posterior)		

HIP EXTENSION

(*Gluteus maximus* and *Hamstrings*)

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair) (Aggregate of All Hip Extensor Muscles)

Position of Patient: Prone. Arms may be overhead or abducted to hold sides of table. (Note: If there is a hip flexion contracture, immediately go to the test described for hip extension modified for hip flexion tightness [page 194].)

Position of Therapist: Standing at side of limb to be tested at level of pelvis. (Note: Figure 5-20 shows examiner on opposite side to avoid obscuring activity.)

The hand providing resistance is placed on the posterior leg just above the ankle. The opposite hand may be used to stabilize or maintain pelvis alignment in the area of the posterior superior spine of the ilium (see Figure 5-20). This is the most demanding test because the lever arm is longest.



FIGURE 5-20



FIGURE 5-21

Alternate Position: The hand that gives resistance is placed on the posterior thigh just above the knee (Figure 5-21). This is a less demanding test.

Test: Patient extends hip through entire available range of motion. Resistance is given straight downward toward the floor. (No resistance is given in the Grade 3 test.)

Instructions to Patient: "Lift your leg off the table as high as you can without bending your knee."

Grading

Grade 5 (Normal): Patient completes available range and holds test position against maximal resistance.

Grade 4 (Good): Patient completes available range against strong to moderate resistance.

Grade 3 (Fair): Completes range and holds the position without resistance (Figure 5-22).



FIGURE 5-22

HIP EXTENSION

(*Gluteus maximus* and *Hamstrings*)

Grade 2 (Poor)

Position of Patient: Side-lying with test limb uppermost. Knee straight and supported by examiner. Lowermost limb is flexed for stability.

Position of Therapist: Standing behind patient at thigh level. Therapist supports test limb just below the knee, cradling the leg (Figure 5-23). Opposite hand is placed over the pelvic crest to maintain pelvic and hip alignment.

Test: Patient extends hip through full range of motion.

Instructions to Patient: "Bring your leg back toward me. Keep your knee straight."

Grading

Grade 2 (Poor): Completes range of extension motion in side-lying position.



FIGURE 5-23

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Prone.

Position of Therapist: Standing on side to be tested at level of hips. Palpate hamstrings (deep into tissue with fingers) at the ischial tuberosity (Figure 5-24). Palpate the gluteus maximus with deep finger pressure over the center of the buttocks and also over the upper and lower fibers.

Test: Patient attempts to extend hip in prone position or tries to squeeze buttocks together.

Instructions to Patient: "Try to lift your leg from the table." OR "Squeeze your buttocks together."

Grading

Grade 1 (Trace): Palpable contraction of either hamstrings or gluteus maximus but no visible joint movement. Contraction of gluteus maximus will result in narrowing of the gluteal crease.

Grade 0 (Zero): No palpable contraction.



FIGURE 5-24

Helpful Hint

The therapist should be aware that the hip extensors are among the most powerful muscles in the body, and most therapists will not be able to "break" a Grade 5 hip extension. Care should be taken not to overgrade a Grade 4 muscle.

HIP EXTENSION

(*Gluteus maximus* and *Hamstrings*)

HIP EXTENSION TEST TO ISOLATE GLUTEUS MAXIMUS

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

Position of Patient: Prone with knee flexed to 90°. (Note: In the presence of a hip flexion contracture, do not use this test but refer to the test for hip extension modified for hip flexion tightness [see page 194].)

Position of Therapist: Standing at the side to be tested at the level of the pelvis. (Note: The therapist in the illustration is shown on the wrong side to avoid obscuring test positions.) Hand for resistance is contoured over the posterior thigh just above the knee. The opposite hand may stabilize or maintain the alignment of the pelvis (Figure 5-25).

For the Grade 3 test, the knee may need to be supported in flexion (by cradling at the ankle).

Test: Patient extends hip through available range, maintaining knee flexion. Resistance is given in a new straight downward direction (toward floor).

Instructions to Patient: "Lift your foot to the ceiling." OR "Lift your leg, keeping your knee bent."

Grading

Grade 5 (Normal): Completes available range of motion and holds end position against maximal resistance.

Grade 4 (Good): Limb position can be held against heavy to moderate resistance.

Grade 3 (Fair): Completes available range of motion and holds end position but takes no resistance (Figure 5-26).



FIGURE 5-25



FIGURE 5-26

HIP EXTENSION

(*Gluteus maximus and Hamstrings*)

Grade 2 (Poor)

Position of Patient: Side-lying with test limb uppermost. Knee is flexed and supported by examiner. Lowermost hip and knee should be flexed for stability (Figure 5-27).

Position of Therapist: Standing behind the patient at thigh level. Therapist cradles uppermost leg with forearm and hand under the flexed knee. Other hand is on pelvis to maintain postural alignment.

Test: Patient extends hip with supported knee flexed.

Instructions to Patient: "Move your leg back toward me."

Grading

Grade 2 (Poor): Completes available range of motion in side-lying position.

Grade 1 (Trace) and Grade 0 (Zero)

This test is identical to the Grade 1 and 0 tests for aggregate hip extension (see Figure 5-24). The patient is prone and attempts to extend the hip or squeeze the buttocks together while the therapist palpates the gluteus maximus.

Helpful Hint

Hip extension range is less when the knee is flexed because of tension in the rectus femoris. A diminished range may be observed, therefore, in tests that isolate the gluteus maximus.



FIGURE 5-27

HIP EXTENSION

(Gluteus maximus and Hamstrings)

HIP EXTENSION TESTS MODIFIED FOR HIP FLEXION TIGHTNESS

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

Position of Patient: Patient stands with hips flexed and places torso prone on the table (Figure 5-28). The arms are used to "hug" the table for support. The knee of the nontest limb should be flexed to allow the test limb to rest on the floor at the start of the test.

Position of Therapist: Standing at side of limb to be tested. (Note: Figure 5-28 shows the examiner on the opposite side to avoid obscuring test positions.) The hand used to provide resistance is contoured over the posterior thigh just above the knee. The opposite hand stabilizes the pelvis laterally to maintain hip and pelvis posture (see Figure 5-25).

Test: Patient extends hip through available range, but hip extension range is less when the knee is flexed (see page 193). Keeping the knee in extension will test all hip extensor muscles; with the knee flexed, the isolated gluteus maximus will be evaluated.

Resistance is applied downward (toward floor) and forward.

Instructions to Patient: "Lift your foot off the floor as high as you can."

Grading

Grade 5 (Normal): Completes available range of hip extension. Holds end position against maximal resistance.

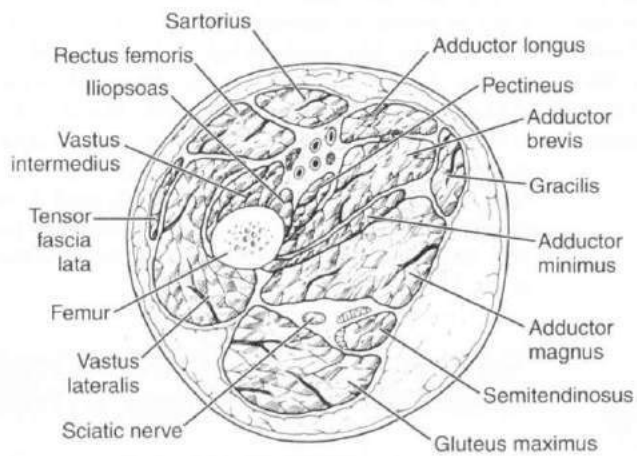
Grade 4 (Good): Completes available range of hip extension. (Note: Because of the intrinsic strength of these muscles, weakened extensor muscles frequently are overgraded.) Limb position can be held against heavy to moderate resistance.

Grade 3 (Fair): Completes available range and holds end position without resistance.

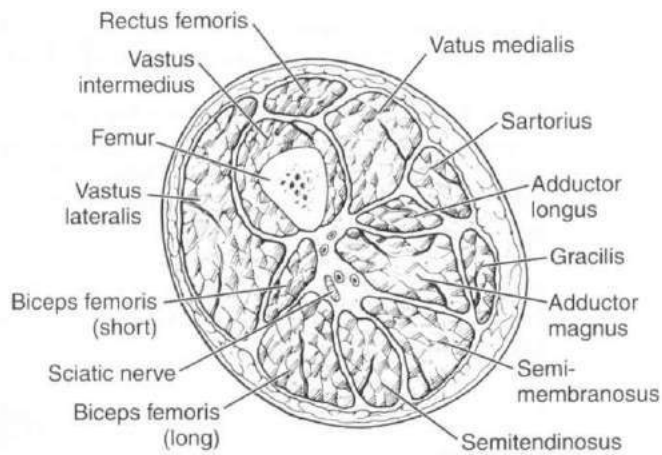


FIGURE 5-28

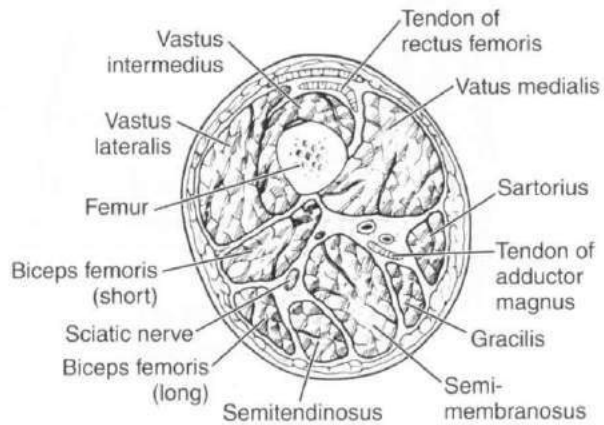
CROSS SECTIONS OF THE THIGH



HIGH
JUST BELOW LESSER
TROCHANTER



MID
JUST ABOVE START OF TENDON
OF RECTUS FEMORIS (ABOUT
7-8" ABOVE CENTER OF KNEE)



LOW
THROUGH TENDON OF
RECTUS FEMORIS (ABOUT 4"
ABOVE CENTER OF KNEE)

PLATE 6

HIP EXTENSION

(*Gluteus maximus* and *Hamstrings*)

Grade 2 (Poor), Grade 1 (Trace), and Grade 0 (Zero)

Do not test the patient with hip flexion contractures and weak extensors (less than Grade 3) in the standing position. Position the patient side-lying on the table. Conduct the test as described for the aggregate of extensor muscles (see page 190) or for the isolated *gluteus maximus* (see page 192).

SUPINE HIP EXTENSION TEST

When for any reason a patient cannot lie prone and hip extension is expected to be greater than Grade 2 (Poor), use the supine hip extension test.² The test Grades 5, 4, 3, and 2 can be assigned. Although the traditional test for hip extension (Grade 2, Poor) is done with the patient side-lying, this supine hip extension test may be substituted to eliminate change of patient position. Grades 5, 4, 3, and 2 have been validated in this position (n = 44 subjects) by measuring maximum hip extension torques recorded via a strain gauge dynamometer.

Grade 5 (Normal), Grade 4 (Good), Grade 3 (Fair), and Grade 2 (Poor)

Position of Patient: Supine, heels off end of table. Arms folded across chest or abdomen. (Do not allow patient to push into table with upper extremities.)

Position of Therapist: Standing at end of table. Both hands are cupped under the heel (Figure 5-29).

Test: Patient presses limb into table, attempting to maintain full extension as the examiner raises the limb 24 to 26 inches from the table. (The opposite limb almost always rises involuntarily and should *not* be considered an aberrant test.)

Instructions to Patient: "Don't let me lift your leg from the table. Keep your hip locked tight and your whole body rigid as a board."

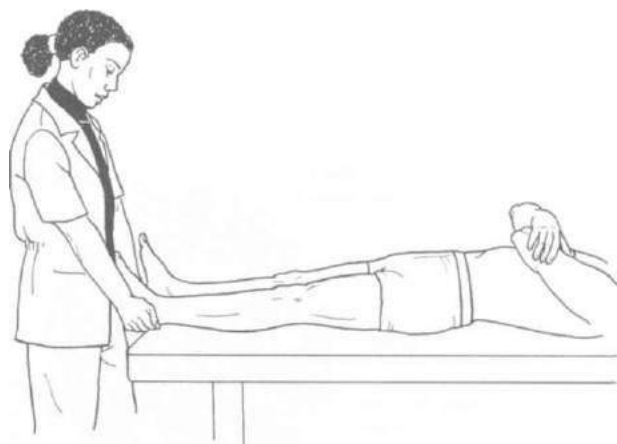


FIGURE 5-29

HIP EXTENSION

(*Gluteus maximus* and *Hamstrings*)

Grade 5 (Normal), Grade 4 (Good), Grade 3 (Fair), and Grade 2 (Poor) Continued

Grading

Grade 5 (Normal): Hip locks in neutral (full extension) throughout this test. Pelvis and back elevate as one locked unit as the examiner raises the limb (Figure 5-30).

Grade 4 (Good): Hip flexes before pelvis and back elevate as the limb is raised by the examiner. Hip flexion should not exceed 30° (Figure 5-31).

Grade 3 (Fair): Full elevation of the limb to the end of straight-leg raising range with little or no elevation of the pelvis. Examiner feels strong resistance throughout the test (Figure 5-32).

Grade 2 (Poor): Hip flexes fully with only minimal resistance felt (examiner should check to ensure that the resistance felt exceeds the weight of the limb) (see Figure 5-32).

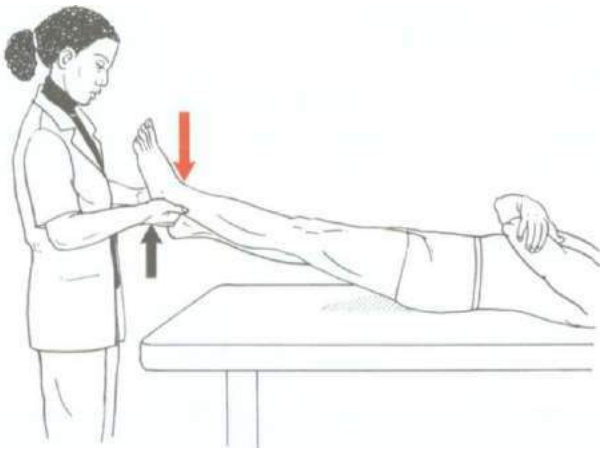


FIGURE 5-30

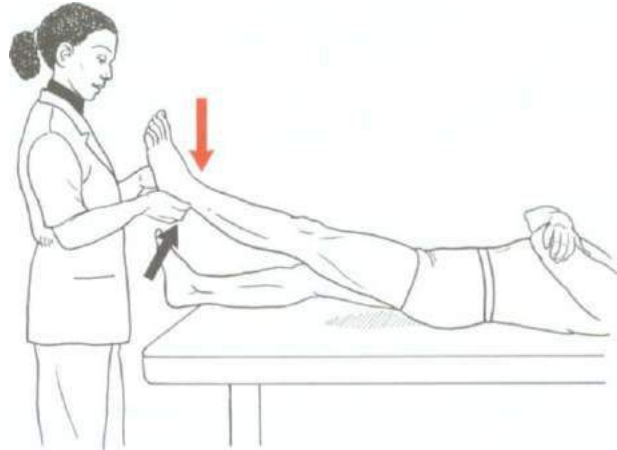


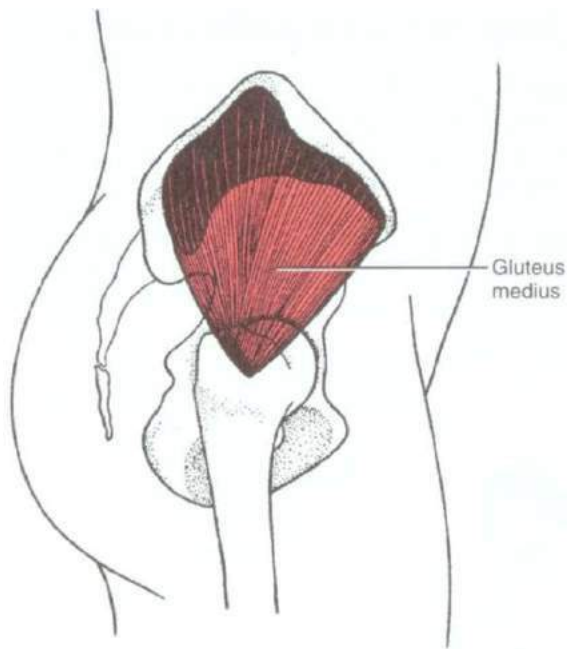
FIGURE 5-32



FIGURE 5-31

HIP ABDUCTION

(*Gluteus medius* and *Gluteus minimus*)



LATERAL

FIGURE 5-33

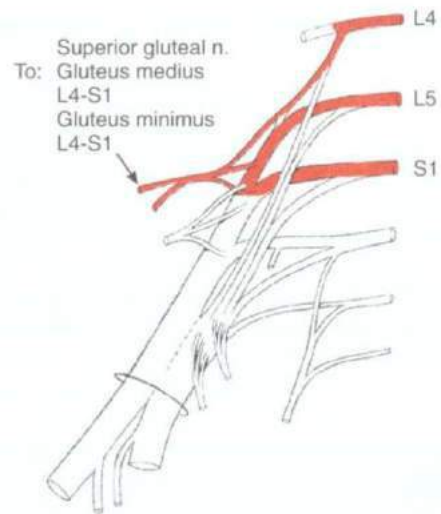


FIGURE 5-34

Range of Motion
0° to 45°

Table 5-4 HIP ABDUCTION

I.D.	Muscle	Origin	Insertion
183	Gluteus medius	Ilium (outer surface between crest and anterior and posterior gluteal lines) Fascia (over upper part)	Femur (greater trochanter, lateral aspect)
184	Gluteus minimus	Ilium (outer surface between anterior and inferior gluteal lines) Greater sciatic notch	Femur (greater trochanter, anterolateral ridge) Fibrous capsule of hip joint
Others			
182	Gluteus maximus (upper fibers)		
185	Tensor fasciae latae		
187	Obturator internus (thigh flexed)		
189	Gemellus superior (thigh flexed)		
190	Gemellus inferior (thigh flexed)		
195	Sartorius		

HIP ABDUCTION

(*Gluteus medius* and *Gluteus minimus*)

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

Position of Patient: Side-lying with test leg uppermost. Start test with the limb slightly extended beyond the midline and the pelvis rotated slightly forward. Lowermost leg is flexed for stability.

Position of Therapist: Standing behind patient. Hand used to give resistance is contoured across the lateral surface of the knee. The hand used to palpate the gluteus medius is just proximal to the greater trochanter of the femur (Figure 5-35). (No resistance is used in a Grade 3 test.)

Alternatively, resistance may be applied at the ankle, which gives a longer lever arm and requires greater strength on the part of the patient to achieve a grade of 5 or 4. The examiner is reminded always to use the same lever in a given test sequence and in subsequent comparison tests.

To distinguish a Grade 5 from a Grade 4 result, first apply resistance at the ankle and then at the knee.

Test: Patient abducts hip through the complete available range of motion without flexing the hip or rotating it in either direction. Resistance is given in a straight downward direction.

Instructions to Patient: "Lift your leg up in the air. Hold it. Don't let me push it down."

Grading

Grade 5 (Normal): Completes available range and holds end position against maximal resistance.

Grade 4 (Good): Completes available range and holds against heavy to moderate resistance.

Grade 3 (Fair): Completes range of motion and holds end position without resistance (Figure 5-36).



FIGURE 5-35



FIGURE 5-36

HIP ABDUCTION

(Gluteus medius and Gluteus minimus)

Grade 2 (Poor)

Position of Patient: Supine.

Position of Therapist: Standing on side of limb being tested. One hand supports and lifts the limb by holding it under the ankle to raise limb just enough to decrease friction. This hand offers no resistance, nor should it be used to offer assistance to the movement. On some smooth surfaces, such support may not be necessary (Figure 5-37).

The other hand palpates the gluteus medius just proximal to the greater trochanter of the femur.

Test: Patient abducts hip through available range.

Instructions to Patient: "Bring your leg out to the side. Keep your kneecap pointing to the ceiling."

Grading

Grade 2 (Poor): Completes range of motion supine with no resistance and minimal to zero friction.



FIGURE 5-37

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Supine.

Position of Therapist: Standing at side of limb being tested at level of thigh. (Note: Figure 5-38 shows therapist on opposite side to avoid obscuring test positions.) One hand supports the limb under the ankle just above the malleoli. The hand should provide neither resistance nor assistance to movement (Figure 5-38). Palpate the gluteus medius on the lateral aspect of the hip just above the greater trochanter.

Test: Patient attempts to abduct hip.

Instructions to Patient: "Try to bring your leg out to the side."

Grading

Grade 1 (Trace): Palpable contraction of gluteus medius but no movement of the part.

Grade 0 (Zero): No palpable contraction.



FIGURE 5-38

HIP ABDUCTION

(*Gluteus medius* and *Gluteus minimus*)

Substitutions

- Hip-hike substitution: Patient may "hike hip" by approximating pelvis to thorax using the lateral trunk muscles, which moves the limb through partial abduction range (Figure 5-39). This movement may be detected by observing the lateral trunk and hip (move clothing aside) and palpating the gluteus medius above the trochanter.
- External rotation and flexion substitution: The patient may try to externally rotate during the motion of abduction (Figure 5-40). This could allow the oblique action of the hip flexors to substitute for the gluteus medius.
- Tensor fasciae latae substitution: If the test is allowed to begin with active hip flexion or with the hip positioned in flexion, there is an opportunity for the tensor fasciae latae to abduct the hip.

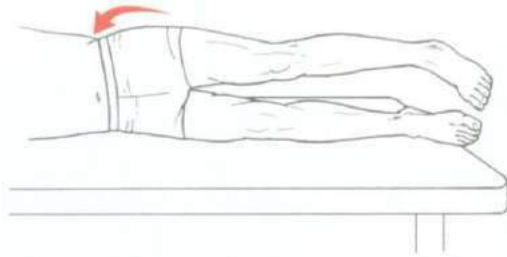


FIGURE 5-39

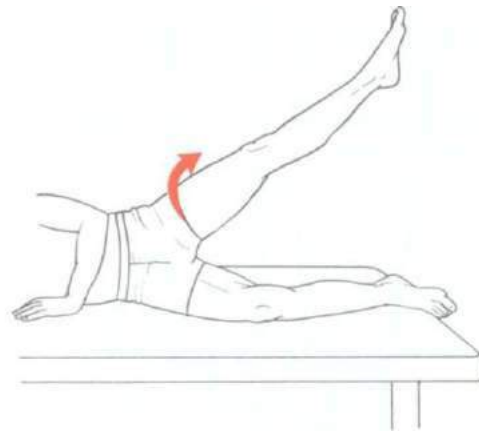


FIGURE 5-40

Helpful Hints

- The examiner should not be able to "break" a Grade 5 muscle, and most therapists will not be able to "break" a Grade 4 muscle. A grade of 4 often masks significant weakness because of the intrinsic great strength of these muscles. Giving resistance at the ankle rather than at the knee assists in overcoming this problem.
- Do not attempt to palpate contractile activity of muscle through clothing. (This is one of the cardinal principles of manual muscle testing.)
- When the patient is supine, the weight of the opposite limb stabilizes the pelvis. It is not necessary, therefore, to use a hand to manually stabilize the contralateral limb.

HIP ABDUCTION FROM FLEXED POSITION

(*Tensor fasciae latae*)



FIGURE 5-41

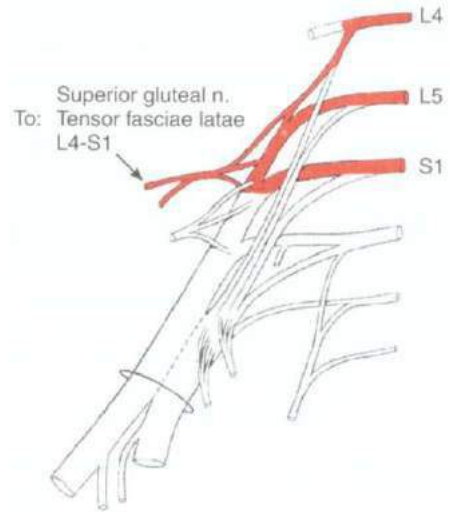


FIGURE 5-42

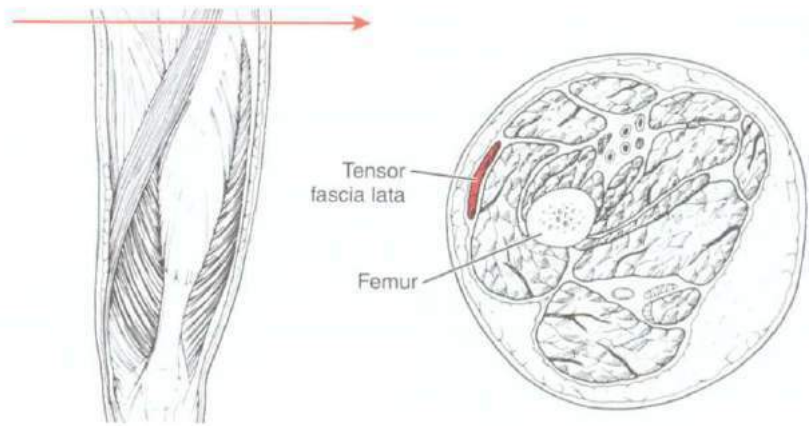


FIGURE 5-43

Range of Motion
 Two-joint muscle. No specific range of motion can be assigned solely to the tensor.

Table 5-5 HIP ABDUCTION FROM FLEXION

I.D.	Muscle	Origin	Insertion
185	Tensor fasciae latae	Iliac crest (outer lip) Fasciae latae (deep) Anterior superior iliac spine (lateral surface)	Iliotibial tract (between its two layers, ending 1/3 of the way down)
Others			
183	Gluteus medius		
184	Gluteus minimus		

HIP ABDUCTION FROM FLEXED POSITION

(*Tensor fasciae latae*)

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

Position of Patient: Side-lying. Uppermost limb (test limb) is flexed to 45° and lies across the lowermost limb with the foot resting on the table (Figure 5-44).

Position of Therapist: Standing behind patient at level of pelvis. Hand for resistance is placed on lateral surface of the thigh just above the knee. Hand providing stabilization is placed on the crest of the ilium (Figure 5-45).

Test: Patient abducts hip through approximately 30° of motion. Resistance is given downward (toward floor) from the lateral surface of the distal femur. No resistance is given for the Grade 3 test.

Instructions to Patient: "Lift your leg and hold it. Don't let me push it down."

Grading

Grade 5 (Normal): Completes available range; holds end position against maximal resistance.

Grade 4 (Good): Completes available range and holds against strong to moderate resistance.

Grade 3 (Fair): Completes movement; holds end position but takes no resistance (Figure 5-46).



FIGURE 5-44

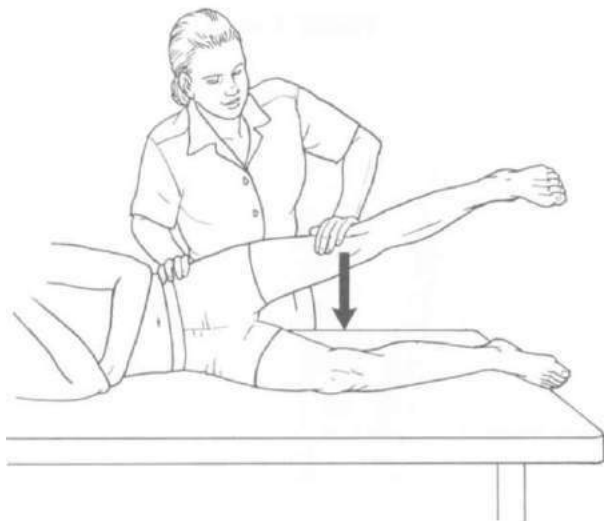


FIGURE 5-45

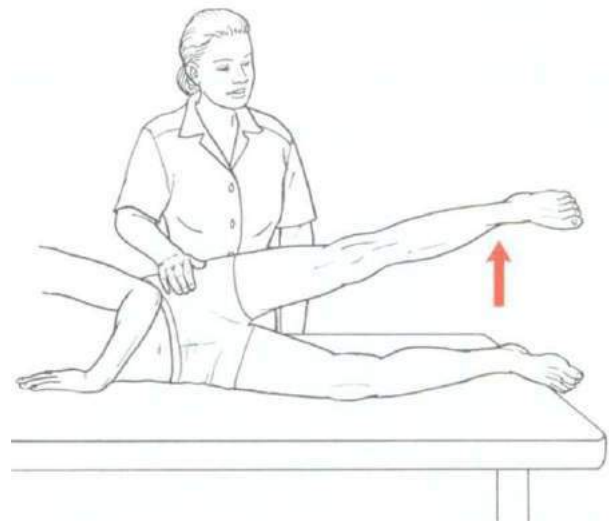


FIGURE 5-46

HIP ABDUCTION FROM FLEXED POSITION

(*Tensor fasciae latae*)

Grade 2 (Poor)

Position of Patient: Patient is in long-sitting position, supporting trunk with hands placed behind body on table. Trunk may lean backward up to 45° from vertical (Figure 5-47).

Position of Therapist: Standing at side of limb to be tested. (Note: Figure 5-47 deliberately shows therapist on wrong side to avoid obscuring test positions.) One hand supports the limb under the ankle; this hand will be used to reduce friction with the surface as the patient moves but should neither resist nor assist motion.

The other hand palpates the tensor fasciae latae on the proximal anterolateral thigh where it inserts into the iliotibial band.

Test: Patient abducts hip through 30° of range.

Instructions to Patient: "Bring your leg out to the side."

Grading

Grade 2 (Poor): Completes hip abduction motion to 30°.

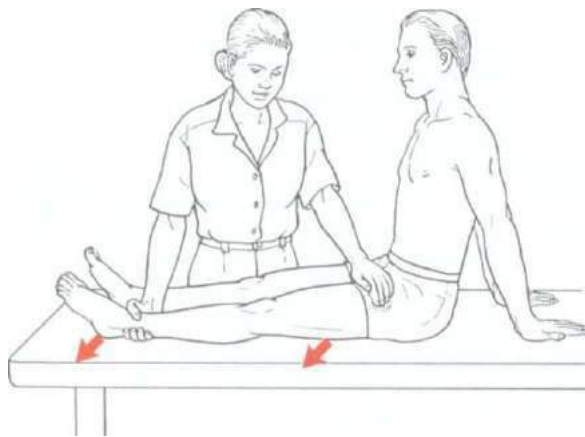


FIGURE 5-47

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Long sitting.

Position of Therapist: One hand palpates the insertion of the tensor at the lateral aspect of the knee. The other hand palpates the tensor on the anterolateral thigh (Figure 5-48).

Test: Patient attempts to abduct hip.

Instructions to Patient: "Try to move your leg out to the side."

Grading

Grade 1 (Trace): Palpable contraction of tensor fibers but no limb movement.

Grade 0 (Zero): No palpable contractile activity.

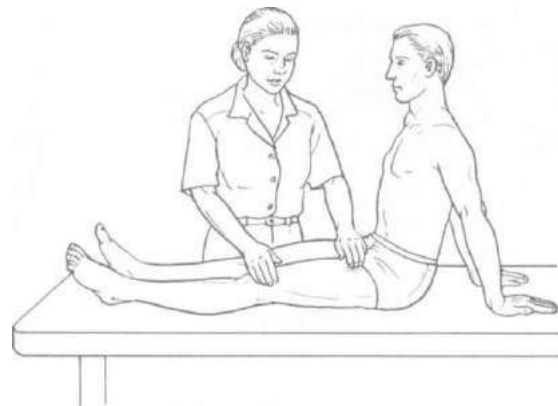


FIGURE 5-48

HIP ADDUCTION

(Adductors magnus, brevis, and longus; Pectineus and Gracilis)

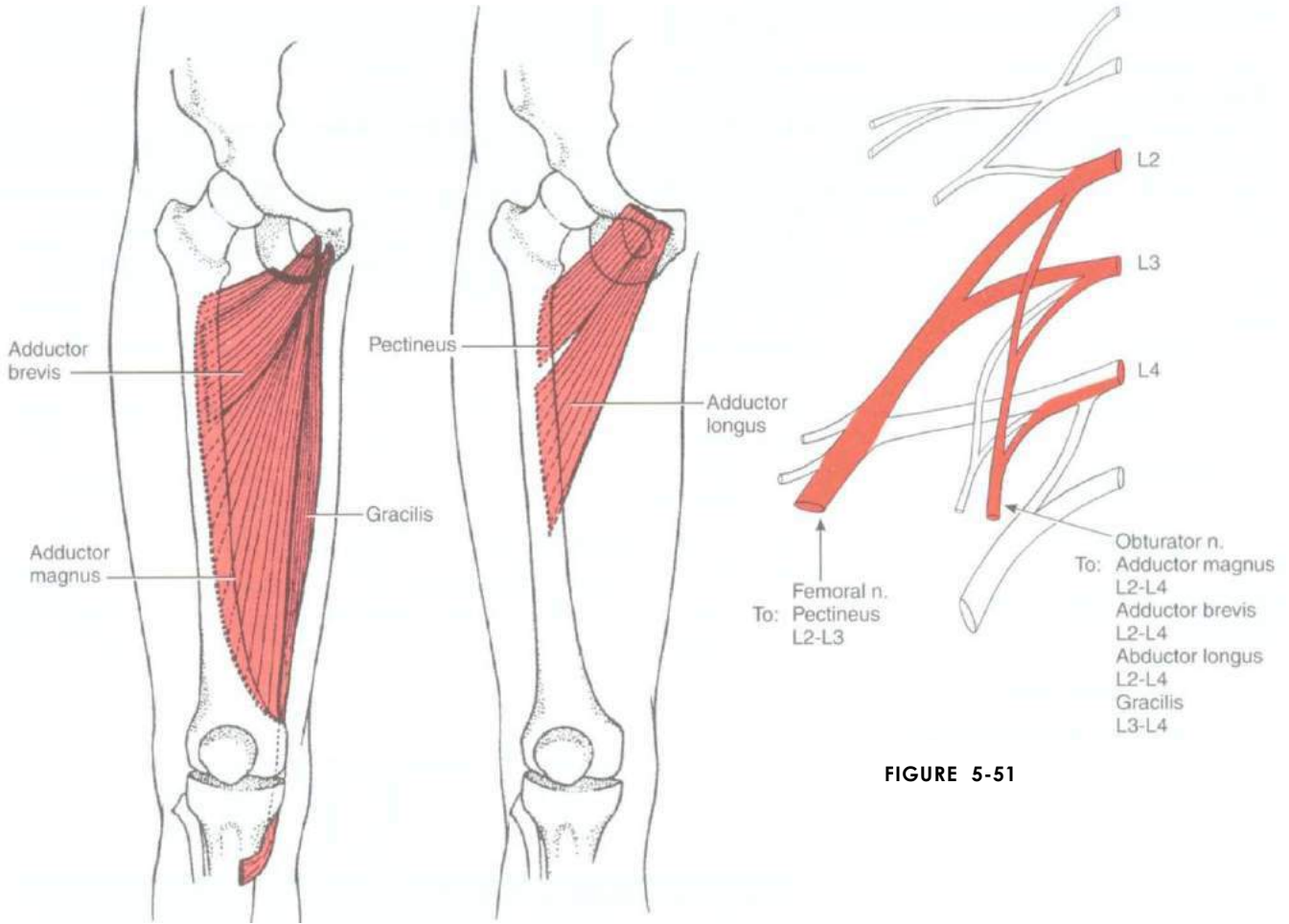
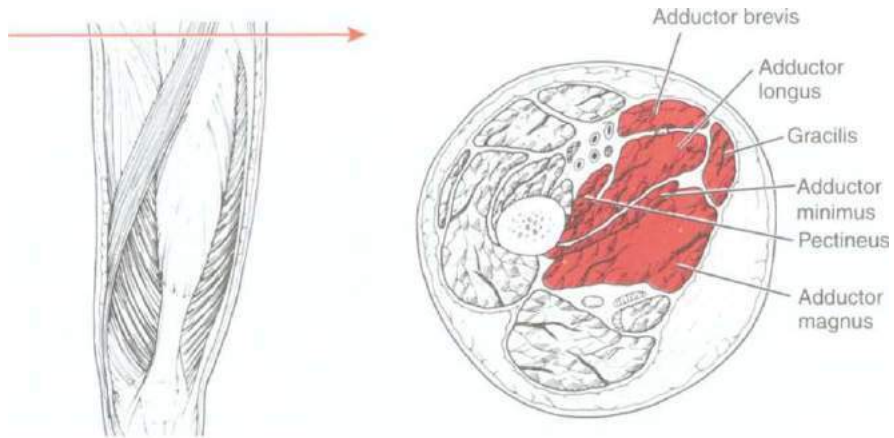


FIGURE 5-51

ANTERIOR

FIGURE 5-49

FIGURE 5-50



HIP ADDUCTION

(*Adductors magnus, brevis, and longus; Pectineus and Gracilis*)

Range of Motion
0° to 15°-20°

Table 5-6 HIP ADDUCTION

I.D.	Muscle	Origin	Insertion
181	Adductor magnus	Ischial tuberosity (inferolateral) Ischium (inferior ramus) Pubis (inferior ramus) Fibers from pubic ramus to femur (gluteal tuberosity), often named the <i>adductor minimus</i>	Femur (linea aspera via aponeurosis; medial supracondylar line; and adductor tubercle on medial condyle)
180	Adductor brevis	Pubis (body and inferior ramus)	Femur (via aponeurosis to linea aspera)
179	Adductor longus	Pubis (anterior aspect between crest and symphysis)	Femur (linea aspera via aponeurosis)
177	Pectineus	Pubic pectin Fascia of Pectineus	Femur (on a line from lesser trochanter to linea aspera)
178	Gracilis	Pubis (body and inferior ramus) Ischial ramus	Tibia (medial shaft distal to condyle) Pes anserina Deep fascia of leg
Others			
188	Obturator externus		
182	Gluteus maximus (lower)		

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

Position of Patient: Side-lying with test limb (lowermost) resting on the table. Uppermost limb (nontest limb) in 25° of abduction, supported by the examiner. The therapist cradles the leg with the forearm, the hand supporting the limb on the medial surface of the knee (Figure 5-53).

Position of Therapist: Standing behind patient at knee level. The hand giving resistance to the test limb (lowermost limb) is placed on the medial surface of the distal femur, just proximal to the knee joint. Resistance is directed straight downward toward the table (Figure 5-54).



FIGURE 5-53

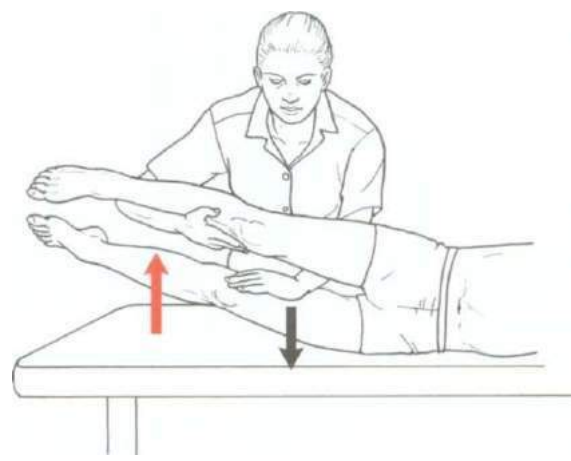


FIGURE 5-54

HIP ADDUCTION

(*Adductors magnus, brevis, and longus; Pectineus and Gracilis*)

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair) Continued

Test: Patient adducts hip until the lower limb contacts the upper one.

Instructions to Patient: "Lift your bottom leg up to your top one. Hold it. Don't let me push it down."

For Grade 3: "Lift your bottom leg up to your top one. Don't let it drop!"

Grading

Grade 5 (Normal): Completes full range; holds end position against maximal resistance.

Grade 4 (Good): Completes full movement but tolerates strong to moderate resistance.

Grade 3 (Fair): Completes full movement; holds end position but takes no resistance (Figure 5-55).



FIGURE 5-55

Grade 2 (Poor)

Position of Patient: Supine. The nontest limb is positioned in some abduction to prevent interference with motion of the test limb.

Position of Therapist: Standing at side of test limb at knee level. One hand supports the ankle and elevates it slightly from the table surface to decrease friction as the limb moves across (Figure 5-56). The examiner uses this hand neither to assist nor to resist motion. The opposite hand palpates the adductor mass on the inner aspect of the proximal thigh.

Test: Patient adducts hip without rotation.

Instructions to Patient: "Bring your leg in toward the other one."

Grading

Grade 2 (Poor): Patient adducts limb through full range.

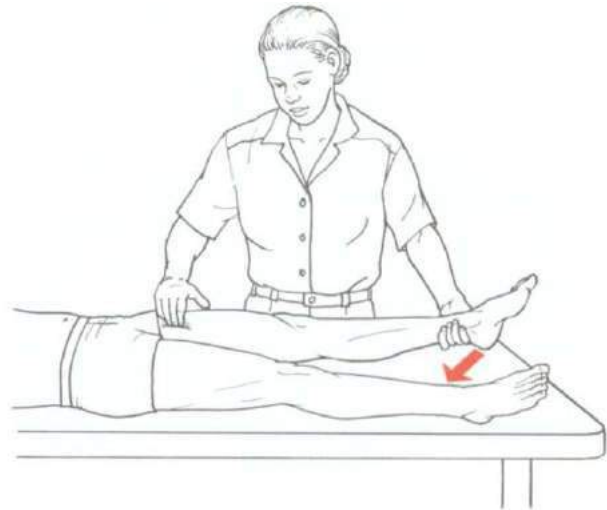


FIGURE 5-56

HIP ADDUCTION

(Adductors magnus, brevis, and longus; Pectineus and Gracilis)

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Supine.

Position of Therapist: Standing on side of test limb. One hand supports the limb under the ankle. The other hand palpates the adductor mass on the proximal medial thigh (Figure 5-57).

Test: Patient attempts to adduct hip.

Instructions to Patient: "Try to bring your leg in."

Grading

Grade 1 (Trace): Palpable contraction, no limb movement.

Grade 0 (Zero): No palpable contraction.



FIGURE 5-57

Substitutions

- **Hip flexor substitution:** The patient may attempt to substitute the hip flexors for the adductors by internally rotating the hip using a posterior pelvic tilt (Figure 5-58). The patient will appear to be trying to turn supine from side-lying. Maintenance of true side-lying is necessary for an accurate test.
- **Hamstring substitution:** The patient may attempt to substitute the hamstrings for the adductors by externally rotating the test hip with an anterior pelvic tilt. The patient will appear to move toward prone. Again, true side-lying is important.



FIGURE 5-58

Helpful Hint

In the supine test position for Grades 2, 1, and 0, the weight of the opposite limb stabilizes the pelvis, so there is no need for manual stabilization of the nontest hip.

HIP EXTERNAL ROTATION

(*Obturator internus and externus, Gemellae superior and inferior, Piriformis, Quadratus femoris, Gluteus maximus [posterior]*)

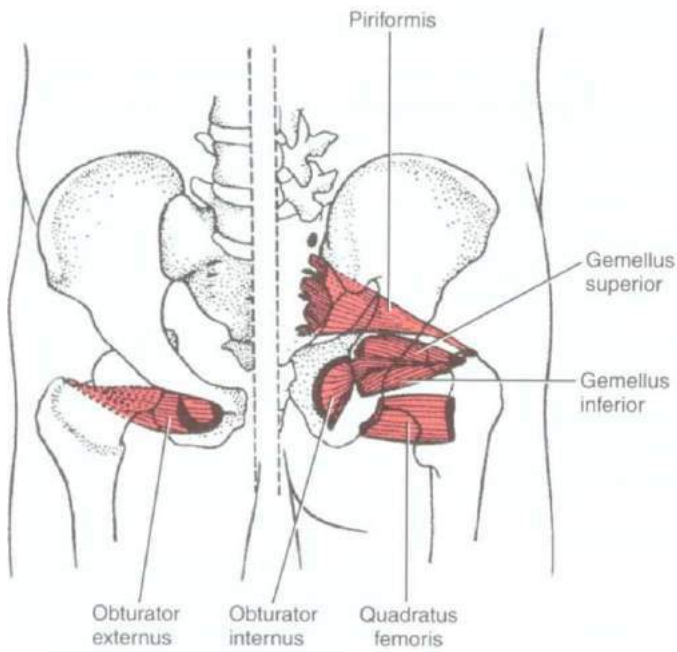


FIGURE 5-59

FIGURE 5-60

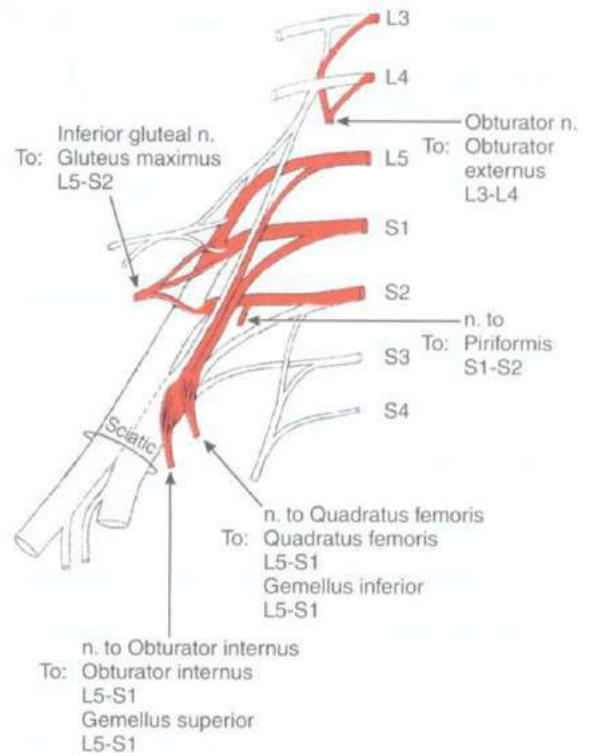


FIGURE 5-61

HIP EXTERNAL ROTATION

(*Obturator internus and externus, Gemelli superior and inferior, Piriformis, Quadratus femoris, Gluteus maximus [posterior]*)

Range of Motion

0° to 45°

Table 5-7 HIP EXTERNAL ROTATION

I.D.	Muscle	Origin	Insertion
188	Obturator externus	Obturator membrane (external surface) Ischium (ramus) Pubis (inferior ramus) Pelvis (lesser pelvic cavity, inner surface)	Femur (trochanteric fossa)
187	Obturator internus	Pubis (inferior ramus) Ischium (ramus) Obturator fascia Obturator foramen (margin) Obturator membrane Upper brim of greater sciatic foramen	Femur (greater trochanter, medial) Tendon fuses with gemelli
191	Quadratus femoris (may be absent)	Ischial tuberosity (external aspect)	Femur (quadrate tubercle on trochanteric crest)
186	Piriformis	Sacrum (anterior surface) Ilium (gluteal surface near posterior inferior iliac spine) Sacrotuberous ligament Capsule of sacroiliac joint	Femur (greater trochanter, medial side)
189	Gemellus superior (may be absent)	Ischium (spine, dorsal surface)	Femur (greater trochanter, medial surface) Blends with tendon of obturator internus)
190	Gemellus inferior	Ischial tuberosity (upper part)	Femur (greater trochanter, medial surface) Blends with tendon of obturator internus
182	Gluteus maximus	Ilium (posterior gluteal line and crest) Sacrum (dorsal and lower aspects) Coccyx (side) Sacrotuberous ligament Aponeurosis over gluteus medius	Femur (gluteal tuberosity) Iliotibial tract of fascia lata
Others			
195	Sartorius		
192	Biceps femoris (long head)		
183	Gluteus medius (posterior)		
174	Psoas major		
181	Adductor magnus (position-dependent)		
179	Adductor longus		
202	Popliteus (tibia fixed)		

HIP EXTERNAL ROTATION

(*Obturator internus and externus, Gemelli superior and inferior, Piriformis, Quadratus femoris, Gluteus maximus [posterior]*)

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

Position of Patient: Short sitting. (Trunk may be supported by placing hands flat or fisted at sides [Figure 5-62].)

Position of Therapist: Sits on a low stool or kneels beside limb to be tested. The hand that gives resistance grasps the ankle just above the malleolus. Resistance is applied as a laterally directed force at the ankle (Figure 5-62).

The other hand, which will offer counterpressure, is contoured over the lateral aspect of the distal thigh just above the knee. Resistance is given as a medially directed force at the knee. The two forces are applied in counterdirections for this rotary motion (Figure 5-62).

Test: Patient externally rotates the hip. This is a test where it is preferable for the examiner to place the limb in the test end position rather than to ask the patient to perform the movement.

Instructions to Patient: "Don't let me turn your leg out."

Grading

Grade 5 (Normal): Holds at end of range against maximal resistance.

Grade 4 (Good): Holds at end of range against strong to moderate resistance.

Grade 3 (Fair): Holds end position but tolerates no resistance (Figure 5-63).



FIGURE 5-62



FIGURE 5-63

HIP EXTERNAL ROTATION

(*Obturator internus and externus, Gemelli superior and inferior, Piriformis, Quadratus femoris, Gluteus maximus [posterior]*)

Grade 2 (Poor)

Position of Patient: Supine. Test limb is in internal rotation.

Position of Therapist: Standing at side of limb to be tested.

Test: Patient externally rotates hip in available range of motion (Figure 5-64). One hand may be used to maintain pelvic alignment at lateral hip.

Instructions to Patient: "Roll your leg out."

Grading

Grade 2 (Poor): Completes external rotation range of motion. As the hip rolls past the midline, minimal resistance can be offered to offset the assistance of gravity.

Alternate Test for Grade 2: With the patient short sitting, the therapist places the test limb in maximal internal rotation. The patient then is instructed to return the limb actively to the midline (neutral) position against slight resistance. Care needs to be taken to ensure that gravity is not the predominant force. If this motion is performed satisfactorily, the test is assessed as a Grade 2.



FIGURE 5-64

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Supine with test limb placed in internal rotation.

Position of Therapist: Standing at side of limb to be tested.

Test: Patient attempts to externally rotate hip.

Instructions to Patient: "Try to roll your leg out."

Grading

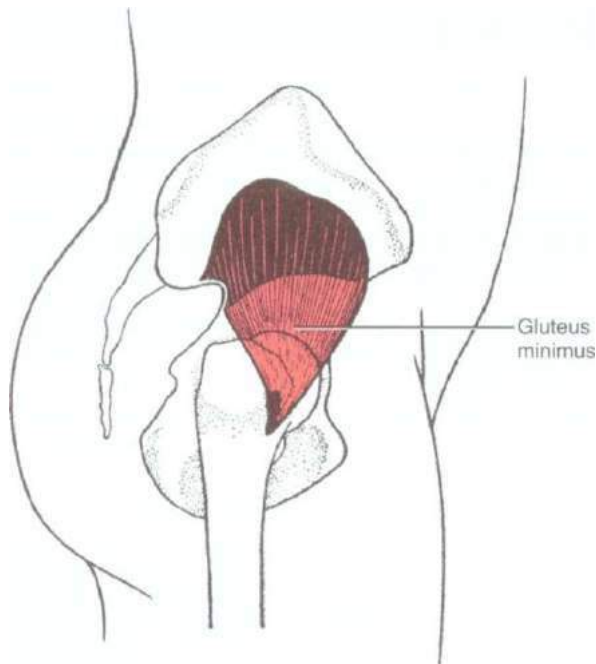
Grade 1 (Trace) and Grade 0 (Zero): The external rotator muscles, except for the gluteus maximus, are not palpable. If there is any discernible movement (contractile activity), a grade of 1 should be given; otherwise, a grade of 0 is assigned on the principle that whenever uncertainty exists, the lesser grade should be awarded.

Helpful Hints

- There is wide variation in the amount of hip external rotation range of motion that can be considered normal. It is imperative, therefore, that a patient's accurate range (in each test position) be known before manual muscle testing takes place.
- There is greater range of rotation at the hip when the hip is flexed than when it is extended, probably secondary to laxity of joint structures.
- In short sitting tests, the patient should not be allowed to use the following motions, lest they add visual distortion and contaminate the test results:
 - a. Lift the contralateral buttock off the table or lean in any direction to lift the pelvis
 - b. Increase flexion of the test knee
 - c. Abduct the test hip

HIP INTERNAL ROTATION

(*Glutei minimus and medius; Tensor fasciae latae*)



LATERAL

FIGURE 5-65

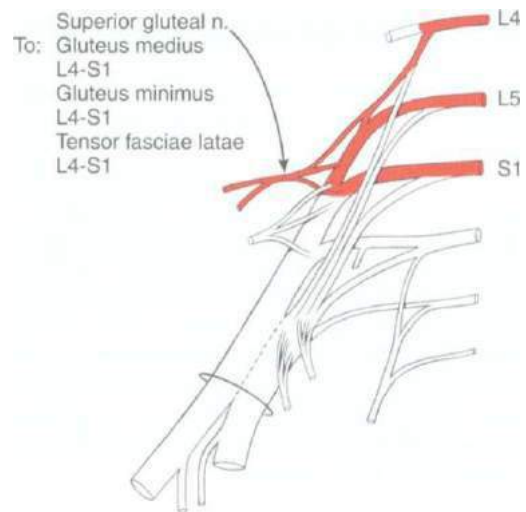


FIGURE 5-66

Range of Motion	
0° to 45°	

Table 5-8 HIP INTERNAL ROTATION

I.D.	Muscle	Origin	Insertion
184	Gluteus minimus (anterior fibers)	Ilium (outer surface between anterior and inferior gluteal lines) Greater sciatic notch	Femur (greater trochanter, anterior aspect) Fibrous capsule of hip joint
185	Tensor fasciae latae	Iliac crest (outer lip) Fascia lata (deep) Anterior superior iliac spine (lateral surface)	Iliotibial tract (between its two layers ending 1/3 down femur)
183	Gluteus medius (anterior fibers)	Ilium (outer surface between crest and posterior gluteal line) Gluteal fascia	Femur (greater trochanter, lateral surface)
Others			
193	Semitendinosus		
194	Semimembranosus		
181	Adductor magnus (position-dependent)		
179	Adductor longus (position-dependent)		

HIP INTERNAL ROTATION

(*Glutei minimus and medius; Tensor fasciae latae*)

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

Position of Patient: Short sitting. Arms may be used for trunk support at sides or may be crossed over chest.

Position of Therapist: Sitting or kneeling in front of patient. One hand grasps the lateral surface of the ankle just above the malleolus (Figure 5-67). Resistance is given (Grades 5 and 4 only) as a medially directed force at the ankle.

The opposite hand, which offers counterpressure, is contoured over the medial surface of the distal thigh just above the knee. Resistance is applied as a laterally directed force at the knee.

Test: The limb should be placed in the end position of full internal rotation by the examiner for best test results (Figure 5-67).

Grading

Grade 5 (Normal): Holds end position against maximal resistance.

Grade 4 (Good): Holds end position against strong to moderate resistance.

Grade 3 (Fair): Holds end position but takes no resistance (Figure 5-68).



FIGURE 5-67

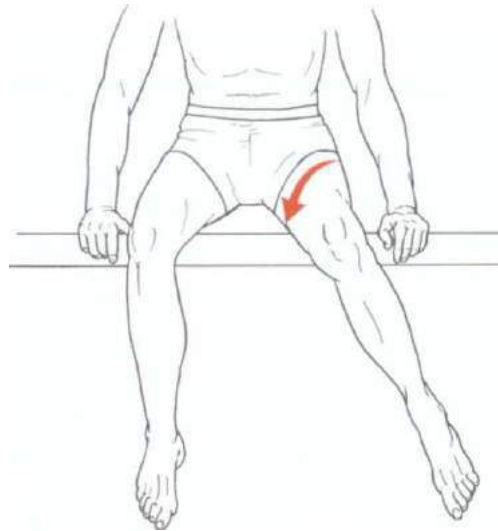


FIGURE 5-68

HIP INTERNAL ROTATION

(*Glutei minimus and medius; Tensor fasciae latae*)

Grade 2 (Poor)

Position of Patient: Supine. Test limb in partial external rotation.

Position of Therapist: Standing next to test leg. Palpate the gluteus medius proximal to the greater trochanter and the tensor fasciae latae (Figure 5-69) over the anterolateral hip below the ASIS.

Test: Patient internally rotates hip through available range.

Instructions to Patient: "Roll your leg in toward the other one."

Grading

Grade 2 (Poor): Completes the range of motion. As the hip rolls inward past the midline, minimal resistance can be offered to offset the assistance of gravity.

Alternate Test for Grade 2: With patient short sitting, the examiner places the test limb in maximal external rotation. The patient then is instructed to return the limb actively to the midline (neutral) position against slight resistance. Care needs to be taken to ensure that gravity is not the predominant force. If this motion is performed satisfactorily, the test may be assessed a Grade 2.

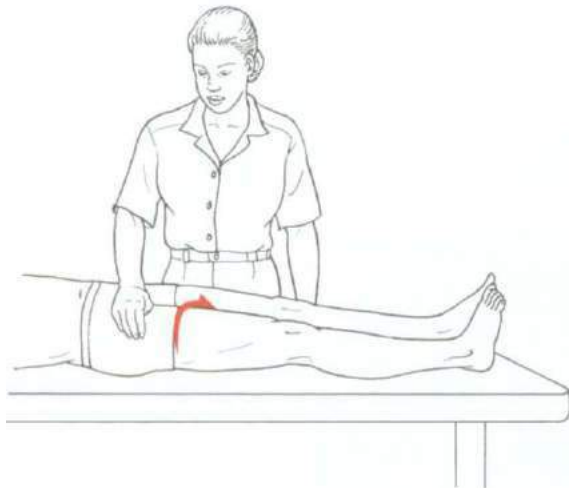


FIGURE 5-69

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Patient supine with test limb placed in external rotation.

Position of Therapist: Standing next to test leg.

Test: Patient attempts to internally rotate hip. One hand is used to palpate the gluteus medius (over the posterolateral surface of the hip above the greater trochanter). The other hand is used to palpate the tensor fasciae latae (on the anterolateral surface of the hip below the ASIS).

Instructions to Patient: "Try to roll your leg in."

Grading

Grade 1 (Trace): Palpable contractile activity in either or both muscles.

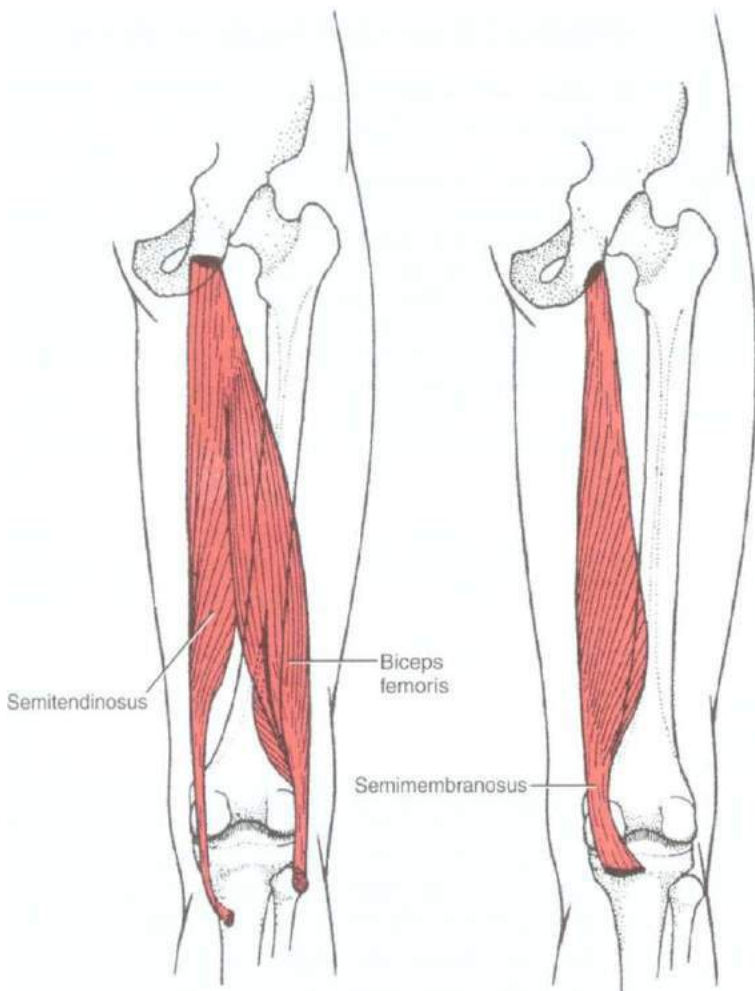
Grade 0 (Zero): No palpable contractile activity.

Helpful Hints

- In the short sitting tests, do not allow the patient to assist internal rotation by lifting the pelvis on the side of the limb being tested.
- Neither should the patient be allowed to extend the knee or adduct and extend the hip during performance of the test. These motions contaminate the test by offering visual distortion to the therapist.
- For the external rotation test, the reader is referred to the Helpful Hints under hip external rotation (page 212), which apply here as well.

KNEE FLEXION

(All hamstring muscles)



POSTERIOR

FIGURE 5-70

FIGURE 5-71

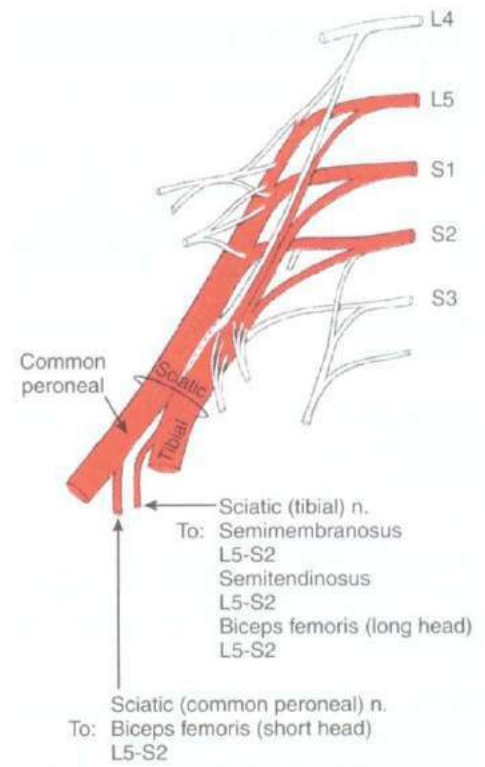


FIGURE 5-72

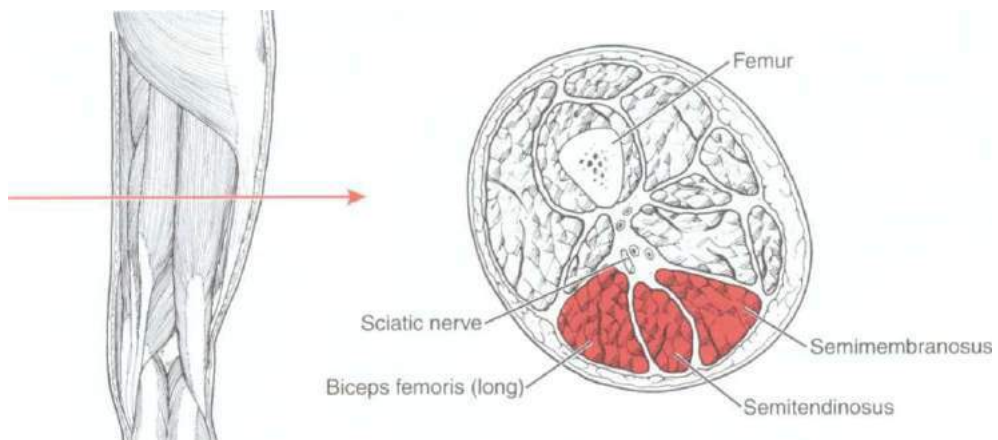


FIGURE 5-73

KNEE FLEXION

(All hamstring muscles)

Range of Motion
0° to 135°

Table 5-9 KNEE FLEXION

I.D.	Muscle	Origin	Insertion
192	Biceps femoris Long head	Ischium (tuberosity) Sacrotuberous ligament	Aponeurosis (posterior) Fibula (head, lateral aspect) Fibular collateral ligament Tibia (lateral condyle)
	Short head (may be absent)	Femur (linea aspera and lateral condylae) Lateral intermuscular septum	
193	Semitendinosus	Ischial tuberosity (inferior medial aspect) Tendon via aponeurosis shared with biceps femoris (long)	Tibia (proximal shaft) Pes anserina Deep fascia of leg
194	Semimembranosus	Ischial tuberosity Sacrotuberous ligament	Distal aponeurosis Tibia (medial condyle) Oblique popliteal ligament of knee joint
Others			
178	Gracilis		
185	Tensor fasciae latae (knee flexed more than 30°)		
195	Sartorius		
202	Popliteus		
205	Gastrocnemius		
207	Plantaris		

KNEE FLEXION

(All hamstring muscles)

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

There are three basic muscle tests for the hamstrings at Grades 5 and 4. The examiner should test first for the aggregate of the three hamstring muscles (with the foot in midline). Only if there is deviation (or asymmetry) in the movement or a question in the examiner's mind is there a need to test the medial and lateral hamstrings separately.

HAMSTRING MUSCLES IN AGGREGATE

Position of Patient: Prone with limbs straight and toes hanging over the edge of the table. Test may be started in about 45° of knee flexion.

Position of Therapist: Standing next to limb to be tested. (Illustration is deliberately incorrect to avoid obscuring test activity.) Hand giving resistance is contoured around the posterior surface of the leg just above the ankle (Figure 5-74). Resistance is applied in the direction of knee extension for Grades 5 and 4.

The other hand is placed over the hamstring tendons on the posterior thigh (optional).

Test: Patient flexes knee while maintaining leg in neutral rotation.

Instructions to Patient: "Bend your knee. Hold it! Don't let me straighten it."



FIGURE 5-74

MEDIAL HAMSTRING TEST (SEMITENDINOSUS AND SEMIMEMBRANOSUS)

Position of Patient: Prone with knee flexed to less than 90°. Leg in internal rotation (toes pointing toward midline).

Position of Therapist: Hand giving resistance grasps the leg at the ankle. Resistance is applied in an oblique direction (down and out) toward knee extension (Figure 5-75).

Test: Patient flexes knee, maintaining the leg in internal rotation (heel toward examiner, toes pointing toward midline).



FIGURE 5-75

LATERAL HAMSTRING TEST (BICEPS FEMORIS)

Position of Patient: Prone with knee flexed to less than 90°. Leg is in external rotation (toes pointing laterally).

Position of Therapist: Therapist resists knee flexion at the ankle using a downward and inward force (Figure 5-76).

Test: Patient flexes knee, maintaining leg in external rotation (heel away from examiner, toes pointing toward examiner) (Figure 5-76).

Grading the Hamstring Muscles (Grades 5 to 3)

Grade 5 (Normal) for All Three Tests: Resistance will be maximal, and the end knee flexion position (approximately 90°) cannot be broken.

Grade 4 (Good) for All Three Tests: End knee flexion position is held against strong to moderate resistance.

Grade 3 (Fair) for All Three Tests: Holds end range position but tolerates no resistance (Figure 5-77).



FIGURE 5-76

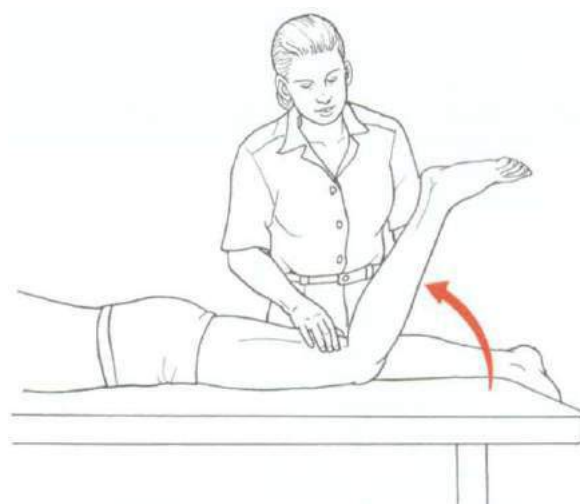


FIGURE 5-77

KNEE FLEXION

(All hamstring muscles)

Grade 2 (Poor)

Position of Patient: Side-lying with test limb (uppermost limb) supported by examiner. Lower limb flexed for stability.

Position of Therapist: Standing behind patient at knee level. One arm is used to cradle thigh, providing hand support at medial side of knee. Other hand supports the leg at the ankle just above the malleolus (Figure 5-78).

Test: Patient flexes knee through available range of motion.

Instructions to Patient: "Bend your knee."

Grading

Grade 2 (Poor): Completes available range of motion in side-lying position.



FIGURE 5-78

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Prone. Limbs are straight with toes extending over end of table. Knee is partially flexed and supported at ankle by examiner.

Position of Therapist: Standing next to test limb at knee level. One hand supports the flexed limb at the ankle (Figure 5-79). The opposite hand palpates both the medial and the lateral hamstring tendons just above the posterior knee.

Test: Patient attempts to flex knee.

Instructions to Patient: "Try to bend your knee."

Grading

Grade 1 (Trace): Tendons become prominent, but no visible movement occurs.

Grade 0 (Zero): No palpable contraction of the muscles; tendons do not stand out.



FIGURE 5-79

Substitutions

- Hip flexion substitution: The prone patient may flex the hip to start knee flexion. The buttock on the test side will rise as the hip flexes, and the patient may appear to roll slightly toward supine (Figure 5-80).
- Sartorius substitution: The sartorius may try to assist with knee flexion, but this also causes flexion and external rotation of the hip. Knee flexion when the hip is externally rotated is less difficult because the leg is not raised vertically against gravity.
- Gracilis substitution: Action of the gracilis contributes a hip adduction motion.
- Gastrocnemius substitution: Do not permit the patient to strongly dorsiflex in an attempt to use the tenodesis effect of the gastrocnemius.

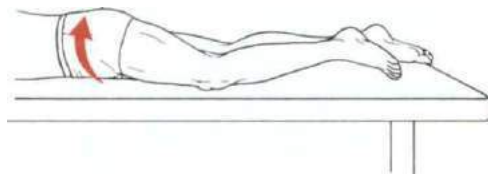


FIGURE 5-80

Helpful Hints

- If the biceps femoris is stronger than the medial hamstrings, the leg will externally rotate during knee flexion. Similarly, if the semitendinosus and semimembranosus are the stronger components, the leg will internally rotate during knee flexion. This is the situation that, when observed, indicates asymmetry and the need to test the medial and lateral hamstrings separately.
- In tests for Grades 3 and 2, the knee may be placed in a 10° flexed position to start the test when gastrocnemius weakness is present (the gastrocnemius assists in knee flexion).
- If the hip flexes at the end of the knee flexion range of motion, check for a tight rectus femoris muscle, because this tightness will limit the range of knee motion.

KNEE EXTENSION

(*Quadriceps femoris*)

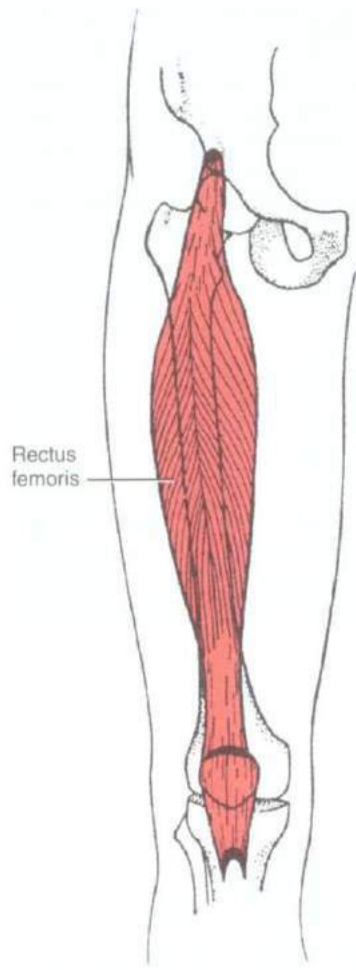
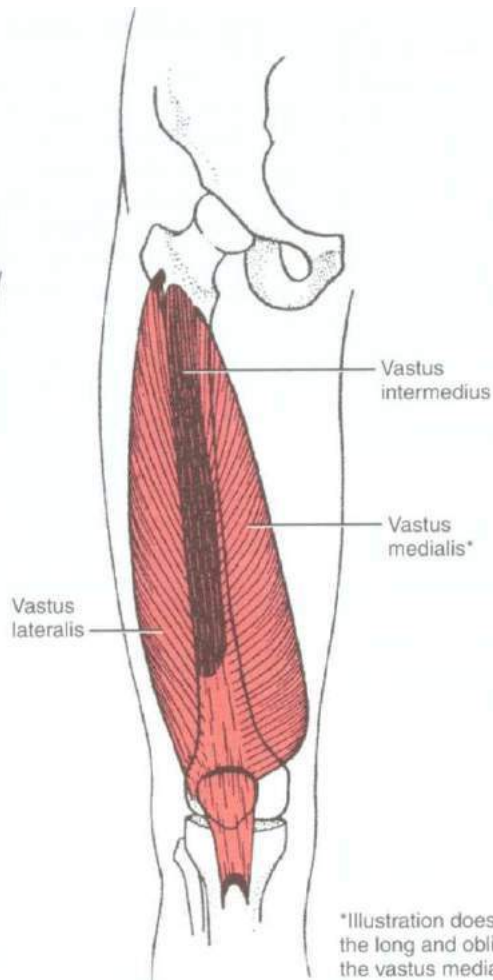


FIGURE 5-81



ANTERIOR

FIGURE 5-82

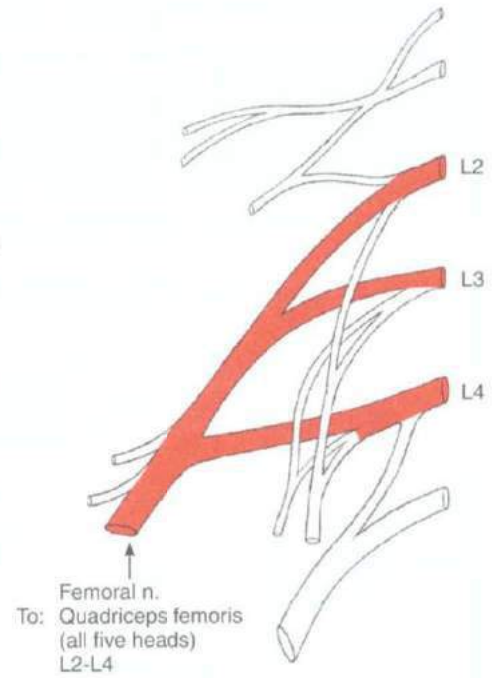


FIGURE 5-83

KNEE EXTENSION

(*Quadriceps femoris*)

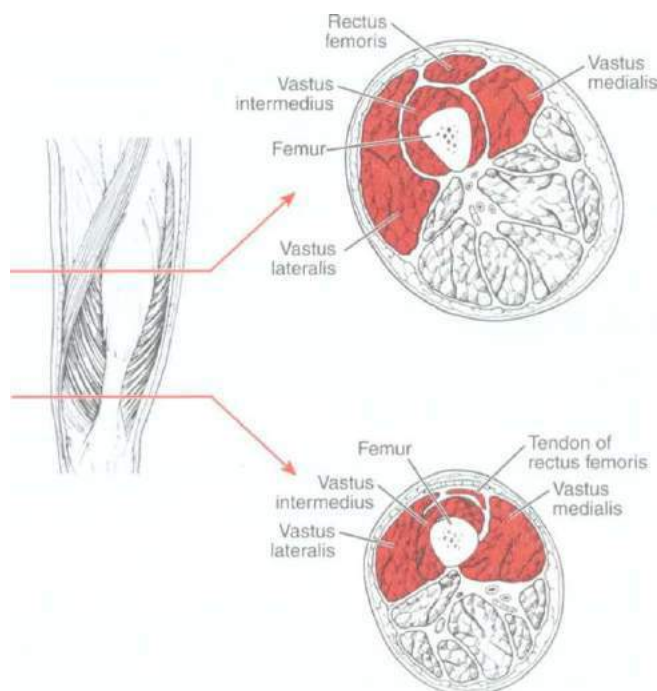


FIGURE 5-84

Range of Motion

135° to 0°

May extend 10° beyond 0° in those with hyperextension.

Table 5-10 KNEE EXTENSION

I.D.	Muscle	Origin	Insertion
196	Rectus femoris	Ilium (anterior inferior iliac spine) Acetabulum (groove above) Capsule of hip joint Aponeurosis (anterior)	Aponeurosis (posterior) Patella (base via quadriceps tendon) Tibial tuberosity via ligamentum patellae
198	Vastus intermedius	Femur (shaft, upper 2/3 lateral and anterior surfaces) Intermuscular septum (lateral)	Aponeurosis (anterior forming deep quadriceps tendon) Patella (base, lateral aspect) Tibia (lateral condyle) Tibial tuberosity via ligamentum patellae
197	Vastus lateralis	Femur Linea aspera (lateral lip) Greater trochanter (inferior) Intertrochanteric line (via aponeurosis) Gluteal tuberosity (lateral lip) Lateral intermuscular septum	Aponeurosis (deep surface, distal) Patella (base and lateral border via quadriceps tendon) Lateral expansion to capsule of knee joint and iliotibial tract Tibial tuberosity via ligamentum patellae
199	Vastus medialis longus	Femur linea aspera, medial lip; intertrochanteric line Origin of vastus medialis oblique Tendon of adductor magnus Intermuscular septum (medial)	Aponeurosis (deep) Patella (medial border) Tibial tuberosity via ligamentum patellae
200	Vastus medialis oblique	Femur: linea aspera (distal); supracondylar line Tendon of adductor magnus Intermuscular septum	Aponeurosis to capsule of knee joint Patella (medial aspect) Quadriceps tendon (medial) Tibial tuberosity via ligamentum patellae

Other

185 Tensor fasciae latae

KNEE EXTENSION

(*Quadriceps femoris*)

The quadriceps femoris muscles are tested together as a functional group. Any given head cannot be separated from any other by manual muscle testing. The rectus femoris is isolated from the other quadriceps during a hip flexion test.

Knowledge of the patient's hamstring range of motion is imperative before conducting tests for knee extension strength. Straight-leg raising (SLR) range dictates the optimal position for the knee extension test in the sitting position. In short sitting for Grades 5, 4, and 3, the less the range of SLR, the greater the backward trunk lean. Range of SLR also informs the examiner of the "available range" within the patient's comfort zone for side-lying tests.

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

Position of Patient: Short sitting. Place wedge or pad under the distal thigh to maintain the femur in the horizontal position. An experienced examiner may replace the padding under the thigh with his or her hand (Figure 5-85). Hands rest on the table on either side of the body for stability, or may grasp the table edge. The patient should be allowed to lean backward to relieve hamstring muscle tension.

Do not allow the patient to hyperextend the knee because this may lock it into position.

Position of Therapist: Standing at side of limb to be tested. The hand giving resistance is contoured over the anterior surface of the distal leg just above the ankle. For Grades 5 and 4, resistance is applied in a downward direction (toward the floor) in the direction of knee flexion.

Test: Patient extends knee through available range of motion but not beyond 0°.

Instructions to Patient: "Straighten your knee. Hold it! Don't let me bend it."

Grading

Grade 5 (Normal): Holds end position against maximal resistance. Most physical therapists will not be able to break the Normal knee extensors.

Grade 4 (Good): Holds end position against strong to moderate resistance.

Grade 3 (Fair): Completes available range and holds the position without resistance (Figure 5-86).



FIGURE 5-85

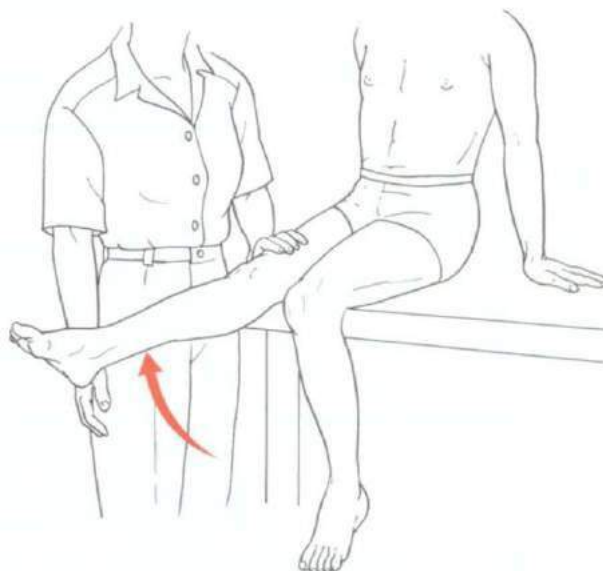


FIGURE 5-86

KNEE EXTENSION

(*Quadriceps femoris*)

Grade 2 (Poor)

Position of Patient: Side-lying with test limb uppermost. Lowermost limb may be flexed for stability. Limb to be tested is held in about 90° of knee flexion. The hip should be in full extension.

Position of Therapist: Standing behind patient at knee level. One arm cradles the test limb around the thigh with the hand supporting the underside of the knee (Figure 5-87). The other hand holds the leg just above the malleolus.

Test: Patient extends knee through the available range of motion. The therapist supporting the limb provides neither assistance nor resistance to the patient's voluntary movement. This is part of the art of muscle testing that must be acquired.

Be alert to activity by the internal rotators (see Substitution, below).

Instructions to Patient: "Straighten your knee."

Grading

Grade 2 (Poor): Completes available range of motion.

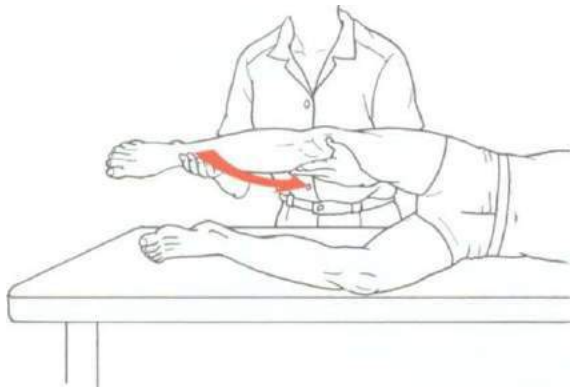


FIGURE 5-87

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Supine.

Position of Therapist: Standing next to limb to be tested at knee level. Hand used for palpation should be on the quadriceps tendon just above the knee with the tendon "held" gently between the thumb and fingers. The examiner also may want to palpate the patellar tendon with two to four fingers just below the knee (Figure 5-88).

Test: Patient attempts to extend knee.

As an alternate test, the therapist may place one hand under the slightly flexed knee; palpate either the quadriceps or the patellar tendon while the patient tries to extend the knee.

Instructions to Patient: "Push the back of your knee down into the table." OR "Tighten your kneecap" (quadriceps setting).

For Alternate Test: "Push the back of your knee down into my hand."

Grading

Grade 1 (Trace): Contractile activity can be palpated in muscle through the tendon. No joint movement occurs.

Grade 0 (Zero): No palpable contractile activity.



FIGURE 5-88

Substitution

When the patient is side-lying (as in the Grade 2 test), he or she may use the hip internal rotators to substitute for the quadriceps, thereby allowing the knee to fall into extension.

ANKLE PLANTAR FLEXION

(Gastrocnemius and Soleus)

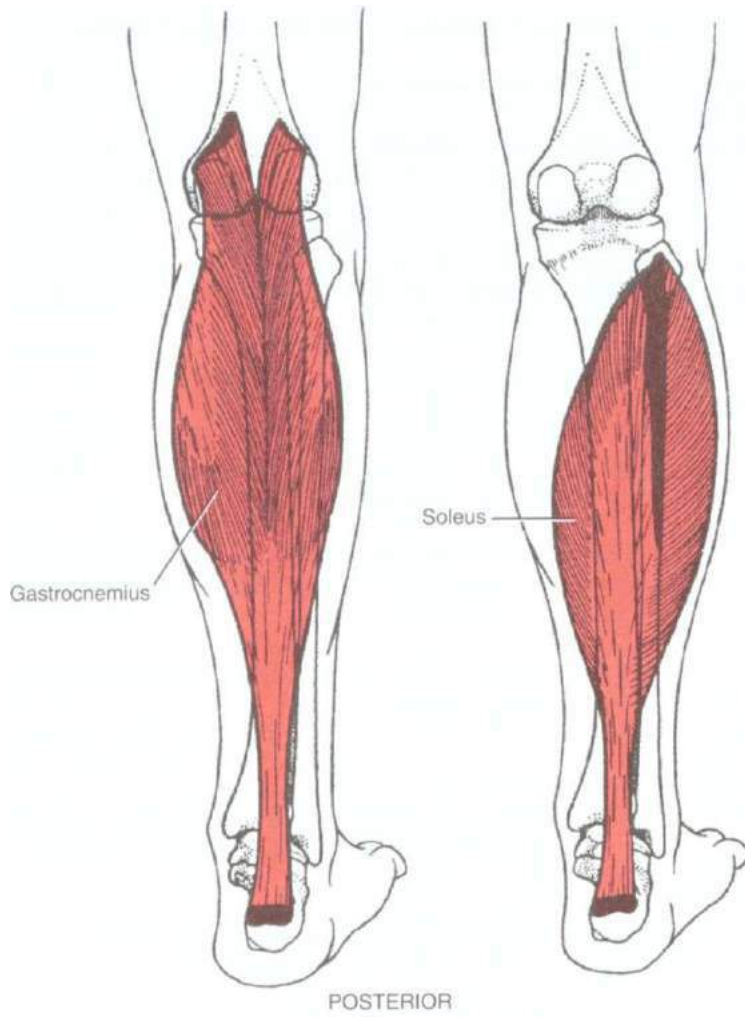


FIGURE 5-89

FIGURE 5-90

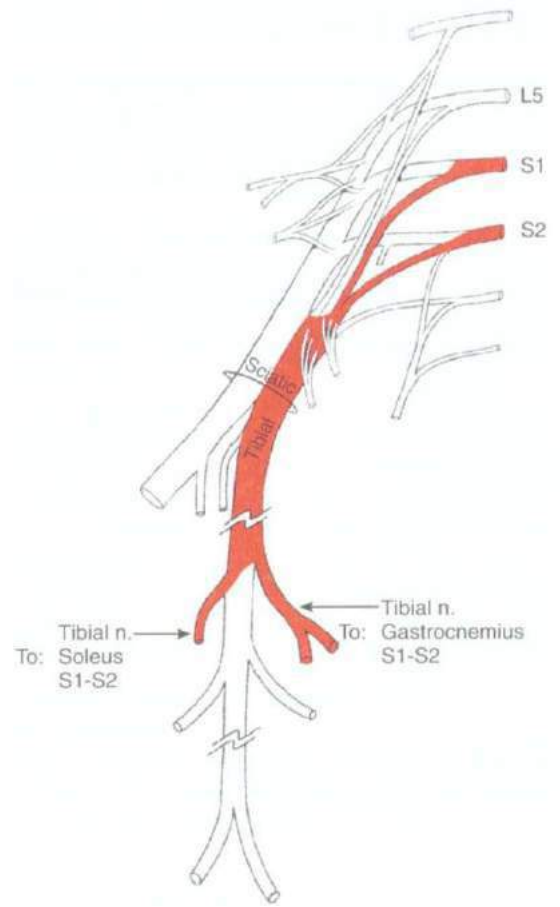


FIGURE 5-91

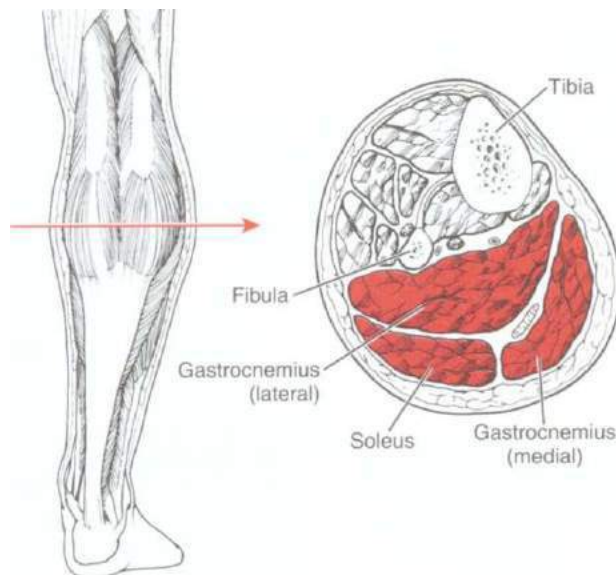


FIGURE 5-92

ANKLE PLANTAR FLEXION

(*Gastrocnemius and Soleus*)

Range of Motion

0° to 45°

Table 5-11 PLANTAR FLEXION

I.D.	Muscle	Origin	Insertion
205	Gastrocnemius Medial head	Femur (medial condyle, popliteal surface) Capsule of knee joint	Anterior aponeurosis Tendo calcaneus (tendon of Achilles) formed when tendon of gastrocnemius joins tendon of soleus
	Lateral head	Femur (lateral condyle, lateral surface, and supracondylar line) Capsule of knee joint Aponeurosis (posterior)	Calcaneus (posterior)
206	Soleus	Fibula (head, posterior aspect, and proximal 1/3 of shaft) Tibia (soleal line and middle 1/3 of medial shaft) Aponeurosis between tibia and fibula over popliteal vessels Aponeurosis (anterior)	Aponeurosis (posterior; tendinous raphe in midline of muscle) Tendo calcaneus when tendon of soleus joins tendon of gastrocnemius Calcaneus via tendo calcaneus
Others			
204	Tibialis posterior		
207	Plantaris		
208	Peroneus longus		
209	Peroneus brevis		
213	Flexor digitorum longus		
222	Flexor hallucis longus		

ANKLE PLANTAR FLEXION

(*Gastrocnemius and Soleus*)

GASTROCNEMIUS AND SOLEUS TEST

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

Position of Patient: Patient stands on limb to be tested with knee extended. Patient is likely to need external support; no more than one or two fingers should be used on a table (or other surface) for balance assist only (Figure 5-93).

Position of Therapist: Standing or sitting with a lateral view of test limb.

Test: Patient raises heel from floor consecutively through full range of plantar flexion.

Instructions to Patient: Therapist demonstrates correct heel rise to patient. "Stand on your right leg. Go up on your tiptoes. Now down. Repeat this 25 times." Repeat test for left limb.

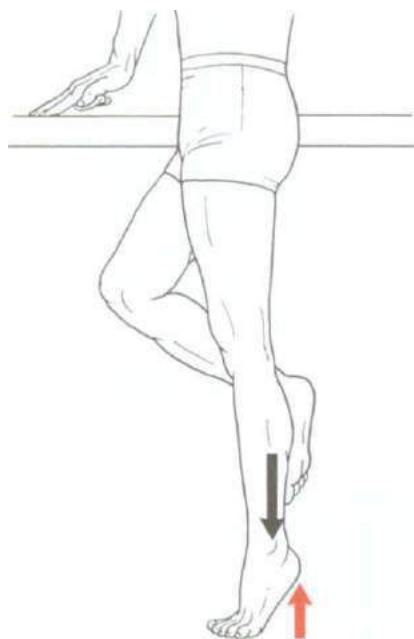


FIGURE 5-93

Grading

Grade 5 (Normal): Patient successfully completes a minimum of 25 heel rises through full range of motion without a rest between rises and without fatigue. Twenty-five heel rises represent approximately 60 percent of maximum electromyographic activity of the plantar flexors.³ One study noted that a normal response required 25 complete heel rises.⁴

Grade 4 (Good): A Grade 4 is conferred when the patient completes any number of correct heel rises between 24 and 10 with no rest between repetitions and without fatigue. Grade 4 is conferred only if the patient uses correct form in all repetitions. Any failure to complete the full range in any given repetition automatically drops the grade to at least the next lower level.³

Grade 3 (Fair): Patient completes between nine and one heel rises correctly with no rest or fatigue.¹

If the patient cannot complete at least one correct full-range heel rise in the standing position, the grade must be less than 3 (Fair). Regardless of any resistance to a nonstanding position for any reason, the patient must be given a grade of less than 3.

ANKLE PLANTAR FLEXION

(*Gastrocnemius and Soleus*)

Grade 2 (Poor)

STANDING TEST

Position of Patient: Standing on limb to be tested with knee extended, with a two-finger balance assist.

Position of Therapist: Standing or sitting with a clear lateral view of test limb.

Test: Patient attempts to raise heel from the floor through the full range of plantar flexion (Figure 5-94).

Instructions to Patient: "Stand on your right leg. Try to go up on your tiptoes." Repeat test for left leg.

Grading

Grade 2+ (Poor+): The patient can just clear the heel from the floor and cannot get up on the toes for the end test position.

Note: This is a rare exception for the use of a 2+ (Poor+) grade. There is no Grade 2 from the standing position.



FIGURE 5-94

PRONE TEST

Position of Patient: Prone with feet off end of table.

Position of Therapist: Standing at end of table in front of foot to be tested. One hand is contoured under and around the test leg just above the ankle (Figure 5-95). Heel and palm of hand giving resistance are placed against the plantar surface at the level of the metatarsal heads.

Test: Patient plantar flexes ankle through the available range of motion. Manual resistance is down and forward toward dorsiflexion.

Grading

Grade 2+ (Poor+): Completes plantar flexion range and holds against maximal resistance.

Grade 2 (Poor): Patient completes plantar flexion range but tolerates no resistance.

Grade 2- (Poor-): Patient completes only a partial range of motion.

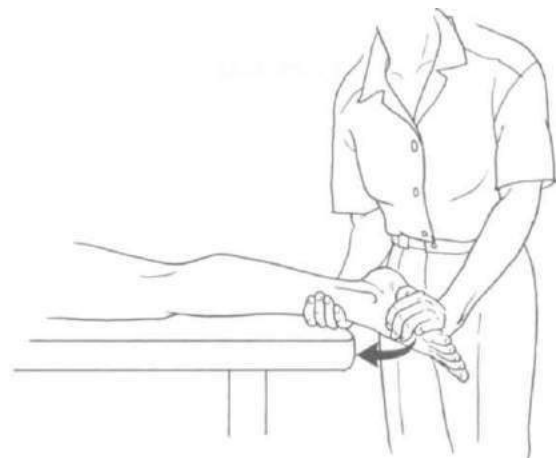


FIGURE 5-95

ANKLE PLANTAR FLEXION

(Gastrocnemius and Soleus)

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Prone with feet off end of table.

Position of Therapist: Standing at end of table in front of foot to be tested. One hand palpates gastrocnemius-soleus activity by monitoring tension in the Achilles tendon just above the calcaneus (Figure 5-96). The muscle bellies of the two muscles also may be palpated (not illustrated).

Test: Patient attempts to plantar flex the ankle.

Instructions to Patient: "Point your toes down, like a toe or ballet dancer."

Grading

Grade 1 (Trace): Tendon reflects some contractile activity in muscle, but no joint motion occurs. Contractile activity may be palpated in muscle bellies. The best location to palpate the gastrocnemius is at mid-calf with thumb and fingers on either side of the midline but above the soleus. Palpation of the soleus is best done on the posterolateral surface of the distal calf. In most people with calf strength of Grade 3 or better, the two muscles can be observed and differentiated during plantar flexion testing because their definition is clear.

Grade 0 (Zero): No palpable contraction.

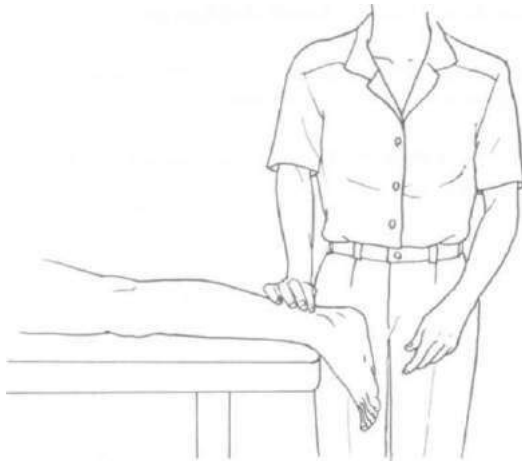


FIGURE 5-96

PLANTAR FLEXION, SOLEUS ONLY

All plantar flexor muscles are active in all positions of plantar flexion testing; therefore no true isolation of the soleus is possible. Testing during standing with the test leg flexed results in a 70 percent decrease in gastrocnemius activity.³ The test performed to "isolate" the soleus should be interpreted with this caveat in mind. Thus in the test to "isolate" the soleus, the knee is placed in flexion to put slack on the gastrocnemius, which crosses the knee joint.

Grade 5 (Normal), Grade 4 (Good), and Grade 3 (Fair)

Position of Patient: Standing on limb to be tested with knee slightly flexed (Figure 5-97). Use one or two fingers for balance assist.

Position of Therapist: Standing or sitting with clear lateral view of test limb.

Test: Patient raises heel from floor through full range of plantar flexion, maintaining flexed position of knee (see Figure 5-97). Twenty correct heel raises must be done consecutively without rest and without great fatigue.

Instructions to Patient: Therapist demonstrates test position and motion. "Stand on your right leg with your knee bent. Keep your knee bent and go up and down on your toes at least 20 times." Repeat test for left leg.

Grading

Grade 5 (Normal): Patient completes 20 consecutive heel rises to full range without rest or complaint of fatigue.³

Grade 4 (Good): Patient completes between 19 and 10 correct heel rises without rest.³

Grade 3 (Fair): Patient completes between nine and one correct heel rises with the knee flexed.

Note: If the patient cannot complete all heel rises through a full range, the grade must be lower than 3. If the patient partially completes one heel rise, he or she may be given a grade of 2+. If the patient is unable to stand for the Grade 3 test for any reason, the grade awarded may not exceed a 2.

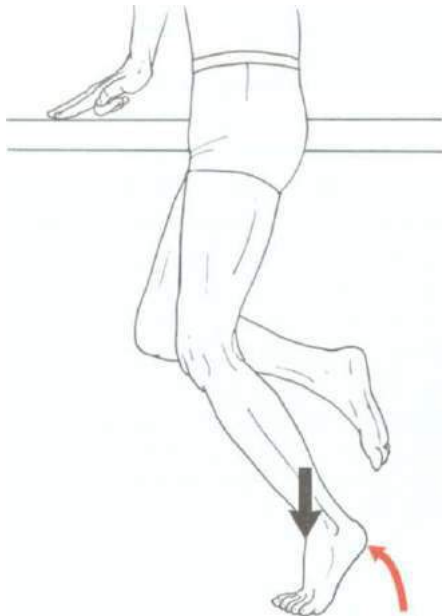


FIGURE 5-97

ANKLE PLANTAR FLEXION

(*Gastrocnemius* and *Soleus*)

Grade 2 (Poor), Grade 1 (Trace), and Grade 0 (Zero)

Position of Patient: Prone with knee flexed to 90°.

Position of Therapist: Standing next to patient. Resistance is given with the heel of the hand placed under the plantar surface of the forefoot in the direction of dorsiflexion.

Test: Patient attempts to plantar flex the ankle while the knee is maintained in flexion.

Instructions to Patient: "Point your toes toward the ceiling."

Grading

Grade 2+ (Poor+): Completes full plantar flexion range against maximal resistance.

Grade 2 (Poor): Completes full plantar flexion range with no resistance.

Grade 2- (Poor-): Completes only a partial range of motion with knee flexed.

Grades 1 and 0: Palpable contraction or Achilles tendon tightening is Grade 1. No contractile activity is Grade 0.

Helpful Hints

- If for any reason the patient cannot lie prone for Grades 2, 1, or 0, an alternative for the Grade 2, 1, or 0 test is to use the supine position for non-weight-bearing testing. The highest grade awarded in this case may not exceed a 2+.
- If the patient is unable to perform a standing plantar flexion test but has a stable forefoot, a different application of resistance may be used with the patient supine. The resistance is applied against the sole of the foot with the forearm while the heel is cupped with the hand of the same arm and the ankle is forced into dorsiflexion. The highest grade that may be awarded in this case is a 2+.

Substitutions

- By flexor hallucis longus and flexor digitorum longus: When substitution by the toe flexors occurs, their motions will be accompanied by plantar flexion of the forefoot and incomplete movement of the calcaneus (Figure 5-98).
- By peroneus longus and peroneus brevis: These muscles substituting for the gastrocnemius and soleus will pull the foot into eversion.
- By tibialis posterior: The foot will move into inversion during plantar flexion testing if the tibialis posterior substitutes for the primary plantar flexors.
- By tibialis posterior, peroneus longus, and peroneus brevis: Substitution by these three muscles will plantar flex the forefoot instead of the ankle.

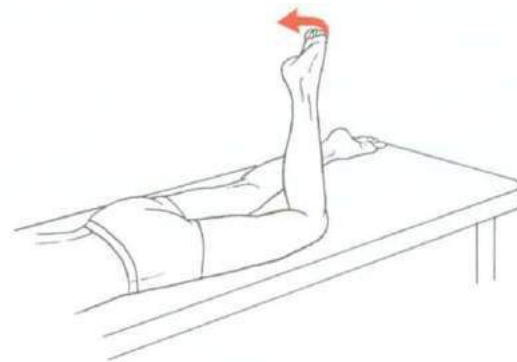
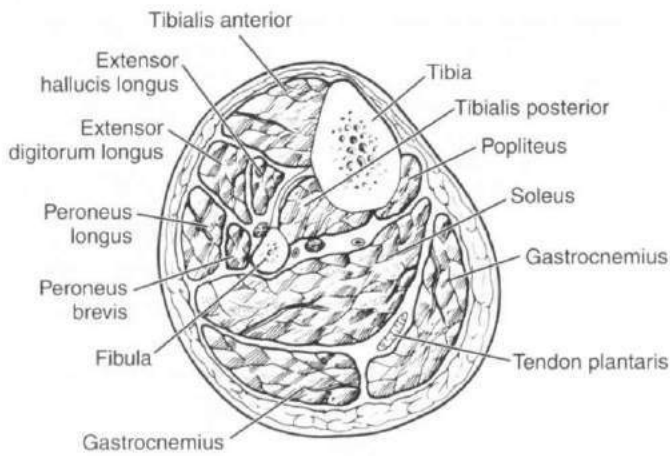


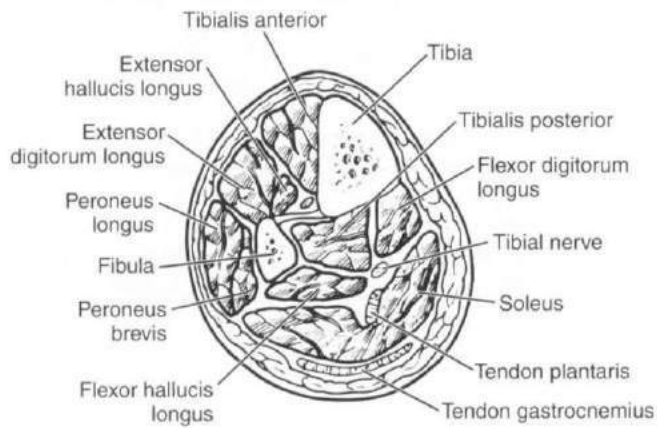
FIGURE 5-98

- During standing plantar flexion tests, the tibialis posterior and the peroneus longus and brevis muscles must be Grade 5 or 4 to stabilize the forefoot to attain and hold the tiptoe position.
- During standing heel rise testing, it is important to be sure that the patient maintains a fully erect posture. If the subject leans forward, such posture can bring the heel off the ground, creating a testing artifact.

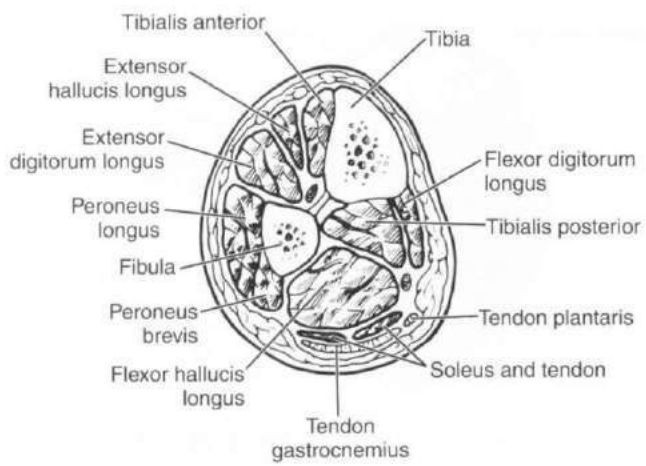
CROSS SECTIONS OF THE LEG



MID LEG
AT UPPER PORTION OF
GASTROCNEMIUS AND
SOLEUS AT LARGEST
CIRCUMFERENCE OF CALF



LOWER LEG
NEAR END OF MUSCULAR
PORTIONS OF TRICEPS
SURAE. GASTROCNEMIUS
IS ALL TENDINOUS.

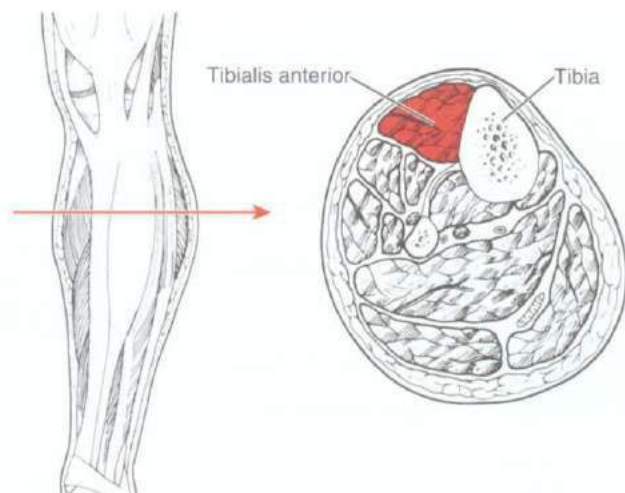
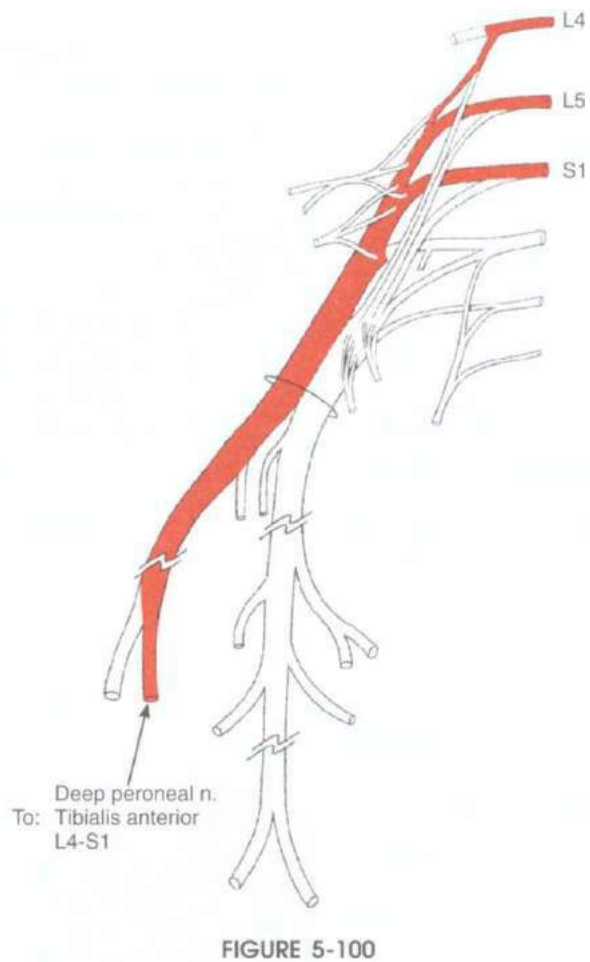
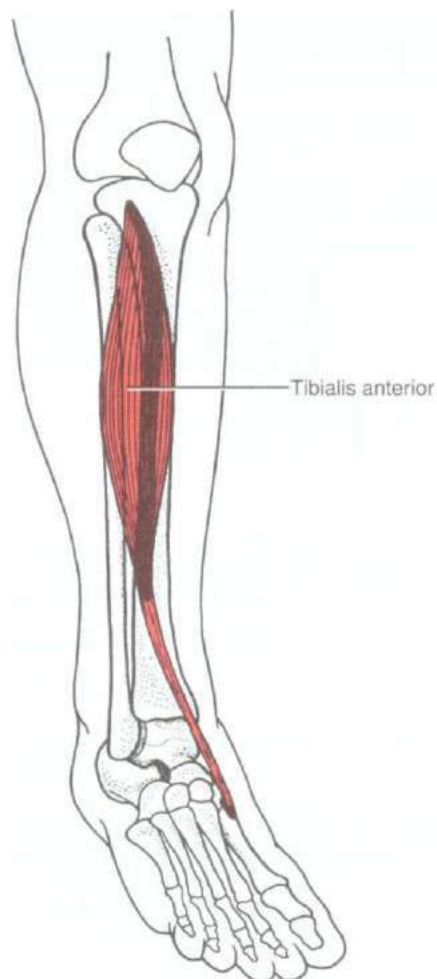


HIGH ANKLE
LOWER LEG WHERE
GASTROCNEMIUS,
SOLEUS, AND PLANTARIS
ARE TENDINOUS

PLATE 7

FOOT DORSIFLEXION AND INVERSION

(*Tibialis anterior*)



FOOT DORSIFLEXION AND INVERSION

(*Tibialis anterior*)

Range of Motion

0° to 20°

Table 5-12 FOOT DORSIFLEXION AND INVERSION

I.D.	Muscle	Origin	Insertion
203	Tibialis anterior	Tibia (lateral condyle and proximal 2/3 of lateral shaft) Interosseous membrane Fascia cruris (deep) Intermuscular septum	1st (medial) cuneiform (on medial and plantar surfaces) 1st metatarsal (base)
Others			
210	Peroneus tertius		
211	Extensor digitorum longus		
221	Extensor hallucis longus		

Grades 5 (Normal) to 0 (Zero)

Position of Patient: Short sitting. Alternatively, patient may be supine.

Position of Therapist: Sitting on stool in front of patient with patient's heel resting on thigh. One hand is contoured around the posterior leg just above the malleoli for Grades 5 and 4 (Figure 5-102). The hand providing resistance for the same grades is cupped over the dorsomedial aspect of the foot (see Figure 5-102).

Test: Patient dorsiflexes ankle and inverts foot, keeping toes relaxed.

Instructions to Patient: "Bring your foot up and in. Hold it! Don't let me push it down."



FIGURE 5-102

FOOT DORSIFLEXION AND INVERSION

(*Tibialis anterior*)

Grades 5 (Normal) to 0 (Zero) Continued

Grading

Grade 5 (Normal): Completes full range and holds against maximal resistance.

Grade 4 (Good): Completes available range against strong to moderate resistance.

Grade 3 (Fair): Completes available range of motion and holds end position without resistance (Figure 5-103).

Grade 2 (Poor): Completes only a partial range of motion.

Grade 1 (Trace): Therapist will be able to detect some contractile activity in the muscle, or the tendon will "stand out." There is no joint movement.

Palpate the tendon of the tibialis anterior on the anteromedial aspect of the ankle at about the level of the malleoli (Figure 5-104, lower hand). Palpate the muscle for contractile activity over its belly just lateral to the "shin" (Figure 5-104, upper hand)

Grade 0 (Zero): No palpable contraction.



FIGURE 5-103



FIGURE 5-104

Helpful Hints

- In the sitting and supine positions, make sure the knee is flexed to put the gastrocnemius on slack. If the knee is extended and there is gastrocnemius tightness, the patient will not be able to achieve full dorsiflexion range.
- If the supine position is used in lieu of the short sitting position for the Grade 3 test, the therapist

Substitution

Substitution by the extensor digitorum longus and the extensor hallucis longus muscles results also in toe extension. Instruct the patient, therefore, to keep the toes relaxed so that they are not part of the test movement.

- should add a degree of difficulty to the test to compensate for the lack of gravity. For example, give mild resistance in the supine position but award no more than a Grade 3.
- In the supine position, to earn a Grade 2 the patient must complete a full range of motion.

FOOT INVERSION

(*Tibialis posterior*)



POSTERIOR VIEW OF LEG
PLANTAR VIEW OF FOOT

FIGURE 5-105

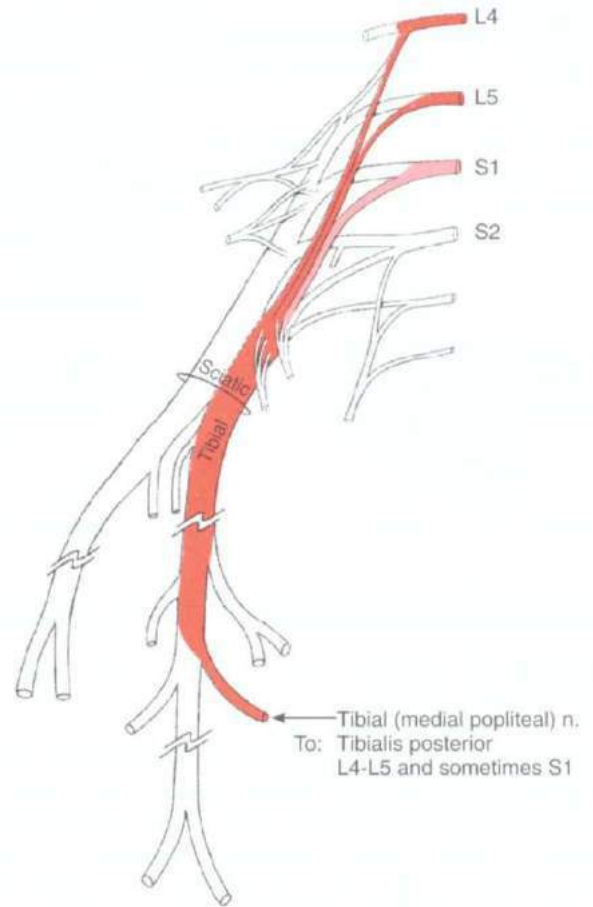


FIGURE 5-106

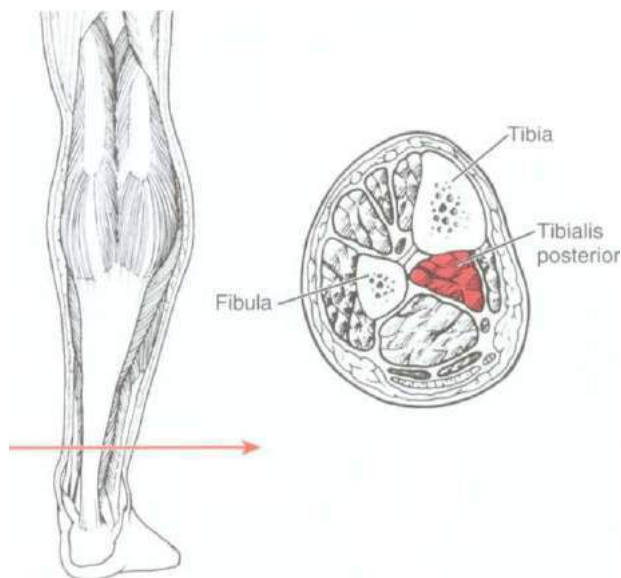


FIGURE 5-107

FOOT INVERSION

(*Tibialis posterior*)

Range of Motion

0° to 35°

Table 5-13 FOOT INVERSION

I.D.	Muscle	Origin	Insertion
204	Tibialis posterior	Tibia (proximal 2/3 of posterior lateral shaft below soleal line) Interosseous membrane (posterior) Fibula (shaft, proximal posterior medial 2/3) Deep transverse fascia Intermuscular septa	Navicular bone (tuberosity) Cuneiform bones Sustentaculum tali (distal) Metatarsals 2-4 (via tendinous band)
Others			
203	Tibialis anterior		
213	Flexor digitorum longus		
222	Flexor hallucis longus		
206	Soleus		
221	Extensor hallucis longus		

Grades 5 (Normal) to 2 (Poor)

Position of Patient: Short sitting with ankle in slight plantar flexion.

Position of Therapist: Sitting on low stool in front of patient or on side of test limb. One hand is used to stabilize the ankle just above the malleoli (Figure 5-108). Hand providing resistance is contoured over the dorsum and medial side of the foot at the level of the metatarsal heads. Resistance is directed toward eversion and slight dorsiflexion.

Test: Patient inverts foot through available range of motion.

Instructions to Patient: Therapist may need to demonstrate motion. "Turn your foot down and in. Hold it."

Grading

Grade 5 (Normal): The patient completes the full range and holds against maximal resistance.

Grade 4 (Good): The patient completes available-range against strong to moderate resistance.

Grade 3 (Fair): The patient will be able to invert the foot through the full available range of motion (Figure 5-109).

Grade 2 (Poor): The patient will be able to complete only a partial range of motion.



FIGURE 5-108

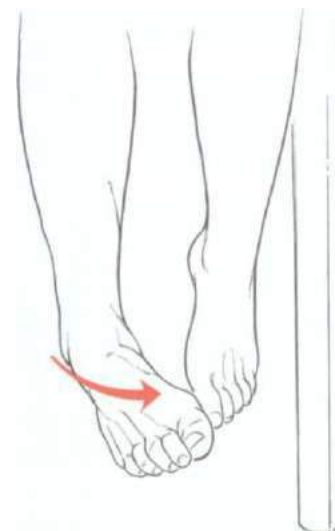


FIGURE 5-109

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Short sitting or supine.

Position of Therapist: Sitting on low stool or standing in front of patient. Palpate tendon of the tibialis posterior between the medial malleolus and the navicular bone (Figure 5-110). Alternatively, palpate tendon above the malleolus.

Test: Patient attempts to invert foot.

Instructions to Patient: "Try to turn your foot down and in."



FIGURE 5-110

Grading

Grade 1 (Trace): The tendon will stand out if there is contractile activity in the muscle. If palpable activity occurs in the absence of movement, the grade is 1.

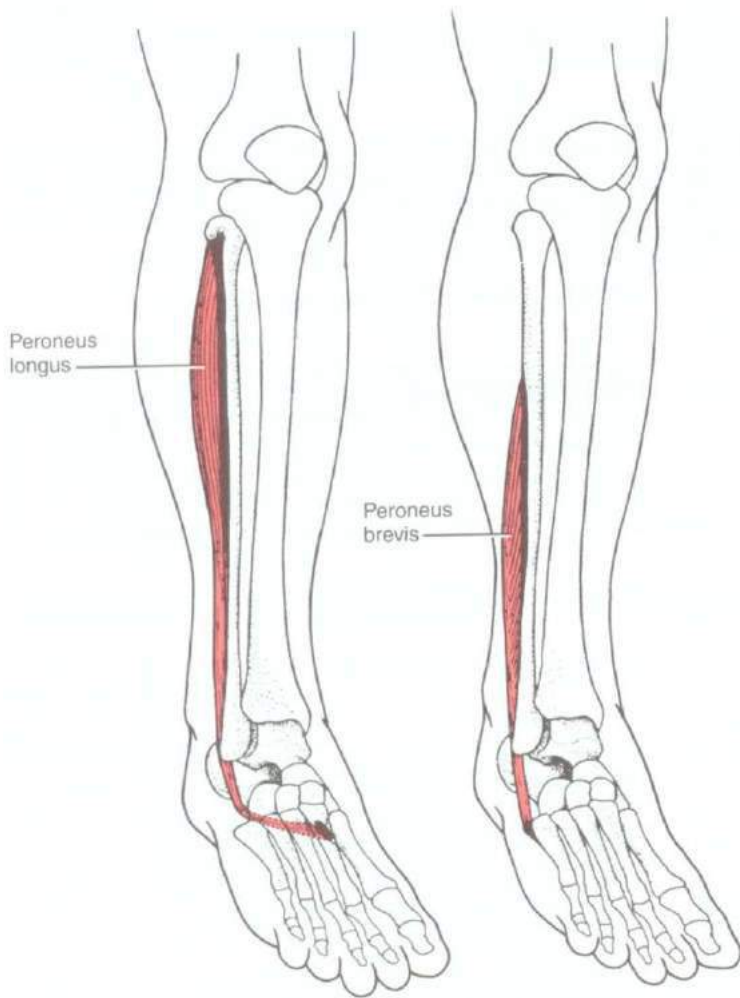
Grade 0 (Zero): No palpable contraction.

Substitution

Flexors of the toes should remain relaxed to prevent substitution by the flexor digitorum longus and flexor hallucis longus.

FOOT EVERSION WITH PLANTAR FLEXION

(*Peroneus longus* and *Peroneus brevis*)



ANTEROLATERAL

FIGURE 5-111

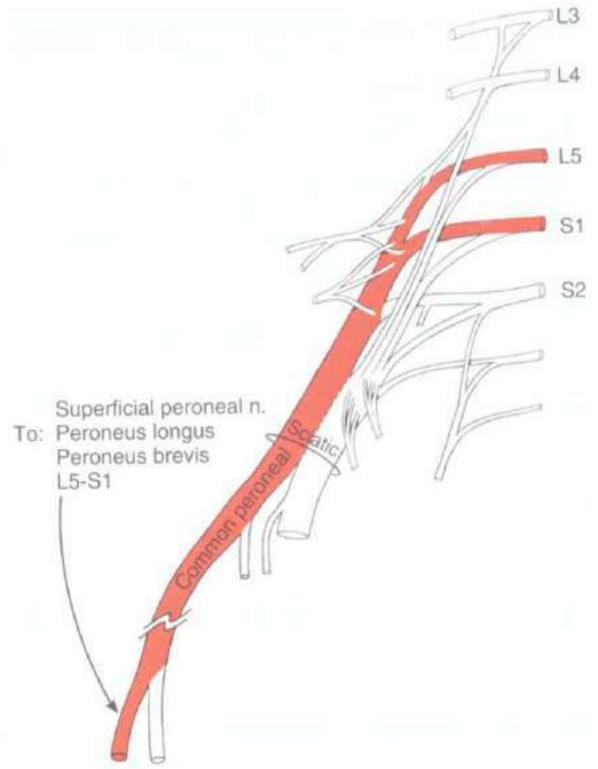


FIGURE 5-113

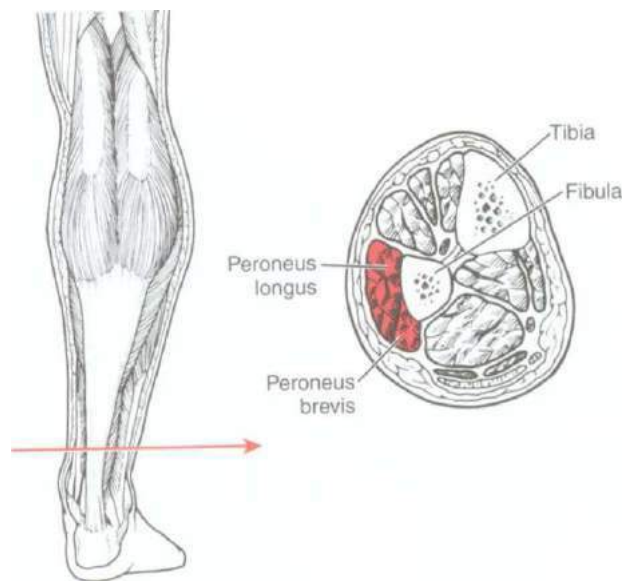


FIGURE 5-114

FOOT EVERSION WITH PLANTAR FLEXION

(*Peroneus longus* and *Peroneus brevis*)

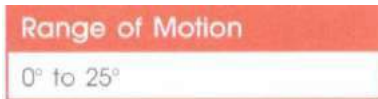


Table 5-14 FOOT EVERSION

I.D.	Muscle	Origin	Insertion
With Plantar Flexion			
208	Peroneus longus	Fibula (head and proximal 2/3 of shaft, lateral aspect) Tibia (lateral condyle) (occasionally) Fascia cruris Intermuscular septa	1st metatarsal (base and lateral aspect) Medial cuneiform (base and lateral aspect) Other metatarsals occasionally
209	Peroneus brevis	Fibula (distal and lateral 2/3 of shaft) Crural intermuscular septum	5th metatarsal (tuberosity at base, lateral aspect)
With Dorsiflexion			
211	Extensor digitorum longus		
210	Peroneus tertius		
Other			
205	Gastrocnemius		

Grade 5 (Normal) to Grade 2 (Poor)

Position of Patient: Short sitting with ankle in neutral position (midway between dorsiflexion and plantar flexion) (Figure 5-115). Test also may be performed with patient supine.

Position of Therapist: Sitting on low stool in front of patient or standing at end of table if patient is supine.

One hand grips the ankle just above the malleoli for stabilization. Hand giving resistance is contoured around the dorsum and lateral border of the forefoot (Figure 5-115). Resistance is directed toward inversion and slight dorsiflexion.

Test: Patient everts foot with depression of first metatarsal head and some plantar flexion.

Instructions to Patient: "Turn your foot down and out. Hold it! Don't let me move it in."

Grading

Grade 5 (Normal): Patient completes full range and holds end position against maximal resistance.

Grade 4 (Good): Patient completes available range of motion against strong to moderate resistance.

Grade 3 (Fair): Patient completes available range of eversion but tolerates no resistance (Figure 5-116).

Grade 2 (Poor): The patient will be able to complete only a partial range of eversion motion.



FIGURE 5-115

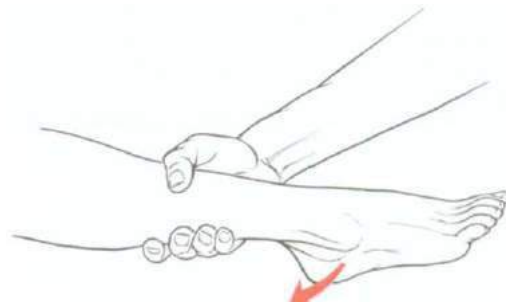


FIGURE 5-116

FOOT EVERSION WITH PLANTAR FLEXION

(*Peroneus longus* and *Peroneus brevis*)

Grade 1 (Trace) and Grade 0 (Zero)

Position of Patient: Short sitting or supine.

Position of Therapist: Sitting on low stool or standing at end of table. To palpate the peroneus longus, place fingers on the lateral leg over the upper one third just below the head of the fibula. The tendon of the muscle can be felt posterior to the lateral malleolus but behind the tendon of the peroneus brevis.

To palpate the tendon of the peroneus brevis, place index finger over the tendon as it comes forward from behind the lateral malleolus, proximal to the base of the 5th metatarsal (Figure 5-117). The belly of the peroneus brevis can be palpated on the lateral surface of the distal leg over the fibula.



FIGURE 5-117

Helpful Hints

- Foot eversion is accompanied by either dorsiflexion or plantar flexion. The toe extensors are the primary dorsiflexors accompanying eversion because the peroneus tertius is an inconstant muscle.
- The primary motion of eversion with plantar flexion is accomplished by the peroneus brevis because the peroneus longus is primarily a depressor of the first metatarsal head rather than an evertor.
- The peroneus brevis cannot be isolated if both peronei are innervated and active.
- If there is a difference in strength between the peroneus longus and the peroneus brevis, the stronger of the two can be ascertained by the relative amount of resistance taken in eversion versus the resistance taken at the first metatarsal head. If greater resistance is taken at the first metatarsal head, the peroneus longus is the stronger muscle.

Grading

Grade 1 (Trace): Palpation will reveal contractile activity in either or both muscles, which may cause the tendon to stand out. No motion occurs.

Grade 0 (Zero): No palpable contractile activity.

Isolation of Peroneus Longus

Give resistance against the plantar surface of the head of the 1st metatarsal in a direction toward inversion and dorsiflexion.

Foot Eversion with Dorsiflexion

If the peroneus tertius is present, it can be tested by asking the patient to evert and dorsiflex the foot. In this motion, however, the extensor digitorum longus participates.

The tendon of the peroneus tertius can be palpated on the lateral aspect of the dorsum of the foot, where it lies lateral to the tendon of the extensor digitorum longus slip to the little toe.

HALLUX AND TOE MP FLEXION

(Lumbricales and Flexor hallucis brevis)

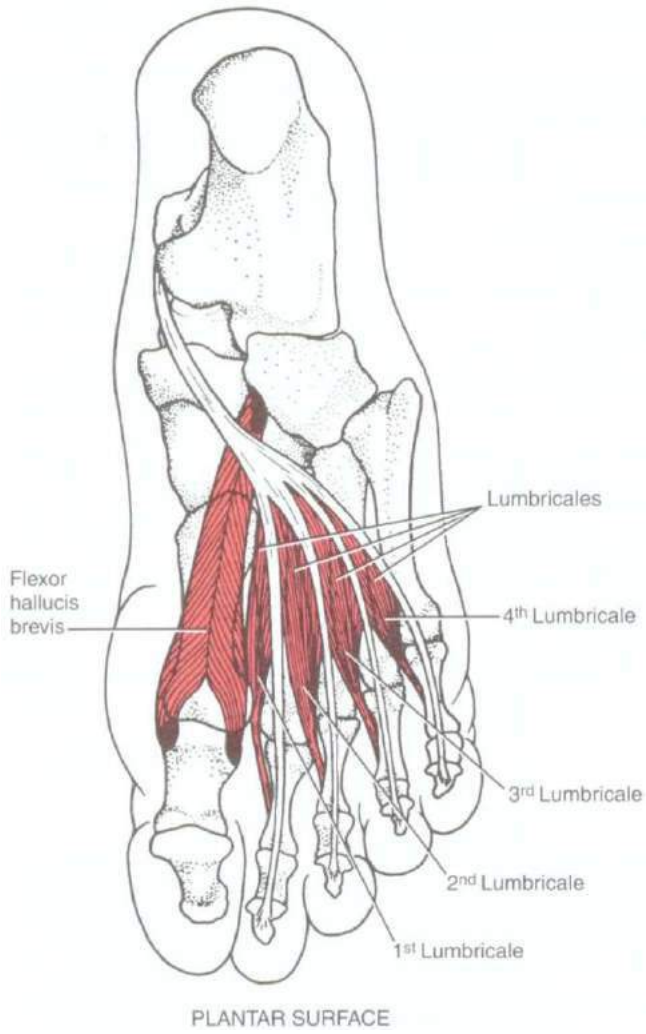


FIGURE 5-118

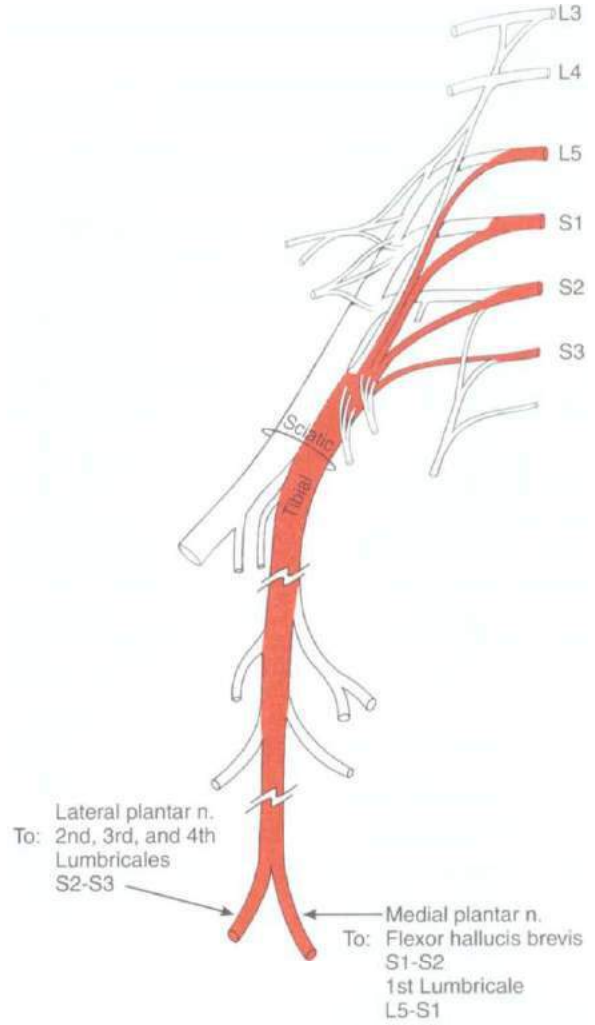


FIGURE 5-119

HALLUX AND TOE MP FLEXION

(*Lumbricales* and *Flexor hallucis brevis*)

Range of Motion

Great toe, 0° to 45°

Lateral four toes, 0° to 40°

Table 5-15 FLEXION OF MP JOINTS OF TOES AND HALLUX

I.D.	Muscle	Origin	Insertion
Toes			
218	Lumbricales	Tendons of flexor digitorum longus near angles of separation 1st lumbricale (by a single head, tendon of flexor digitorum longus bound for toe 2) 2nd to 4th lumbricales (arise by dual heads from adjacent sides of tendons of flexor digitorum longus bound for toes 3-5)	All: toes 2-5 (proximal phalanges and dorsal expansions of the tendons of extensor digitorum longus)
Hallux			
223	Flexor hallucis brevis (rises by 2 heads) Lateral head	Cuboid bone (plantar surface) Lateral cuneiform bone	Hallux (proximal phalanx on both sides of base) Blends with adductor hallucis
	Medial head	Medial intermuscular septum Tibialis posterior (tendon)	Hallux (proximal phalanx on both sides of base) Blends with abductor hallucis
Others			
219, 220	Interossei, dorsal and plantar		
216	Flexor digiti minimi brevis		
213	Flexor digitorum longus		
214	Flexor digitorum brevis		
222	Flexor hallucis longus		
224	Abductor hallucis		
225	Adductor hallucis		

HALLUX MP FLEXION (*Flexor hallucis brevis*)

Grades 5 (Normal) to 0 (Zero)

Position of Patient: Short sitting (alternate position: supine) with legs hanging over edge of table. Ankle is in neutral position (midway between dorsiflexion and plantar flexion).

Position of Therapist: Sitting on low stool in front of patient. Alternate position: standing at side of table near patient's foot.

Test foot rests on examiner's lap. One hand is contoured over the dorsum of the foot just below the ankle for stabilization (Figure 5-120). The index finger of the other hand is placed beneath the proximal phalanx of the great toe. Alternatively, the tip of

the finger (with very short fingernails) is placed up under the proximal phalanx.



FIGURE 5-120

HALLUX AND TOE MP FLEXION

(*Lumbricales* and *Flexor hallucis brevis*)

Grades 5 (Normal) to 0 (Zero) Continued

Test: Patient flexes great toe.

Instructions to Patient: "Bend your big toe over my finger. Hold it. Don't let me straighten it."

Grading

Grade 5 (Normal): Patient completes available range and tolerates strong resistance.

Grade 4 (Good): Patient completes available range and tolerates moderate to mild resistance.

Grade 3 (Fair): Patient completes available range of metatarsophalangeal (MP) flexion of the great toe but is unable to hold against any resistance.

Grade 2 (Poor): Patient completes only partial range of motion.

Grade 1 (Trace): Therapist may note contractile activity but no toe motion.

Grade 0 (Zero): No contractile activity.

Helpful Hints

- The muscle and tendon of the flexor hallucis brevis cannot be palpated.
- When the flexor hallucis longus is not functional, the flexor hallucis brevis will flex the MP joint but with no flexion of the interphalangeal (IP) joint. In the opposite condition, when the flexor hallucis brevis is not functional, the IP joint flexes and the MP joint may hyperextend. (When this condition is chronic, the posture is called hammer toe.)

TOE MP FLEXION

(*Lumbricales*)

Grades 5 (Normal) to 0 (Zero)

Position of Patient: Short sitting with foot on examiner's lap. Alternate position: supine. Ankle is in neutral (midway between dorsiflexion and plantar flexion).

Position of Therapist: Sitting on low stool in front of patient. Alternate position: standing next to table beside test foot.

One hand grasps the dorsum of the foot just below the ankle to provide stabilization (as in test for flexion of the hallux) (Figure 5-121). The index finger of the other hand is placed under the MP joints of the four lateral toes to provide resistance to flexion.

Test: Patient flexes lateral four toes at the MP joints, keeping the IP joints neutral.

Instructions to Patient: "Bend your toes over my finger."

Grading

Grading is the same as that used for the great toe.



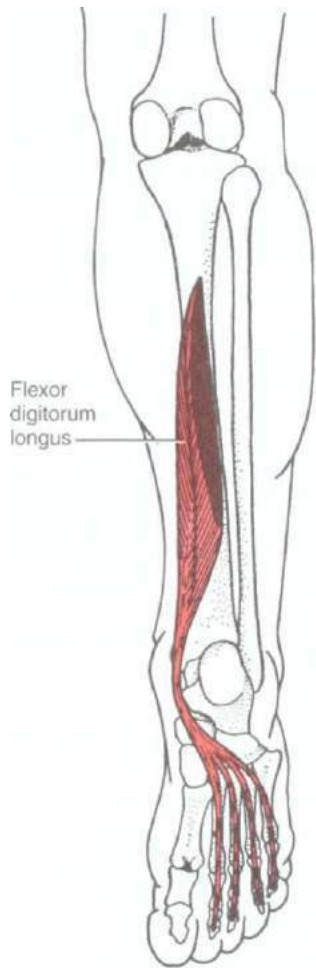
FIGURE 5-121

Helpful Hints

- In actual practice, the great toe and the lateral toes are rarely tested independently. Many patients cannot separate hallux motion from motion of the lateral toes, nor can they separate MP and IP motions.
- The examiner could test each toe separately because the lumbricales are notoriously uneven in strength. This may not, however, be practicable.

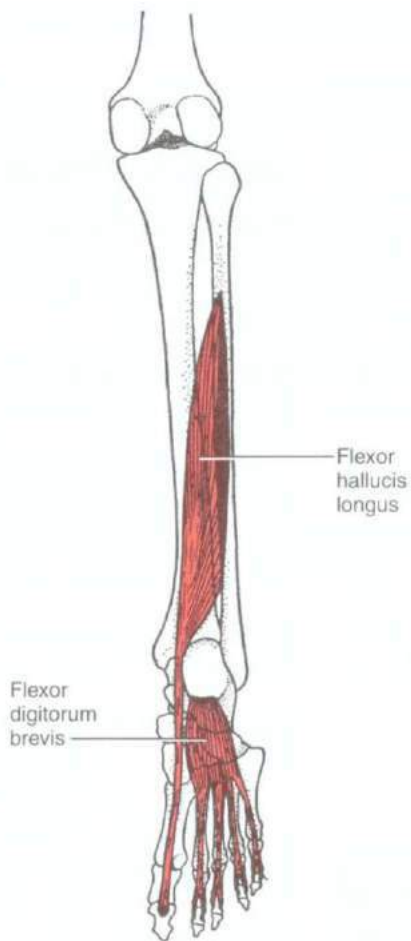
HALLUX AND TOE DIP AND PIP FLEXION

(*Flexor digitorum longus*, *Flexor digitorum brevis*, *Flexor hallucis longus*)



POSTERIOR VIEW OF LEG

FIGURE 5-122



PLANTAR VIEW OF FOOT

FIGURE 5-123

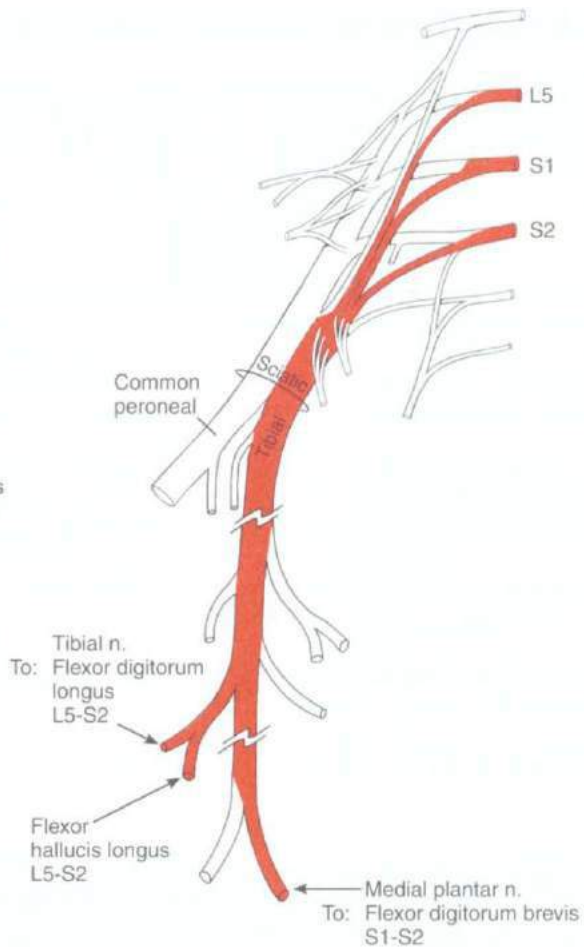


FIGURE 5-124

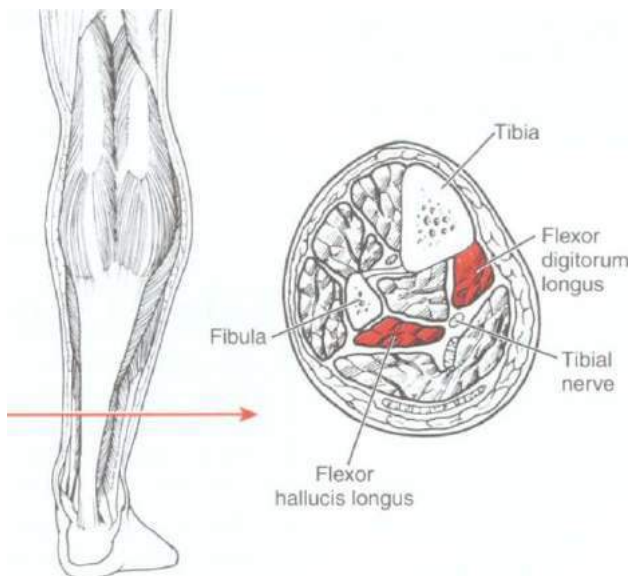


FIGURE 5-125

HALLUX AND TOE DIP AND PIP FLEXION

(*Flexor digitorum longus*, *Flexor digitorum brevis*, *Flexor hallucis longus*)

Range of Motion
PIP flexion, four lateral toes: 0° to 35°
DIP flexion, four lateral toes: 0° to 60°
IP flexion of hallux: 0° to 90°

Table 5-16 FLEXION OF IP JOINTS OF HALLUX AND TOES

I.D.	Muscle	Origin	Insertion
DIP—Toes			
213	Flexor digitorum longus	Tibia (shaft, posterior aspect of middle 2/3) Fascia over tibialis posterior	Toes 2-5 (distal phalanges, plantar surfaces and base)
PIP—Toes			
214	Flexor digitorum brevis	Calcaneus (tuberosity, medial process) Plantar aponeurosis Intermuscular septum	Toes 2-5 (by four tendons to middle phalanges, both sides)
IP—Hallux			
	Flexor hallucis longus	Fibula (shaft, 2/3 of posterior aspect) Interosseous membrane Intermuscular septum (posterior crural) Fascia over tibialis posterior	Slip of tendon to flexor digitorum longus Hallux (distal phalanx, base, plantar aspect)
Others			
DIP—Toes			
217	Quadratus plantae		
PIP—Toes			
213	Flexor digitorum longus		

HALLUX AND TOE DIP AND PIP FLEXION

(*Flexor digitorum longus*, *Flexor digitorum brevis*, *Flexor hallucis longus*)

Grades 5 (Normal) to 0 (Zero)

Position of Patient: Short sitting with foot on examiner's lap, or supine.

Position of Therapist: Sitting on short stool in front of patient or standing at side of table near patient's foot.

One hand grasps the anterior foot with the fingers placed across the dorsum of the foot and the thumb under the proximal phalanges (PIP) or distal phalanges (DIP) or under the IP of the hallux for stabilization (Figures 5-126, 5-127, and 5-128).

The other hand applies resistance using the examiner's four fingers or thumb under the middle pha-

langes (for the IP test) (Figure 5-126); under the distal phalanges for the DIP test (Figure 5-127); and with the index finger under the distal phalanx of the hallux (Figure 5-128).

Test: Patient flexes the toes or hallux.

Instructions to Patient: "Curl your toes; hold it. Curl your big toe and hold it."

Grading

Grades 5 (Normal) and 4 (Good): Patient completes range of motion of toes and then hallux; resistance in both tests may be minimal.

Grades 3 (Fair) and 2 (Poor): Patient completes range of motion with no resistance (Grade 3) or completes only a partial range (Grade 2).

Grades 1 (Trace) and 0 (Zero): Minimal to no palpable contractile activity occurs. The tendon of the flexor hallucis longus may be palpated on the plantar surface of the proximal phalanx of the great toe.

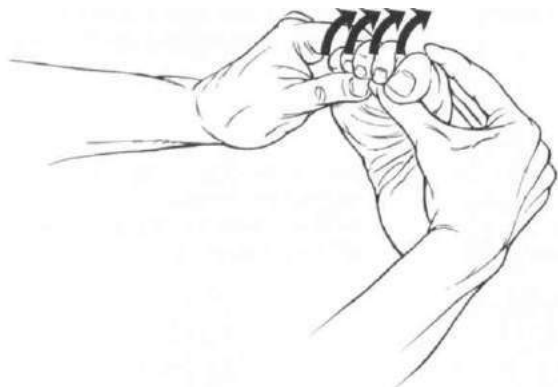


FIGURE 5-126



FIGURE 5-127



FIGURE 5-128

Helpful Hints

- As with all toe motions, the patient may not be able to move one toe separately from another or separate MP from IP activity among individual toes.
- Some persons can separate hallux activity from toe motions, but fewer can separate MP from IP hallux activity.
- Many people can "pinch" with their great toe (adductor hallucis), but this is not a common clinical test.
- The abductor hallucis is not commonly tested because it is only rarely isolated. Its activity can be observed by resisting adduction of the forefoot, which will bring the great toe into abduction, but the lateral toes commonly extend at the same time.

HALLUX AND TOE MP AND IP EXTENSION

(*Extensor digitorum longus and brevis, Extensor hallucis longus*)

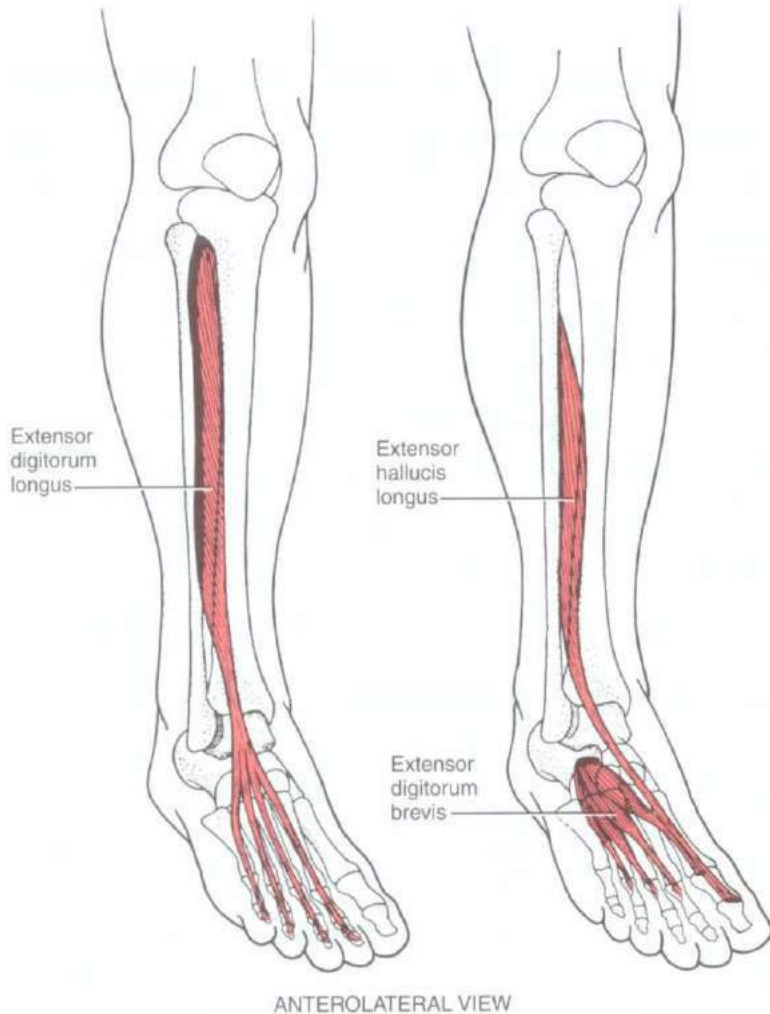


FIGURE 5-129

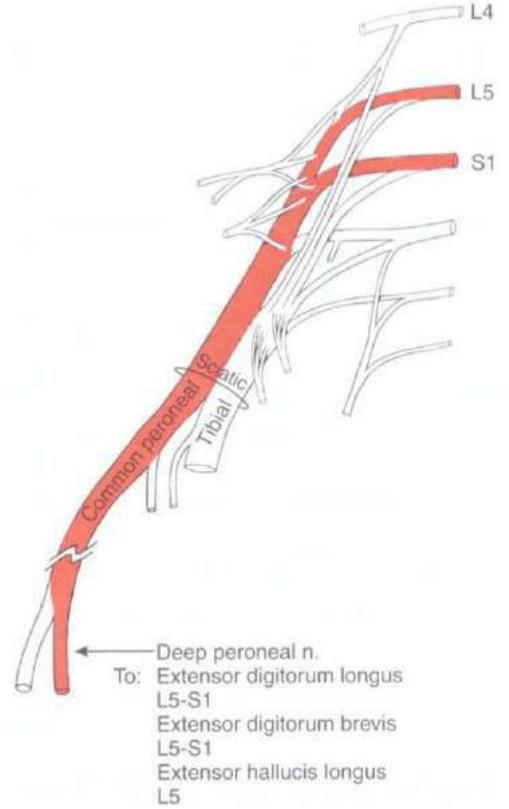


FIGURE 5-131

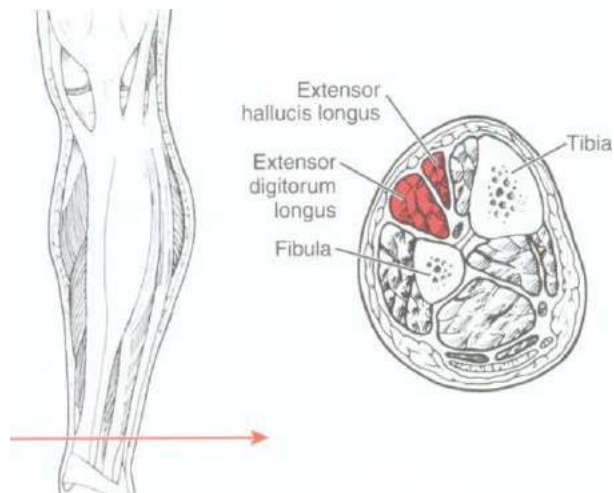


FIGURE 5-132

HALLUX AND TOE MP AND IP EXTENSION

(*Extensor digitorum longus and brevis, Extensor hallucis longus*)

Range of Motion

Hallux: 0° to 75°-80°

Digits 2-5: 0° to 40°

Table 5-17 EXTENSION OF MP JOINTS OF TOES AND IP JOINT OF HALLUX

I.D.	Muscle	Origin	Insertion
211	Extensor digitorum longus	Tibia (lateral condyle) Fibula (shaft, proximal 3/4 of medial surface) Fascia cruris (deep) Interosseous membrane (anterior) Intermuscular septum	Toes 2-5 (to each middle and each distal phalanx, dorsal surface)
212	Extensor digitorum brevis	Calcaneus (anterior superolateral surface) Lateral talocalcaneal ligament Extensor retinaculum (inferior)	Ends in four tendons: Hallux (proximal phalanx, dorsal surface; may be named <i>extensor hallucis brevis</i>) Toes 2-4: join tendons of <i>extensor digitorum longus</i> (lateral sides)
221	Extensor hallucis longus	Fibula (shaft, middle 1/2 of medial aspect) Interosseous membrane	Hallux (distal phalanx, dorsal aspect of base) Expansion to proximal phalanx

Grades 5 (Normal) to 0 (Zero)

Position of Patient: Short sitting with foot on examiner's lap. Alternate position: supine. Ankle in neutral (midway between plantar flexion and dorsiflexion).

Position of Therapist: Sitting on low stool in front of patient, or standing beside table near the patient's foot.

Lateral Toes: One hand stabilizes the metatarsals with the fingers on the plantar surface and the thumb on the dorsum of the foot (Figure 5-133). The other hand is used to give resistance with the thumb placed over the dorsal surface of the proximal phalanges of the toes.



FIGURE 5-133

HALLUX AND TOE MP AND IP EXTENSION

(*Extensor digitorum longus and brevis, Extensor hallucis longus*)

Grades 5 (Normal) to 0 (Zero) Continued

Hallux: Stabilize the metatarsal area by contouring the hand around the plantar surface of the foot with the thumb curving around to the base of the hallux (Figure 5-134). The other hand stabilizes the foot at the heel. For resistance, place thumb over the MP joint (Figure 5-134) or over the IP joint (Figure 5-135).



FIGURE 5-134



FIGURE 5-135

Test: Patient extends lateral four toes or extends hallux.

Instructions to Patient: "Straighten your big toe. Hold it." "Straighten your toes and hold it."

Grading

Grades 5 (Normal) and 4 (Good): Patient can extend the toes fully against variable resistance (which may be small).

Grades 3 (Fair) and 2 (Poor): Patient can complete range of motion with no resistance (Grade 3) or can complete a partial range of motion (Grade 2).

Grades 1 (Trace) and 0 (Zero): Tendons of the extensor digitorum longus can be palpated or observed over dorsum of metatarsals. Tendon of the extensor digitorum brevis often can be palpated on the lateral side of the dorsum of the foot just in front of the malleolus.

Palpable contractile activity is a Grade 1; no contractile activity is a Grade 0.

Helpful Hints

- Many (if not most) patients cannot separate great toe extension from extension of the four lateral toes. Nor can most separate MP from IP activity.
- The test is used not so much to ascertain strength as to determine whether the toe muscles are active.

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