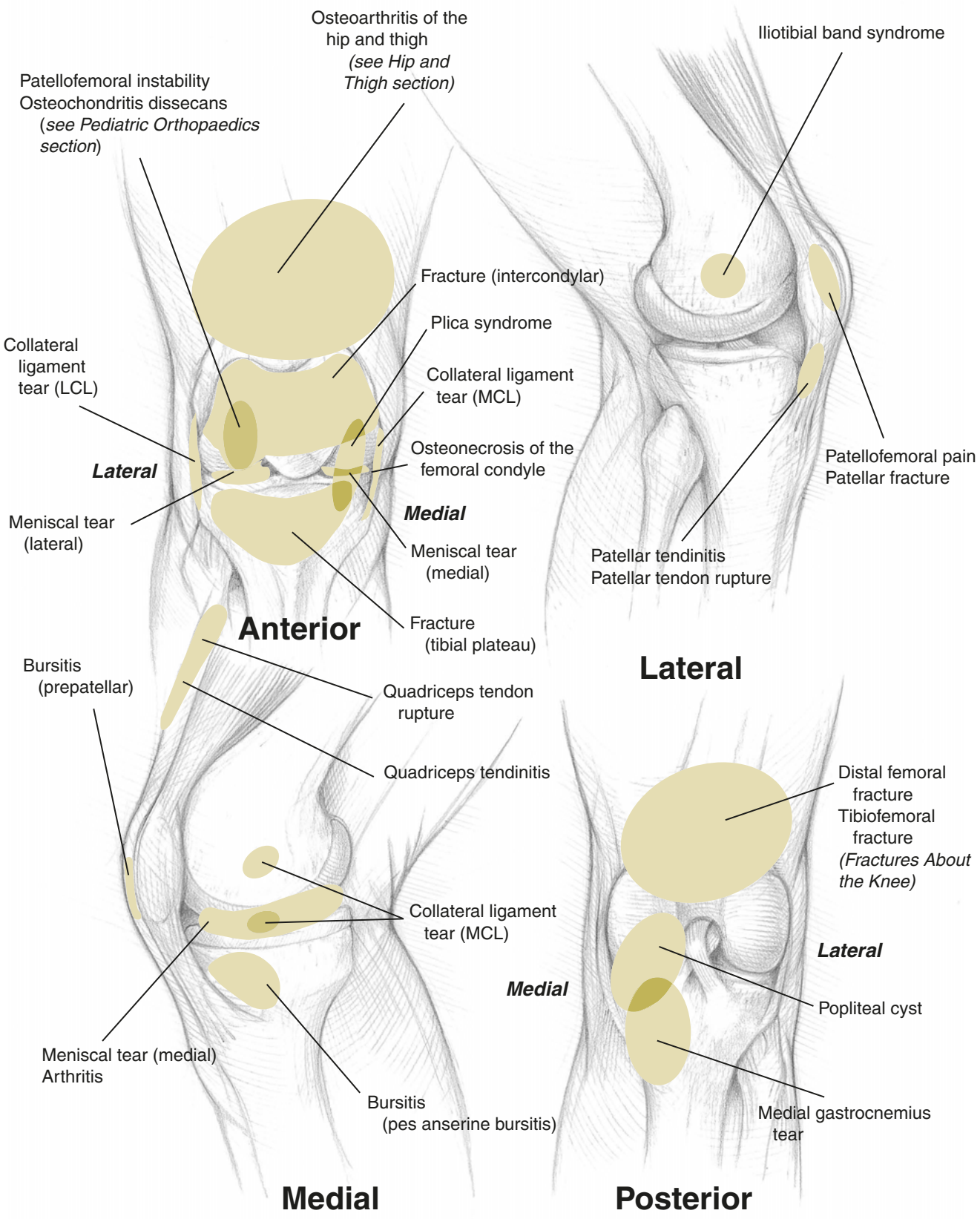
PAIN DIAGRAM

Knee and Lower Leg



Knee and Lower Leg

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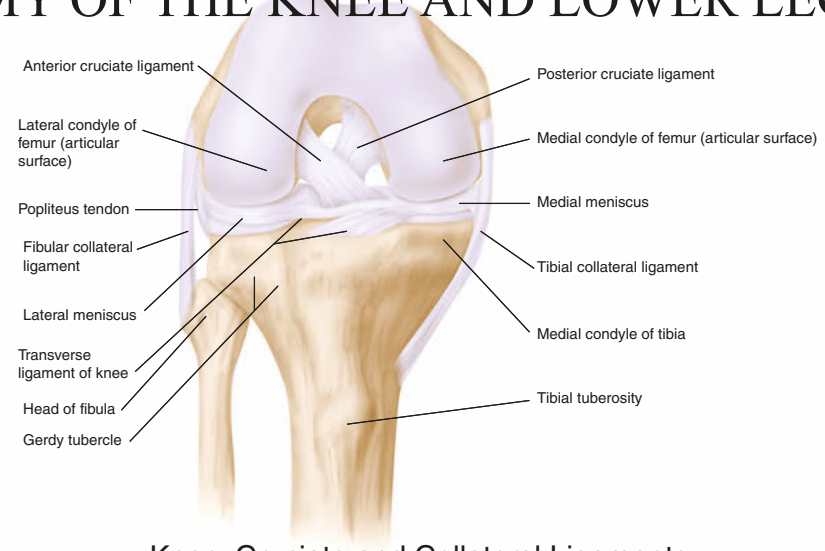
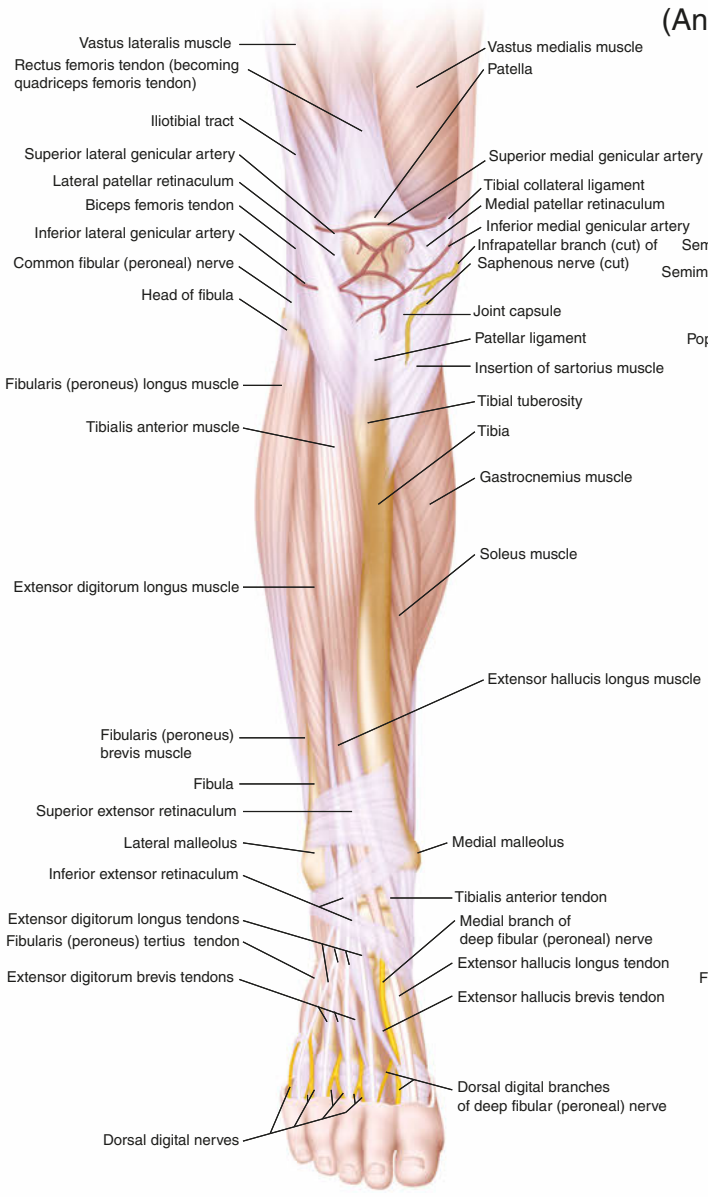
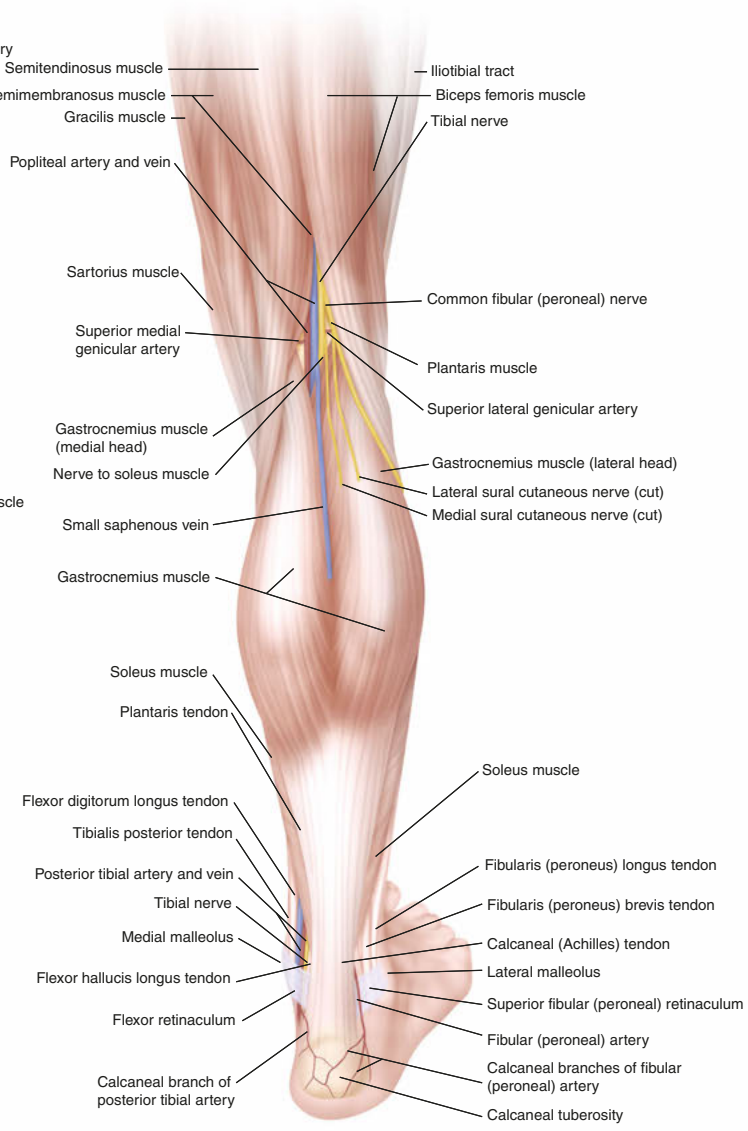
ANATOMY OF THE KNEE AND LOWER LEG



Knee: Cruciate and Collateral Ligaments
(Anterior View, Right Knee in Flexion)



Muscles of Leg
(Superficial Dissection)
Anterior View



Muscles of Leg (Superficial Dissection): Posterior View

Overview of the Knee and Lower Leg

Knee and lower leg problems are diagnosed by obtaining an appropriate medical history, performing a physical examination, and obtaining appropriate imaging studies. Radiographs are the initial imaging study of choice. Patients with knee problems report pain, instability, stiffness, swelling, locking, or weakness. These findings may occur in or around any aspect of the knee. Careful localization of the pain and tenderness will substantially narrow the differential diagnosis. The examination of patients with knee problems also includes a screening evaluation of the hip, spine, and back; some patients with problems intrinsic to the hip present with distal thigh pain and other symptoms that mimic knee disorders, whereas lumbar radiculopathy can produce thigh, knee, or leg pain.

Radiographic examination of the adult knee includes AP, 30° weight-bearing, lateral, and axial patellofemoral (Merchant or sunrise) views (**Figure 1**). Because of a higher incidence of osteochondritis dissecans and reduced likelihood of osteoarthritis, tunnel views obtained with the knee at 40° of flexion should replace the 30° weight-bearing views in patients younger than 20 years. If the patient is able to stand, weight-bearing AP radiographs of both knees should be obtained to allow comparison of the injured knee with the opposite, uninjured knee. A 30° weight-bearing view has been shown to demonstrate arthritis and joint space loss more readily than the AP view obtained in full extension. An axial patellofemoral view helps visualize the patellofemoral joint. Radiographs should be inspected

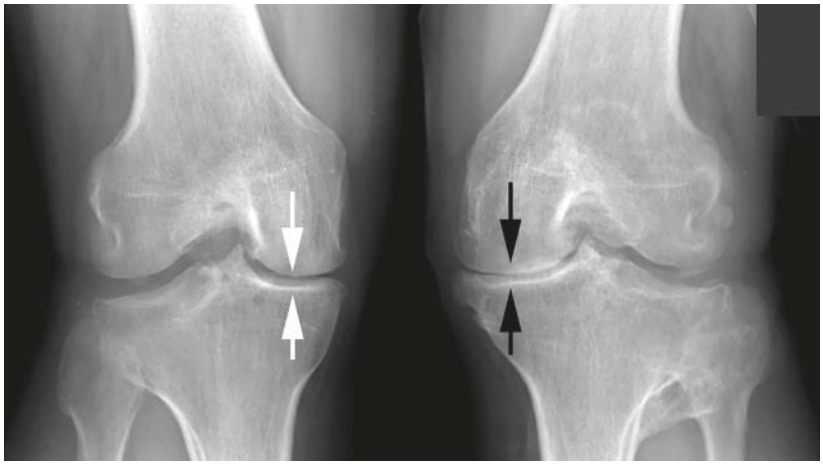


Figure 1 A 30° weight-bearing radiograph demonstrates joint space narrowing in the medial compartment of the left knee (black arrows). Note the more subtle joint space narrowing in the medial compartment of the right knee (white arrows) with less obvious degenerative change. (Reproduced from Johnson TR, Steinbach LS, eds: *Essentials of Musculoskeletal Imaging.* Rosemont, IL, American Academy of Orthopaedic Surgeons, 2004, p 532.)

Table 1

Possible Causes of Acute Leg and Knee Pain

Musculotendinous strains or contusions
Fractures
Dislocations
Compartment syndrome
Ligamentous injuries
Extensor mechanism injuries (patellar fracture, quadriceps or patellar tendon rupture)
Meniscal injuries

for changes in bony architecture, including lytic lesions, blastic lesions, and other areas of radiolucencies and opacities.

Weight-bearing AP radiographs obtained with the knee in full extension and 30° of flexion are used to evaluate medial and lateral compartment arthritis, fractures of the distal femur and proximal tibia, and tibiofemoral alignment. Lateral radiographs are helpful in assessing the patella for fractures and malposition (patella alta and patella baja). Axial patellofemoral views are used to assess patellar alignment within the trochlea and arthritis of the patellofemoral joint.

With the exception of an acute traumatic effusion and no apparent radiographic fracture, MRI is rarely indicated in the initial diagnostic workup. However, MRI often plays an important role as an advanced diagnostic tool or in surgical planning.

Acute Pain

Acute pain in the leg and knee often occurs secondary to an injury. Possible diagnoses fall into several categories, any of which can be associated with acute pain (**Table 1**).

Prompt diagnosis of unreduced fractures, unreduced dislocations, or acute compartment syndrome is required to prevent permanent residual sequelae, including substantial loss of limb function. Deformity and acute effusions often indicate the presence of a substantial injury.

Fractures can involve any of the periarticular osseous structures; dislocations can affect the tibiofemoral, patellofemoral, or rarely, the tibiofibular joint. The location of swelling, deformity, and tender areas can narrow the differential diagnosis, and radiographs can often confirm the presence of a fracture or dislocation. Patellar fractures can result from direct or indirect forces, such as rapid deceleration during falls, whereas fractures of the proximal tibia and distal femur often stem from major trauma. Knee dislocations are rare and result from low- or high-energy events. A high index of suspicion should be reserved for these injuries because knee dislocations often spontaneously reduce and can be associated with occult vascular injuries. The ankle-brachial index of the affected extremity should be determined in any patient suspected of sustaining a knee dislocation. In this setting, an ankle-brachial index less than 0.9 should prompt further vascular imaging. Patellar dislocations are often reduced at the scene when a patient or helper extends the knee. Compartment syndrome results from fractures or crush injuries and represents a surgical emergency. Clinically, the predominant early findings are paresthesia and excessive pain as the pressure increases within the tight fascial compartment. Although compartment syndrome is a clinical diagnosis, compartment pressure measurements are the definitive method to confirm a diagnosis. To minimize myonecrosis, fasciotomies should not be delayed in persons with suspected compartment syndrome.

Although these injuries are not as urgent, isolated ligamentous disruptions, musculotendinous strains and tears, and meniscal tears are other structural causes of acute pain. Patients with ligamentous

injuries often recall a "pop" that occurred at the time of injury and present with acute pain, substantial swelling, and instability. Patients with injuries to the extensor mechanism (such as quadriceps or patellar tendon rupture) report sudden collapse and an inability to actively straighten the knee. Meniscal injury should be suspected in persons with a history of a twisting injury sustained with the foot planted on the ground and localized pain and tenderness along the joint. Some patients with meniscal tears describe a locking sensation that prevents full extension and is relieved by gentle manipulation, which reduces or "unlocks" the meniscus. Contusions result from direct blows and cause localized pain and tenderness; musculotendinous strains are indirect causes of pain and swelling.

Acute pain without obvious injury can be caused by infection or crystalline arthropathy. Septic arthritis within the knee joint is rare in adults. More commonly, the prepatellar bursa is the source. Inspection and palpation of the involved area can help localize the infection. Infection in the prepatellar bursa causes swelling superficial to the patella; joint sepsis produces a substantial effusion within the knee joint deep to the patella. Although presentation is similar, infection is often distinguished from an acute crystalline arthropathy flare using knee aspiration for cell count, crystal, Gram stain, and culture. A cell count greater than 50,000 cells per mL suggests infection, and prompt irrigation and débridement of the joint should be considered.

Chronic Pain

Chronic knee and leg pain conditions are defined as those that have been present for more than 2 weeks. Conditions that cause chronic knee pain include osteoarthritis, overuse syndromes (including bursitis, tendinitis, and patellofemoral-related disease), tumors, chondral injuries, and meniscal tears. Inflammatory or crystalline arthropathies such as gout are chronic conditions that can sometimes manifest as an acute flare with an effusion and minimal radiographic change. The etiology of calf pain includes a spectrum of disorders. In addition to the unique ailments discussed in this section, chronic pain in the calf region also can be secondary to less common conditions such as infection (such as osteomyelitis or pyomyositis) and tumor (soft-tissue or bone).

Osteoarthritis and degenerative meniscal tears have similar presenting symptoms and often occur simultaneously. Although both are characterized by symptoms localized to the joint line and can be associated with loss of motion and radiographic changes, isolated degenerative meniscal tears can cause pain without radiographic changes. Bursitis, tendinitis, patellofemoral syndromes, and chondral injuries have similar characteristics; they are often bilateral, associated with increased activity, and worsen with rising or walking after sitting. Primary tumors involving the bone and joint are uncommon but important to recognize. Night sweats and unrelenting night pain are concerning signs and symptoms that should prompt further investigation for the presence of a tumor, which can usually

be identified on radiographs. The most common malignant primary bone tumors are osteosarcoma in adolescents and chondrosarcoma in adults, whereas the most common benign tumor involving the knee is the giant cell tumor, which typically occurs in persons aged 20 to 30 years. Metastatic disease in the knee region is uncommon.

Location of Pain

Anterior Knee Pain

Anterior knee pain is a common presenting symptom and suggests the presence of chondromalacia patella. Usually, patients describe a diffuse, dull, achy pain deep to the patella. In contrast, pain and focal tenderness at the upper and lower poles of the patella indicate tendinitis or partial tear of the patellar insertions of the quadriceps and patellar tendons, respectively.

Medial Knee Pain

Pain along the medial joint line is the hallmark finding associated with a torn meniscus. When the tear involves a large or unstable segment of the meniscus, patients may report a sensation of catching or locking. However, pain and tenderness in this region also can be secondary to arthritis or a focal chondral defect involving the medial compartment of the knee. When the medial joint line is associated with localized swelling and recent injury, a sprain or tear of the midsubstance of the medial collateral ligament should be considered. Alternatively, the medial collateral ligament can be injured near its femoral or tibial attachments with pain localized to the medial epicondyle or a region several centimeters distal to the joint line, respectively. Because of its proximity, injuries to the distal medial collateral ligament are often confused with pes anserinus pathology. The pes anserinus is composed of the insertion of the sartorius, gracilis, and semitendinosus tendons and is named as such because it resembles a goose's foot. Pain in this area in the absence of trauma suggests inflammation of the bursa beneath the pes anserine tendons.

Lateral Knee Pain

Pain along the lateral aspect of the knee is usually caused by iliotibial band syndrome, a lateral meniscal tear, lateral compartment arthritis, or a focal chondral defect affecting the lateral femoral condyle or tibial plateau. Although iliotibial band syndrome, presumably caused by friction between the tendon and the underlying lateral epicondyle, can cause pain anywhere along its course from the lateral epicondyle to the Gerdy tubercle, meniscal tears and chondral pathology are usually localized to the lateral joint line.

Posterior Knee Pain

Posterior knee pain is relatively uncommon. Meniscal tears involving the meniscal root and those associated with the formation of a Baker cyst are common causes of posterior knee pain. In addition, patients with knee effusions may perceive popliteal pain from the distention of the joint capsule. Because of the posterior location of the popliteal neurovascular bundle, abnormalities of the neurovascular system

should be considered in patients presenting with posterior knee pain. Popliteal artery aneurysms present as painful, pulsatile masses in the popliteal space and can result in catastrophic consequences if left unrecognized.

Instability

The knee joint can be divided into three compartments: medial tibiofemoral, lateral tibiofemoral, and patellofemoral. The tibiofibular joint, the articulation between the tibia and fibula, is rarely a source of knee symptoms and therefore is not commonly mentioned as a compartment.

Instability refers to a phenomenon in which an articulation has periods in which its components are incongruent, such as the patella subluxating laterally within the femoral trochlea during patellar subluxation or the tibia shifting anteriorly on the femur in the anterior cruciate ligament–deficient knee. Some patients present with feelings of instability, and others describe a sensation of giving way, slipping, or buckling. Buckling can also be caused by collapse of the knee secondary to pain causing reflex inhibition of the quadriceps mechanism.

Tibiofemoral

In the acute setting, muscle guarding by the patient often limits ligamentous evaluation. An ideal examination of the cruciate (anterior and posterior) and collateral (medial and lateral) ligaments is performed with the patient relaxed. Patient relaxation can often be gauged by the amount of tension palpated within the hamstring tendons posteriorly on the medial and lateral aspects of the knee.

Chronic knee instability can occur with severe arthritis; the loss of articular cartilage and the narrowing of the compartment are results of the ligaments not being fully tensioned. In these instances, the knee may have increased laxity when the ligament is tested; however, if the ligament is intact, there will be a firm end point when the ligament eventually tightens.

Patellofemoral

Instability within the patellofemoral joint usually manifests laterally with patellar subluxation or dislocation over the lateral trochlear ridge. Medial subluxation is seen almost exclusively in patients who have undergone a previous "lateral release" in which the lateral retinaculum is surgically divided to release a theoretical lateral tether to the patella. In most cases of patellar instability, the patella transiently subluxates or dislocates and spontaneously reduces. Occasionally, the patella will remain dislocated and the patient's knee will appear deformed and locked in approximately 45° of flexion. In either case, the patient usually exhibits apprehension when lateral displacement of the patella is attempted.

Stiffness

Stiffness generally refers to difficulty obtaining full range of motion. Stiffness has many acute causes (ligamentous injuries, fractures, infection, postoperative) and chronic causes (osteoarthritis, previous trauma or surgery). Stiffness is often associated with an effusion (an accumulation of fluid within the joint) and is an indicator that pathology is present. Distention of the knee joint capsule prevents full flexion. Although an effusion can be a subtle finding, especially in patients with obesity, stiffness can be the finding that alerts both patient and provider that intra-articular pathology exists.

Swelling

Swelling can occur intra-articularly (as an effusion) or extra-articularly. An effusion can be difficult to appreciate on examination. Distention occurs in regions where the osseous structures do not obscure the capsule from the skin. Therefore, an effusion is usually most noticeable above the patella in the suprapatellar pouch and posteriorly within the popliteal fossa. Conversely, extra-articular swelling is superficial to the joint capsule and is often more apparent. Prepatellar bursitis is the most common cause of extra-articular swelling around the knee. The swollen bursa is found superficial to the extensor mechanism and just inferior to the patella.

Locking

Locking of the knee occurs when a fragment, usually a loose body or a portion of a torn meniscus, gets caught between the femoral condyle and the tibial plateau and prevents the knee from extending fully. The knee can typically flex from the locked position, but the end range of flexion is also restricted. Patients "unlock" the knee by forcefully flexing, extending, or twisting, or making a "trick" movement.

"Pseudolocking" is a phenomenon that can present in patients with osteoarthritis or, less commonly, medial synovial plica syndrome. In osteoarthritis, pseudolocking occurs when adjacent irregular articular surfaces stick momentarily as they glide on one another, whereas with medial synovial plica syndrome, the thickened synovial tissue (plica) becomes momentarily caught beneath the patella as the knee extends. Most patients report that pseudolocking happens most commonly when the knee has been immobile, such as rising after prolonged sitting.

Weakness

Weakness of the muscles around the knee can occur acutely or chronically. Acute catastrophic weakness most often involves a complete disruption of the extensor mechanism at the insertion of the quadriceps or patellar tendon into the patella or a displaced patellar fracture. With partial ruptures, the extensor mechanism may remain functional, but without proper protection and a period of activity modification, the tear may become complete. Weakness of knee flexion may be related to a hamstring strain, or rarely, a tear of the

proximal hamstring insertion into the ischial tuberosity. Alternatively, weakness can be secondary to a reflex inhibition from knee pain or a knee effusion. An effusion with as little as 30 mL of synovial fluid can cause this inhibition.

Musculoskeletal Conditioning of the Knee

A conditioning program consists of three basic phases: stretching exercises to improve range of motion; strengthening exercises to improve muscle power; and proprioception (joint position sense) exercises to enhance balance and agility. In addition, the exercise session should begin with an active warm-up. Plyometric exercises (high-intensity explosive exercises) may be added for power only after basic strength and flexibility have been achieved. Patient handouts are provided here for the strengthening and stretching exercises. Advanced proprioception exercises and plyometric exercises should be performed under the supervision of a rehabilitation specialist or other exercise professional.

The goal of a conditioning program is to enable people to live a more fit and healthy lifestyle by being more active. A well-structured conditioning program also will prepare the individual for participation in sports and recreational activities. The greater the intensity of the activity in which a person wishes to engage, the greater the intensity of the conditioning that will be required. If the individual participates in a supervised rehabilitation program that provides instruction in a conditioning routine instead of using only an exercise handout such as provided here, the focus should be on developing and committing to a home exercise fitness program. A conditioning program for the body as a whole that includes exercises for the shoulder, hip, foot, and spine, as well as the knee, is described in the chapter Musculoskeletal Conditioning: Helping Patients Prevent Injury and Stay Fit, found in the General Orthopaedics section.

The knee has both dynamic and static stabilizers. Muscles provide dynamic stability to the knee joint and the patellofemoral articulation. Strengthening the quadriceps and hamstrings muscle groups provides dynamic stability to the knee. In addition, the hip muscles such as the gluteus maximus, the gluteus medius, and the internal and external rotators help to control the movements of the femur and the position of the patellofemoral articulation. Conditioning of the knee should focus on three phases: strengthening, stretching, and neuromuscular (proprioceptive) training. Plyometric exercises (power training) would be added for the competitive athlete after basic strength and flexibility have been achieved. Advanced proprioception exercises and plyometric exercises should be performed under the supervision of a rehabilitation specialist or other exercise professional.

Strengthening Exercises

Exercises to strengthen the quadriceps and hamstrings can be performed conveniently with progressively heavier ankle weights.

The resistance training must be progressive so that the muscle is constantly stimulated to grow. Forward lunges (for the quadriceps), hamstring curls, side-lying hip abductions, and hip extensions are good strengthening exercises. The patient should begin with a weight that allows 6 to 8 repetitions and should work up to 12 repetitions. After reaching 12 repetitions with a given weight, the patient should add weight and drop back to 6 to 8 repetitions.

Stretching Exercises

The effectiveness of strengthening exercises for the quadriceps muscle group can be compromised if the range of motion of the knee is limited. Stretching the soft tissues, especially after trauma or periods of immobilization, can be very effective in increasing range of motion. Hamstring stretching exercises such as leg crossovers and crossover standing increase the range of motion at the knee and hip during functional activities such as walking and running.

After the patient has achieved normal range of motion and strength, sport-specific or work-specific training should begin. The knee musculature needs to be strong and powerful, and protective reflexes need to be optimized to reduce the risk of injury during athletic maneuvers such as sudden changes in direction while running.

Proprioceptive Training

Proprioceptive training is important for balance. Balance, or postural control, is the result of the integration of visual, vestibular, and proprioceptive afferent inputs. The goal of proprioceptive training is to enhance the activity of the proprioceptors, thereby improving their ability to protect the ligaments of the knee. Several commercial devices, such as tiltboards and proprioceptive disks, are available for proprioceptive training. Advanced balance training should be performed under the supervision of a physical therapist, athletic trainer, or other exercise specialist.

Plyometric Exercises

Explosive power of the lower leg is necessary for a high level of athletic performance. Plyometrics and explosive weight training facilitate the development of power in the quadriceps, hamstrings, and gluteal muscles. Examples of plyometric exercises are jumping rope and jumping from side to side over a 6-inch–high barrier. More advanced exercises should be performed under the supervision of a physical therapist, athletic trainer, or other trained professional.

Home Exercise Program for Knee Conditioning

- Before beginning the conditioning program, warm up the muscles by riding a stationary bicycle or jogging for 10 minutes.
- After the active warm-up and the strengthening exercises, stretching exercises should be performed to maintain or increase flexibility. When performing the stretching exercises, you should stretch slowly to the limit of motion, taking care to avoid pain.
- If you experience pain with exercising, call your doctor.
- The following exercise program is introductory only, and progression of this program will vary based on your specific injury, symptoms, and baseline level of fitness. For further progression of this routine, your physician may recommend evaluation and treatment by a physical therapist or other exercise professional.

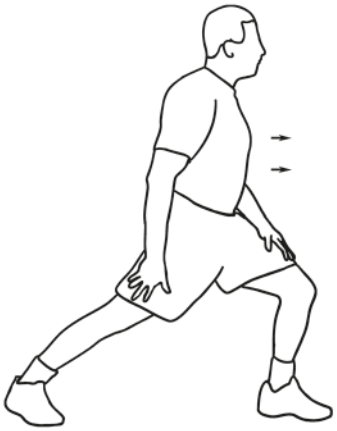
Strengthening and Stretching Exercises for the Knee

Exercise	Muscle Group	Number of Repetitions/Sets	Number of Days per Week	Number of Weeks
Strengthening				
Forward lunge	Quadriceps	Work up to 3 sets of 10 repetitions	3	6 to 8
Hamstring curl	Hamstrings	10 repetitions/3 sets	3	6 to 8
Side-lying hip abduction	Gluteus medius	6 to 8 repetitions, progressing to 12 repetitions	3	6 to 8
Hip extension (prone)	Gluteus maximus	6 to 8 repetitions, progressing to 12 repetitions	3	6 to 8
Straight leg raise	Quadriceps	6 to 8 repetitions, working up to 12 repetitions	3	6 to 8
Straight leg raise (prone)	Gluteus maximus	6 to 8 repetitions, working up to 12 repetitions	3	6 to 8
Wall slide	Quadriceps Hamstrings	Work up to 3 sets of 10 repetitions	3	6 to 8
Stretching				
Hamstring stretch	Hamstrings	3 to 6 repetitions/3 sets	Daily	6 to 8
Leg crossover	Hamstrings	3 to 6 repetitions/3 sets	Daily	6 to 8
Standing crossover	Hamstrings	3 to 6 repetitions/3 sets	Daily	6 to 8

Strengthening Exercises

Forward Lunge

- Stand up with the feet approximately 3 to 4 feet apart and with the forward foot pointing forward and the back foot angled to provide support.
- Lunge forward, bending the forward knee and keeping the back and the back leg straight. You should feel a slight stretch in the left groin area. Do not let the forward-lunging knee pass beyond the toes.
- Hold the stretch for 5 seconds.
- Repeat with the opposite leg.
- Work up to 3 sets of 10 repetitions, 3 days per week. Continue for 6 to 8 weeks.

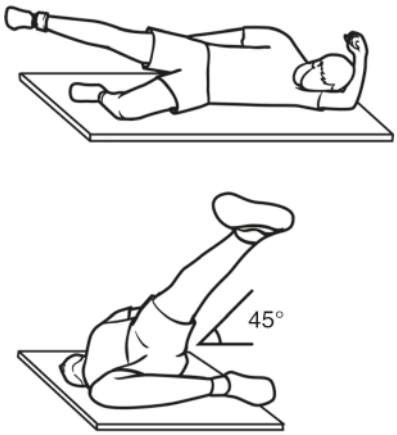


Hamstring Curl

- Stand on a flat surface with your weight evenly distributed over both feet. Hold on to the back of a chair or the wall for balance.
- Raise the heel of one leg toward the ceiling. Hold this position for 5 seconds and then relax.
- Perform 3 sets of 10 repetitions, 3 days per week. Continue for 6 to 8 weeks.

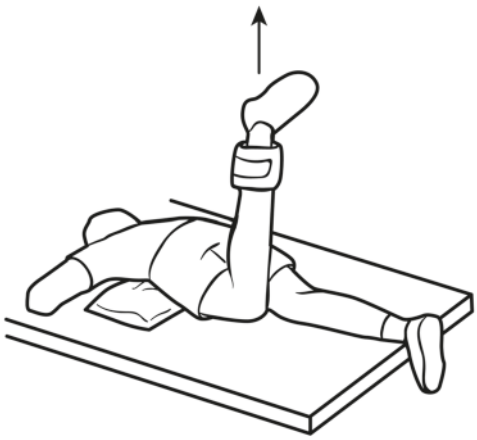
Side-Lying Hip Abduction

- Lie on your side, cradling your head in your arm. Bend the bottom leg for support.
- Slowly move the top leg up and back to 45°, keeping the knee straight. Hold this position for 5 seconds.
- Slowly lower the leg and relax it for 2 seconds.
- Ankle weights should be used, starting with a weight light enough to allow 6 to 8 repetitions, progressing to 12 repetitions. Then add weight and return to 6 to 8 repetitions.
- Repeat on the opposite leg.
- Perform the exercise 3 days per week. Continue for 6 to 8 weeks.



Hip Extension (Prone)

- Lie face down with a pillow under your hips and one knee bent 90°.
- Elevate the leg off the floor approximately 4 inches for a count of 5, lifting the leg straight up with the knee bent.
- Ankle weights should be used, starting with a weight light enough to allow 6 to 8 repetitions, working up to 12 repetitions. Then add weight and return to 6 to 8 repetitions.
- Repeat on the opposite leg.
- Perform the exercise 3 days per week. Continue for 6 to 8 weeks.



Straight Leg Raise

- Lie on the floor supporting your torso with your elbows as shown, with one leg straight and the other leg bent.
- Tighten the thigh muscle of the straight leg and slowly raise it 6 to 10 inches off the floor. Hold this position for 5 seconds. Repeat with the opposite leg.
- Ankle weights may be used, starting with a weight light enough to allow 6 to 8 repetitions, working up to 12 repetitions. Then add weight and return to 6 to 8 repetitions.
- Perform the exercise 3 days per week, for 6 to 8 weeks.

Straight Leg Raise (Prone)

- Lie on the floor on your stomach with your legs straight.
- Keeping the leg straight, tighten the hamstrings of one leg and raise the leg approximately 6 inches. Keep your stomach muscles tight and avoid arching the back.
- Repeat with the opposite leg.
- Ankle weights may be used, starting with a weight light enough to allow 6 to 8 repetitions, working up to 12 repetitions. Then add weight and return to 6 to 8 repetitions.
- Perform the exercise 3 days per week. Continue for 6 to 8 weeks.

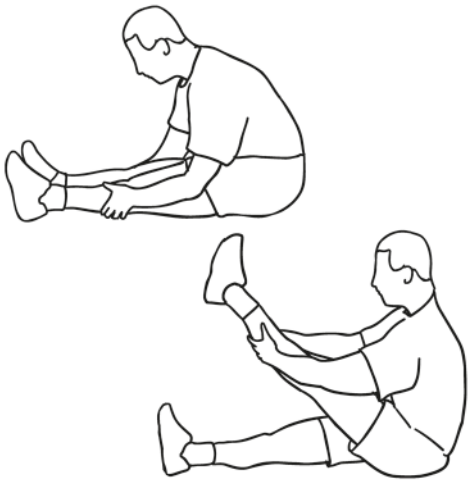
Wall Slide

- Stand with your back against a wall and your feet approximately 1 foot from the wall.
- Tighten your stomach muscles so that your lower back is flat against the wall.
- Stop when your knees are bent 90°. The knees should not pass beyond the toes.
- Hold for 5 seconds and then return to the starting position. Work up to 3 sets of 10 repetitions.
- Perform the exercise 3 days per week, for 6 to 8 weeks.

Stretching Exercises

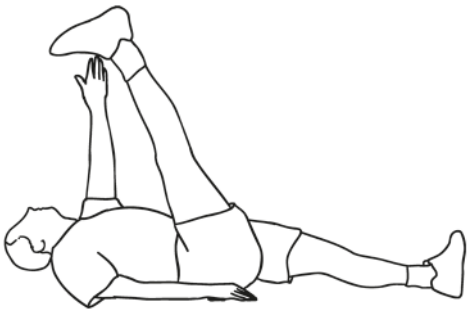
Hamstring Stretch

- Sit on the floor with your legs straight in front of you, and place your hands on the backs of your calves. For comfort, you may slightly bend the leg not being stretched.
- Slowly lift and pull one leg toward your ear, keeping your back straight. Hold the stretch for 5 seconds.
- Alternate from side to side.
- Repeat the exercise with each leg 3 to 6 times. Perform 3 sets per day for 6 to 8 weeks.



Leg Crossover

- Lie on the floor with your legs spread and your arms out to the sides.
- Bring your right toe to your left hand, keeping the leg straight.
- Hold the stretch for 5 seconds.
- Alternate from side to side.
- Repeat the exercise with each leg 3 to 6 times. For comfort, you may slightly bend the leg not being stretched. Perform 3 sets per day for 6 to 8 weeks.



Standing Crossover

- Stand with your legs crossed.
- Keeping your feet close together and your legs straight, slowly bend forward toward your toes.
- Hold the stretch for 5 seconds.
- Repeat with the opposite leg crossed in front for 3 to 6 repetitions. Perform 3 sets per day for 6 to 8 weeks.

Physical Examination of the Knee and Lower Leg

Inspection/Palpation

Anterior View

With the patient standing, inspect alignment and muscle symmetry, especially of the medial portion of the quadriceps muscles. Valgus malalignment is characterized by an ankle-to-ankle distance wider than the distance between the knees (knock knees). Conversely, varus malalignment is characterized by a knee-to-knee distance wider than the distance between the ankles. Persons with genu varum are referred to as being bowlegged. Internal femoral torsion, usually caused by the femoral neck leaning forward on the femoral shaft (femoral anteversion), aligns the knees with the patellae pointed inward when the feet are pointing straight ahead.

Posterior View

With the patient standing, assess for asymmetry of the posterior thigh and calf musculature, including the hamstrings and calf muscles.

Gait

Watch the patient walk. Gait observation provides information on function and may be helpful in developing a differential diagnosis. With arthritic and other knee conditions that produce pain with weight bearing, the patient will limit motion and shorten the duration of weight bearing on the affected side (antalgic gait pattern).

Persons with primary hip pathology may demonstrate a Trendelenburg gait in which the patient leans over the affected leg to compensate for hip abductor weakness. Patients with insufficiency of the lateral knee ligamentous structures, either from trauma or severe medial compartment osteoarthritis, may walk with a varus thrust, which involves normal alignment when standing but in which the knee falls into varus malalignment when the foot strikes the ground during ambulation. Footdrop or inability to dorsiflex the ankle can indicate a peroneal nerve injury, which can be seen in association with an injury to the lateral collateral ligament.

Squat

To assess knee flexion, ask the patient to squat. The patient should be able to flex both knees symmetrically. Pain with squatting may indicate meniscal injury or patellofemoral arthritis.

Knee Effusion

To assess for the presence of an effusion, with the patient supine and the knee extended, inspect the suprapatellar region. If a large knee effusion is present, fullness of the suprapatellar region and loss of the normal dimpling on either side of the patella will be apparent. Subtle knee effusions can be demonstrated by "milking down" joint fluid from the suprapatellar pouch. To perform the milking maneuver, apply downward pressure to the patella with one hand while using the other hand to hold the fluid wave in place. Excess fluid will create a "spongy" feeling as the patella is pushed down.

Patella

To assess for pathology within the extensor mechanism, palpate the superior and inferior poles of the patella. Quadriceps and patellar tendinitis produce tenderness at the superior and inferior poles of the patella, respectively; complete rupture of these tendons creates a palpable defect at their respective locations. The defect becomes more prominent with increasing knee flexion and is associated with the patient's inability to actively straighten the knee.

Patellar tenderness can be elicited by placing the patient supine, ensuring relaxation of the extensor mechanism, and displacing the patella laterally and medially to allow palpation of the edges and undersurface of the patella. To perform a sensitive test for patellofemoral crepitus, place the patient supine with the hip flexed to 90°, and then place a hand on the patella as the knee is moved through a range of motion. A sensation of crepitus with this maneuver suggests articular cartilage damage within the patellofemoral joint.

Joint Line Tenderness

Assess joint line tenderness with the patient supine and the knee flexed 90°. Identify the joint line within the soft spot between the femur and the tibia, then palpate the joint line along the entire joint margin on both the medial and lateral sides of the knee. An area of focal tenderness directly at the joint line supports the diagnosis of a torn meniscus. Joint line tenderness remains the most sensitive and specific physical examination test for the diagnosis of a meniscal tear.

Infrapatellar Bursa

The swollen infrapatellar bursa is usually visible as a dumbbell-shaped swelling on either side of the patellar tendon. In addition, the infrapatellar bursa can be palpated inferior to and on either side of the patella. Swelling of the infrapatellar bursa associated with erythema is concerning for a septic bursitis.