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ACL History and Physical Examination

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Most of this textbook deals with the surgical management specific to the anterior cruciate ligament (ACL)-injured knee or failed ACL reconstruction. It is critical to establish the diagnosis of an ACL-deficient knee to minimize the potential for reinjuries. A sports medicine surgeon may encounter the ACL-injured patient on the playing field or more commonly will see a patient in the office. The history is frequently classic for ACL-related injuries. Of note is the high association of meniscal pathology and, in chronic settings, chondral abnormalities that warrant consideration.

ACL injuries can occur from either contact or noncontact injuries. The majority of ACL injuries occur from noncontact deceleration, pivoting, changing direction activities. Patients will frequently relate that it felt like their knee was "coming apart" and may describe this as a "2-fist sign" (Figure 5-1), whereby they place one fist atop the other and move one of the hands to demonstrate the sense of knee instability. The vast majority of patients will have a significant sense of instability, generally collapsing to the playing field, and are unable to continue playing their respective sport that day. Anywhere from two-thirds to 80% of patients will hear an audible pop or feel a "tearing" sensation.[1,2] Frequently, there is rapid onset of swelling. This hemarthrosis occurs because of tearing of the synovial tissue and the cruciate branch of the middle geniculate artery. The majority of acute ACL injuries will develop a hemarthrosis within 3 h. If swelling occurs between 12 and 24 h, this does not preclude an ACL injury. Frequently athletes will quickly apply ice to the knee and the development of an effusion may be of slower onset. A differential diagnosis for hemarthrosis includes ACL injury, posterior crucial ligament (PCL) injury, patellar dislocation, osteochondral fracture, popliteus avulsion, and peripheral meniscal tear. Effusions related to ACL injuries, patellar dislocations, and osteochondral fractures are generally more significant than a peripheral meniscal tear or even a PCL injury.

It is important to determine whether the injury was the index injury or whether the athlete has had previous injuries to the affected knee. Occasionally patients may have had a previous injury that they felt they had recovered from and, in fact, have a chronic ACL-deficient knee that has sustained a major episode of reinjury. Anywhere from 5% to 10% of patients may have had a contralateral ACL injury, so they might relate that they have had a previous ACL injury on the opposite knee. They may relate that they have been told that they had a "trick knee." Occasionally patients may be given the incorrect diagnosis of "patellar instability" when in fact they have an ACL-deficient knee. In the more chronic setting, patients may have mechanical symptoms related to meniscal pathology. With an acute ACL injury, the lateral meniscus is torn more frequently.[3] In chronic settings, the medial meniscus is more commonly torn. Locking symptoms may occur from either an incarcerated stump in the acute ACL-injured knee or from a displaced bucket-handle tear. Displaced bucket-handle tears occur far more frequently medially than laterally.[3] If a patient presents with a displaced bucket-handle tear, one must be cognizant that he or she may have had an acute bucket-handle tear superimposed upon a chronic ACL-deficient knee. One should be suspicious of a chronic ACL-deficient knee if a patient presents having related that in his or her teenage years he or she had a previous bucket-handle tear or meniscal surgery.

If a patient presents with a known chronic ACL-deficient knee, important aspects of the history include the ability to participate in sports, what sports are played, the number of hours in sports participation weekly, and the intensity of

Bach BR Jr, Provencher MT.
ACL Surgery: How to Get it Right the First Time and What to Do if it Fails (pp 39-52).

Table 6-1

Recommended Images to Identify Concomitant Pathologies

Pathology	*Recommended Imaging*
Tibial plateau fractures	Radiographs: AP, lateral, skiers
Pediatric bone age	Radiographs: AP left hand and wrist
Osteoarthritis secondary to untreated ACL injury	Radiographs: skiers
Bone bruises	T1-weighted coronal or axial
Chondral surfaces	T2-weighted coronal
Meniscus tears	T1- and T2-weighted coronals
PCL injury	T1- and T2-weighted coronals
MCL and LCL injury	Degree of injury: T1-weighted coronal Time of injury: T2-weighted coronal

AP=anteroposterior; ACL=anterior cruciate ligament; PCL=posterior cruciate ligament; MCL=medial collateral ligament; LCL=lateral collateral ligament.

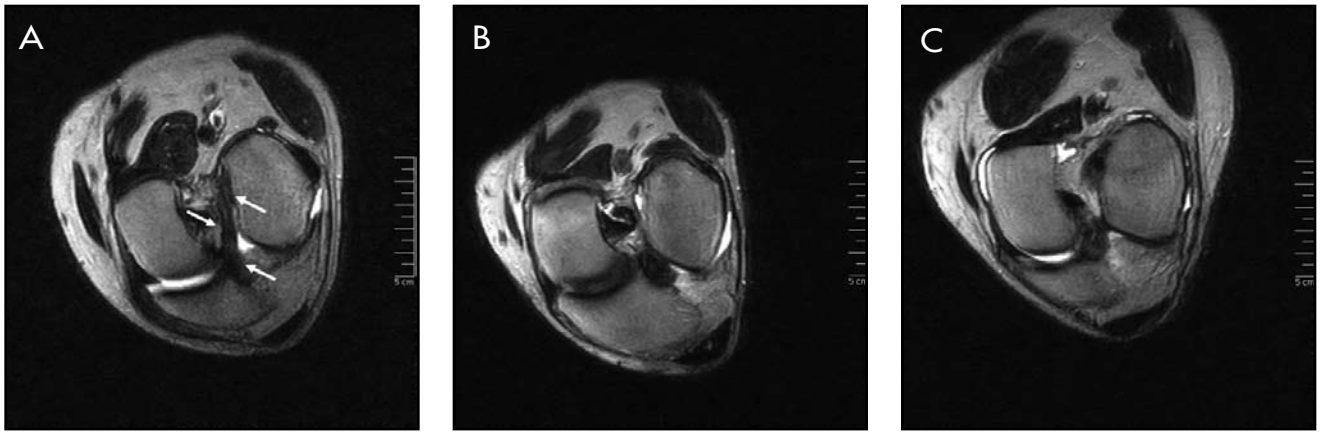

Figure 6-11. (A) Oblique ACL view of an intact ACL, (B) functionally deficient, and (C) injured ACL.

Blumensaat line and the projected course to the distal portion of the ACL[41]—less than 40 degrees provides an 84% to 94% sensitivity[41,42] and 94 to 100% specificity[41,42] for an injured ACL (Figure 6-12). In radiographic review, the clinician needs to observe the ACL in multiple planes and in its entirety (often 3 slices) and maintain an open eye on surrounding structures (Figure 6-13).

The surrounding structures can provide radiographic signs that are true pathologies and indirectly represent an ACL injury. These signs are classically noted to be kissing bone contusions in the lateral compartment, tibial plateau anterior translation and lateral meniscus tears. Despite the popularity of these signs, it is important to note that although their presence is useful for ruling in your diagnosis, their absence has little value in ruling out the diagnosis.[43] Similarly, it is useful to maintain an age-focused review for associated injuries.

Pediatric Patients

In their retrospective review of 84 patient MRIs, Prince et al[7] found associated injuries specific to the pediatric ages. In the skeletally immature population, there is a higher incidence of tibial spine avulsion fractures causing ACL insufficiency (26%) than found in the skeletally mature (4%).[7] The frequency of associated meniscus tears in the pediatric ACL-injured knee is less than that found in the adult populations.[7]

The clinician needs to maintain a high degree of suspicion for concurrent chondral injuries in pediatric or adolescent patients. When untreated, focal chondral lesions are possible predictors for the early progression to osteoarthritis. Oeppen et al[44] found isolated chrondral lesions to be the most prevalent concomitant pathology in the pediatric knee after acute trauma with or without ACL injury.

Figure 29-9. Preparation of a medial meniscus transplant. Some of the medial tibial spine can be removed with a high-speed burr to facilitate visualization and passage of the allograft.

Figure 29-10. Final preparation of the medial meniscus bone plugs. These are generally 8 mm in diameter and about 8 to 10 mm in depth. High-strength sutures are placed both in the bone plugs as well as in the medial meniscus horn attachment.

MEDIAL MENISCUS ALLOGRAFT TRANSPLANT WITH ACL RECONSTRUCTION

The most widely utilized technique for medial meniscal transplantation is the double-bone-plug procedure; however, the slot or dovetail technique has also been described.[39] When performing an ACL reconstruction, revision or primary, the tunnel for the anterior horn bone plug can converge to create a single hole in the anterior tibial cortex. A tibial trough used for a medial meniscal bone bridge potentially could violate the ligamentous insertion of the ACL; however, a trough technique for medial meniscal transplant has been well described and serves to preserve the native insertions of the meniscal allograft (Figure 29-9).

Keys for successful meniscal transplant:

- Anatomic placement of the allograft is critical for proper function of the meniscus. Placement of the medial meniscus allograft 5 mm or more medially and 5 mm or more posteriorly will cause a significant increase in the contact pressure between the femoral condyle and the tibial plateau.[40]
- Insertion of the anterior horn is more anterior than that of the lateral meniscus and is concealed deep to the intermeniscal ligament.

PEARL: The anterior and the posterior horn insertion sites need to be clearly identified for exact creation of the tibial tunnels for fixating the anterior and posterior horns of the meniscal allograft.

PEARL: To save operative time, the graft may be prepared prior to the case, or it can be prepared concurrently by an experienced assistant.

ALLOGRAFT PREPARATION

- Cut the bone block to a depth of 10 mm and insert a 2.4-mm guide pin perpendicularly through the center of the allograft insertion site (Figure 29-10).
- Introduce a collared pin over the guide pin and use an 8-mm coring reamer to cut the bone plug.
- Repeat for other meniscus insertion site.

PITFALL: Take great care not to damage the meniscus during this process.

PEARL: Alternatively, the bone plugs can be fashioned with a rongeur.

- High-strength No. 2 suture is passed through the bottom of the posterior bone plug and secured to the posterior allograft horn with a modified Kessler suture before passing back through the bone plug (Figure 29-11).

The knee is prepared in similar fashion to the lateral meniscal transplant and ACL reconstruction ensuring a 1- to 2-mm bleeding remnant of the medial meniscus remains.

PEARL: The medial portal is the working portal and will be easiest to use if it is lined up with the anterior and posterior horn insertion sites; however, when combined with an ACL reconstruction, this can affect the positioning of the over-the-top guide for placement of the femoral tunnel.

- Identify the insertion sites and use a drill guide to place 2.4-mm guide pins through the center of the site of origin for the posterior horn.

PEARL: A talar (ankle) drill guide works well in the posterior knee because it is low profile.

PEARL: Visualization of the posterior remnant can be improved by using a high-speed burr to clear away