CME

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LEARNING OBJECTIVES

- Describe the elements of a complete history as the first part of a comprehensive knee evaluation
- Discuss a systematic method for the physical evaluation of the knee
- Explain the special tests used to ascertain specific types of knee injuries and the integrity of the neurovascular systems

How to perform a comprehensive examination of the knee

The knee is a complex and easily injured joint. This step-by-step guide leads the physician assistant through a thorough examination to an accurate diagnosis.

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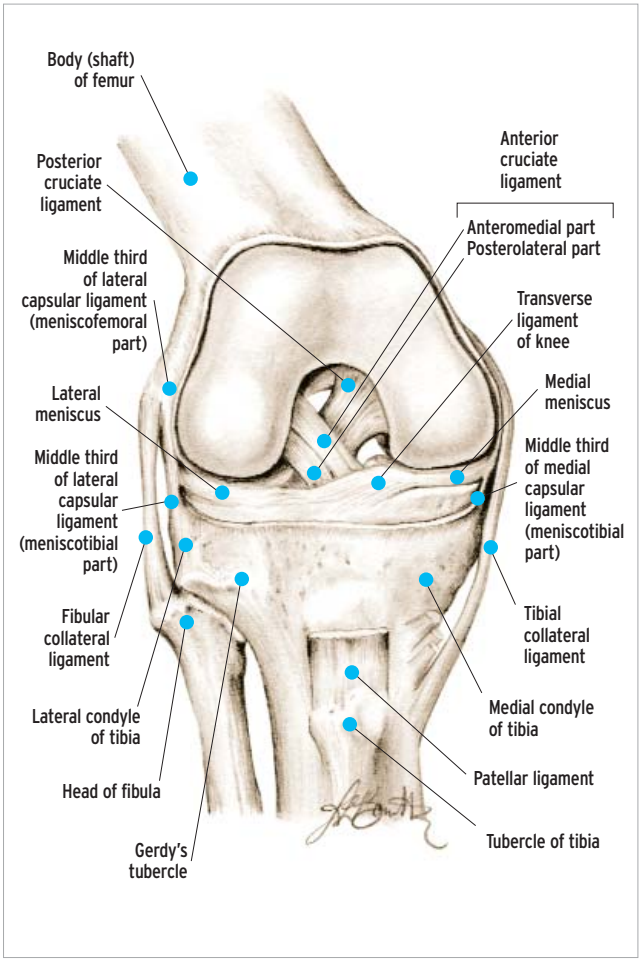
The American Academy of Orthopaedic Surgeons reports that in 2003, 19.4 million Americans visited a physician because of a knee problem.[1] An increasing older population and a greater number of persons who participate in recreational activities are making knee pain and injuries more common among the general population. All health care providers should be able to perform a physical examination of the knee, accurately determine a differential diagnosis, and decide whether to treat or refer the patient.

As with any clinical evaluation, begin by taking a complete history of the patient's problem, including the date of the injury, the mechanism of injury, and any treatment the patient has already received. Table 1 lists key questions that will provide critical information about the nature of the injury, the onset of symptoms, and any prior problems the patient has had with the involved knee. The answers to these basic questions can go a long way toward developing the differential diagnosis. A young, athletic person who sustains an acute knee injury while participating in a sport will generate a different list of potential diagnoses than will a middle-aged sedentary person with atraumatic insidious pain. In many cases, the differential can be narrowed down simply by talking to the patient.

THE PHYSICAL EXAMINATION

A systematic approach is vital when examining the knee. This prevents the examiner from missing pathology and allows him or her to recognize which signs indicate a possible abnormality. Observation, range of motion (ROM), palpa-



Jean L. Bonnette

FIGURE 1. Soft tissue and bony landmarks of the knee

tion, special tests, and a neurovascular examination are the components of a comprehensive examination.

The uninvolved knee is examined first to establish normalcy for that patient. Pain felt in the knee may be referred from the back or the hip, so examining both of those areas is important as well. A systematic examination may seem time-consuming; however, a PA who performs it consistently can become quite proficient very quickly.

Observation and inspection The examination begins by inspecting the knee and observing the patient walk. The patient's gait can provide information about the location of the pain and its effect on activities of daily living. Knee alignment is evaluated both while the patient is standing and lying supine; signs to look for are genu varum (also known as *bowleg*), genu valgum (or *knock knee*), and genu recurvatum (a hyperextension of the knee or *back knee*). In addition, the PA should note the details about any signs of muscle atrophy, ecchymosis, scars, abrasions, lacerations, or rashes.

Range of motion Musculoskeletal joint examinations must include an assessment of ROM. Active and passive ROM are assessed. ROM is recorded as the degree of hyperextension (if any), neutral position, and degree of flexion (ie, 5/0/135 indicates 5° of hyperextension, neutral position is at 0, and 135° of flexion). If the patient does not have full ROM, determine what is preventing full motion. Is pain and/or swelling limiting ROM?

The examiner must determine if the patient has an isolated area of swelling or a knee effusion. *Swelling* is defined as a localized area of edema on one part of the knee and is caused by an extra-articular injury. An *effusion* is a symmetrical area of inflammation around the knee that manifests hours after a traumatic event; it is a common sign of an intra-articular injury. To differentiate between swelling and an effusion, place your hand on the patient's thigh and apply gentle pressure, sliding your hand down toward the suprapatellar area, and palpate the knee with your other hand. A ballotable patella indicates presence of a knee effusion. The most common causes of an acute effusion resulting from hemarthrosis are peripheral meniscal tears, anterior cruciate ligament (ACL) rupture, intra-articular fracture, extensor tendon rupture, patella dislocation, and knee dislocation.[2-6]

TABLE 1. Key questions to ask during the history

Did you hear a pop or notice any swelling?
Does your knee feel like it locks or is unstable? Describe what you are experiencing.
Have you ever had surgery on this knee?
Have you ever injured your knee before this episode?
Have you had any type of dislocation? Does your knee cap ever shift out to the side, or does your lower leg shift out from under your knee in any direction?
What makes the pain worse? What relieves the pain?
Was the onset of the problem immediate or delayed?
Was there any trauma to your knee? Was it contact or noncontact?

Palpation The soft tissue and bony landmarks of the knee are evaluated (see Figure 1). The most painful areas should be palpated last. Starting above the knee, palpate along the quadriceps and patella tendons with the knee straight; any defects or gaps indicate an extensor tendon rupture. Next, palpate along the medial collateral ligament (MCL), lateral collateral ligament (LCL), iliotibial band, biceps femoris, pes anserine, and hamstring tendons. Flex the knee to 90°, and palpate along the medial and lateral joint lines (see Figure 2, page 22). The assessment continues with the bony landmarks, including the medial and lateral femoral condyles, the patella, the tibial tubercle, and the fibular head. As each of these structures is palpated, determine if the patient's pain is reproduced.

SPECIAL TESTS

Lateral/medial collateral ligament Laxity in the collateral ligaments is determined by testing the uninvolved knee first, then repeating the test on the involved knee. Test findings of the involved knee are compared with those of the other knee. The **valgus stress test**, used to test the MCL, is performed by placing one hand on the outside of the patient's knee and the other hand on the inside of the patient's ankle. The knee is pushed inward while simultaneously pushing the ankle outward (see Figure 3, page 23). This test is performed

KEY POINTS

- Basic questions during the history can go a long way toward developing the differential diagnosis. A young, athletic person who sustains an acute knee injury while participating in a sport will generate a different list of potential diagnoses than will a middle-aged sedentary person with atraumatic insidious pain. In many cases, the differential can be narrowed down simply by talking to the patient.
- The uninvolved knee is examined first to establish normalcy for that patient. A systematic examination may seem time-consuming; however, when performed consistently, a physician assistant can become quite proficient very quickly.
- The PA must determine if the patient has an isolated area of swelling or a knee effusion. Swelling is defined as a localized area of edema on one part of the knee and is caused by an extra-articular injury. An effusion is a symmetrical area of inflammation around the knee that manifests hours after a traumatic event; it is a common sign of an intra-articular injury.
- All extremity examinations must include a neurovascular evaluation. The vascular examination is performed by palpating pulses distal to the knee, including the posterior tibialis and the dorsalis pedis pulse. The neurologic examination involves evaluating both sensory and motor functions.

"No single diagnostic test is specific for a meniscal tear; however, the presence of joint-line tenderness is the most accurate clinical sign."

with the knee at 0° and 30° of flexion. An increase in laxity at 30° indicates an isolated injury to the MCL; increased laxity at 0° indicates additional injury to the cruciate ligaments.

Laxity in the LCL is determined with the **varus stress test**, performed in the same manner with the hand positions reversed. Place one hand on the inside of the knee and the other hand on the outside of the ankle. The knee is pushed outward while the ankle is pushed inward (see Figure 4). Analogous to the valgus stress test, increased laxity at 30° indicates an isolated injury to the LCL; increased laxity at 0° indicates additional injury to the cruciate ligaments.

Meniscus An inability to fully extend the knee should raise suspicions of a meniscal tear. Other signs indicative of this diagnosis are presence of a knee effusion, which occurs in 51% of patients,[7] and tenderness to palpation along either joint line. Although no single diagnostic test is specific for a meniscal tear, the presence of joint-line tenderness (77%-86% of cases) is the most accurate clinical sign.[8] Lowery and colleagues found a 92.3% positive predictive value for a meniscal tear if all physical examination findings are positive, including a history of catching or locking, pain with forced hyperextension, pain with maximum flexion, pain or click on McMurray's test, and joint-line tenderness to palpation.[9]

A provocative maneuver useful for differentiating a meniscal tear from patellofemoral pain is the **deep knee squat**. If the patient has a meniscal injury, pain will be localized to the medial or lateral side of the knee; patellofemoral pain is localized to the anterior aspect of the knee. Reproducing the patient's pain with the **Apley compression test** is suggestive of a meniscal tear. With the patient prone on the examination table, flex the knee to 90° and rotate the tibia internally and externally, applying axial compression through the patient's heel (see Figure 5). Pain on compression and/or a click is positive for a meniscal tear.

The **McMurray's test** is another test used to diagnose a tear of the meniscus. With the patient supine and the knee in full flexion, rotate the patient's foot outward and apply force inward while passively moving the leg into full extension. A click is positive for a tear of the lateral meniscus. An inward rotation of the foot and an outward force during extension is used to diagnose a tear of the medial meniscus. **Ege's test** is a weight-bearing version of this test. The patient stands with feet approximately 12 to 16 inches apart and performs a deep knee squat. The patient's feet are turned to a maximum external rotation to evaluate the medial meniscus or turned to a maximum internal rotation to evaluate the lateral meniscus. Findings are positive for a meniscal tear if the patient experiences pain or a click along the joint line.[10]

Anterior cruciate ligament Assessment of the ACL is achieved with the **anterior drawer test**. With the patient supine, flex the knee to 90° and stabilize the patient's foot flat on the examination table. Palpate along the medial and lateral anterior joint lines with your thumbs to determine how much the tibia translates forward. Wrap your hands around the tibia just below the knee and pull on the patient's leg (see Figure 6, page 24). Increased laxity compared with the uninvolved knee indicates ACL insufficiency.

The preferred examination maneuver for assessing ACL tears, however, is **Lachman's test**. The patient will completely relax more easily if you use your leg as a rest; with the patient supine, place the patient's leg over your leg, flexing the knee to 20° to 30°. Stabilize the femur by placing one hand on the patient's thigh and pull the tibia anteriorly with the other hand (see Figure 7, page 24). Increased laxity or lack of a firm end point compared with that in the uninvolved knee is indicative of ACL insufficiency.

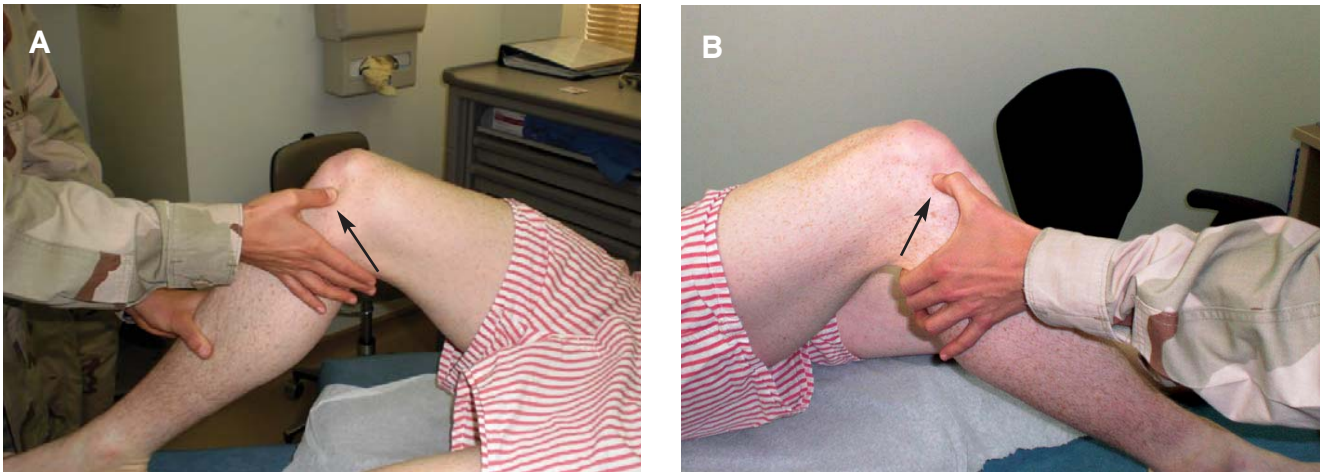


FIGURE 2. Palpation along the medial (A) and lateral (B) joint lines. Tenderness indicates a meniscal tear.

FIGURE 3. Valgus stress test

FIGURE 4. Varus stress test

FIGURE 5. Apley compression test

The **pivot shift test** assesses the rotational component of the ACL and a positive finding is pathognomonic of ACL insufficiency. With the patient supine on the examination table, hold the patient's leg at the ankle with the knee in full extension; push the knee inward (as you would in the valgus stress test). Rotate the tibia with the hand that is on the patient's ankle, and apply upward pressure. While holding this position, slowly bend the patient's knee. An audible and/or palpable clunk or shift felt at approximately 30° of flexion indicates a reduction of the tibia, which is a positive finding. This maneuver subluxates and reduces the tibia, which can cause the patient discomfort. Therefore, the test may be difficult to perform on a patient who is awake. The test is easier to perform with the patient under general anesthesia.[11]

Posterior cruciate ligament The gold standard for diagnosing tears in the posterior cruciate ligament (PCL) is the **posterior drawer test**.[11,12] Use the same position and stabilize the patient in the same way as for the anterior drawer test. Palpate along the medial and lateral anterior joint lines with your thumbs to determine if the tibia translates forward; wrap your hands around the tibia and push forward. Increased laxity compared with that of the uninvolved knee indicates PCL insufficiency.

The **reverse pivot shift** is used to evaluate PCL insufficiency with a posterolateral corner injury. With the patient supine on the examination table, hold the patient's leg flexed to 45°. Rotate the tibia outward, apply inward pressure on the tibia, and move the knee into full extension. A positive finding is confirmed by an audible and/or palpable clunk as the leg is fully extended.

An additional method for diagnosing PCL insufficiency is the **posterior sag test**. With the patient supine on the examination table, flex the hip and the knee to 90° (see Figure 8, page 24). If the tibia subluxates or sags below the femur, the finding is positive for PCL insufficiency.

Posterolateral corner This complex combination of soft tissue structures is located along the posterior and lateral aspect of the knee. The key anatomic elements are the LCL, the popliteus tendon, the popliteofibular ligament, and the posterolateral joint capsule.[13] An isolated injury to the posterolateral corner is rare; it usually occurs in combination with a ligament injury or knee dislocation. The posterolateral corner must be evaluated if an ACL tear is diagnosed because an injury requires immediate repair or reconstruction. ACL reconstruction will ultimately fail if the posterolateral corner injury is missed.

> "Consistent use of a systematic knee examination allows PAs to be more confident in their ability to diagnose knee problems."

The **dial test** evaluates posterolateral corner insufficiency. This test is best performed with the patient prone with the knees together. Rotate the tibias outward at both 30° and 90° flexion (see Figure 9, page 24). A positive finding is an increased rotation of more than 10° to 15° on the involved leg. Increased rotation at only 30° flexion indicates an isolated posterolateral corner injury; increased rotation at both 30° and 90° indicates a posterolateral corner injury and PCL insufficiency.[14-16]

Patellofemoral joint A positive finding on the **patella grind test** reproduces the patient's pain and indicates that the pa-

FIGURE 6. Anterior drawer test

FIGURE 7. Lachman's test

FIGURE 8. Posterior sag test

FIGURE 9. The dial test

tient has patellofemoral-related pathology. With the patient's leg in full extension, push the patella down and toward the femur as the patient contracts the quadriceps muscles. The **Q angle**, also called the quadriceps angle, is the difference between the alignment of the femur from the iliac spine to the patella and the alignment of the tibia from the patella to the tibial tubercle (see Figure 10). In men, the Q angle is 10°; in women, 15°.[17] A greater angle is indicative of patella malalignment.[18-20] The **J sign** is used to evaluate patella tracking. A positive finding is pathognomonic for lateral patella subluxation.[17] The patient sits at the end of the exam table with the knee flexed 90°. As the patient fully extends the knee, the examiner watches the movement of the patella. A positive J sign occurs when the patella slides laterally as the leg approaches full extension.[21]

Extensor mechanism The quadriceps tendon, the patella, and the patella tendon make up the extensor mechanism of the knee.[22] Ruptures of the quadriceps or patella tendon can have a detrimental outcome if not diagnosed acutely. Quadriceps tendon ruptures typically occur in persons older than 40 years, whereas patella tendon ruptures typically occur in younger persons.[11] These ruptures tend to occur with an eccentric contraction of the knee. Patients may hear a pop, are usually unable to walk after the injury, and develop a large knee effusion. Examination findings are a palpable suprapatellar gap if the quadriceps tendon is ruptured and a palpable infrapatellar gap if the patella tendon is ruptured.[23] A person who ruptures either of these tendons is unable to perform a straight leg raise or extend the knee.[22] These patients must be referred to an orthopedic surgeon immediately.

NEUROVASCULAR EXAMINATION

All extremity examinations must include a neurovascular evaluation. The vascular examination is performed by palpating pulses distal to the knee, including the posterior tibialis and the dorsalis pedis pulse. Capillary refill should occur in less than 2 seconds.

The neurologic examination involves evaluating both sensory and motor functions. Sensation is evaluated over the L2-S2 dermatomes. A decrease in sensation over a particular dermatome is a positive finding. Motor testing is performed to assess the function of nerves L2-S2. Knee extension is used to evaluate the femoral nerve; knee flexion, the sciatic nerve; plantar flexion of the foot, the tibial nerve; and dorsiflex and an outward turn of the foot, the peroneal nerve. An evaluation of the patella (L4) and Achilles (S1) deep tendon reflexes completes the neurovascular examination. An inability to perform any of the motor test maneuvers is a positive finding for a knee injury. In addition, strength can be graded using the 5/5 muscle-grading system.

CONCLUSION

Knee injuries are one of the most common reasons for a patient visit with a primary care provider. Acute or chronic knee pain also results in millions of patient visits each year. All clinicians should know how to perform a complete knee examination. Consistent use of a systematic knee examination allows PAs to be more confident in their ability to diagnose knee problems. A thorough knee history leads to an appropriate differential diagnosis, and a comprehensive physical examination leads to an accurate diagnosis. A discussion of treatment options can begin promptly. The patient will be grateful to know what is wrong, and treatment is more effective with timely initiation or prompt referral to an orthopedic surgeon. JAAPA

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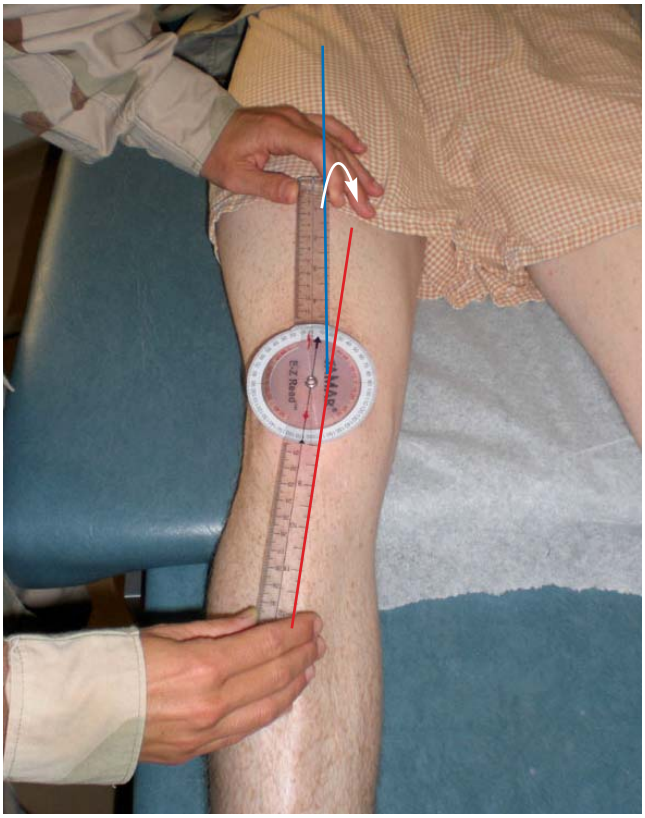

FIGURE 10. The *Q angle* (arrow) is the angle of difference between the superior iliac spine to mid-patella (blue line) and mid-patella to the tibial tubercle (red line).

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