Lower Limb - Clinical Disorders

INTRODUCTION

The ***Lower Limb - Clinical Disorders*** will focus on helping you understand common disorders involving the lower extremity that present throughout the lifespan. The syllabus is divided into three sections focusing on the Hip, Knee, and Ankle/Foot. Each section is organized to provide an overview of a specific clinical disorder, clinical presentation, imaging, and treatment. You should review the pertinent section of the ***Lower Limb Anatomy*** while reading about the common disorders so you can appreciate the underlying anatomy and its function in the setting of the clinical problem. Focus on the important information, which has been **BOLDED.** The document will be helpful for the **Large Group Case Presentation and Small Group Case Discussions.**

HIP

Hip region pain is a common presenting complaint to primary care offices and sports medicine clinics. Patients' definition of "hip" pain is highly variable and typically can be divided into three areas: posterior hip or gluteal, lateral, and anterior or groin. **True hip pain, from the femoroacetabular joint, typically localizes to the groin region**. Pain in the hip is also a **common site of referred pain, particularly from the lumbar spine area**.

Osteoarthritis of the hip

OVERVIEW – **Osteoarthritis** is the most common cause of **groin area hip pain** in adults. As with most degenerative changes, this is typically a use over time phenomenon which becomes **more common later in life.** It can also be **post-traumatic** in nature or have an earlier onset for other reasons (such as **systemic inflammatory disorders)**. Therefore, it should be considered in the differential diagnosis of hip and groin pain in any adult patient.

PRESENTATION – Typically patients experience **gradual onset of aching-type groin pain**. It is typically the worst when **getting up from sitting** and then with **increased activity**. **Flexion and internal rotation** of the hip are typically impacted most and patients will often describe difficulty with putting on socks or tying their shoes. Pain may radiate into the thigh or even knee so consider hip OA in the context of thigh and knee pain in **older adults** as well.

The physical exam typically reveals pain and **limited motion** with **internal rotation and flexion** of the hip and may have **tenderness over the anterior hip and groin region**. **Strength testing is typically normal** unless impacted by pain.

IMAGING – **Radiographs of the hip** (Figure 1-4) are typically **diagnostic for osteoarthritis.** Obtain AP pelvis and frog-leg views for the best look at the joint and comparison to the contralateral side. As is typical with osteoarthritis, **x-rays will show joint space narrowing, subchondral cyst formation, sclerosis of the joint lines, and**

osteophytosis. If OA is visualized on x-ray, additional imaging is rarely needed unless an additional diagnosis is being contemplated based on history and exam

Figure 1 AP x-ray of hip with osteoarthritis

Figure 2 "Frog leg' x-ray of hip with osteoarthritis

Figure 3 "Frog leg" x-ray of normal hip

Figure 4 AP x-ray of normal hip

TREATMENT – Standard treatment for osteoarthritis should be applied to the hip as well. These include **oral anti-inflammatories, intra-articular injections, rehabilitation exercises aimed at increasing range of motion and strengthening muscles around the hip and activity modifications.** An important note on activity in patients with osteoarthritis – they should avoid activities which cause pain but be encouraged to stay as physically active as possible as this is the best treatment for quality of life and functional limitations which result from OA. All other treatments should be directed towards promoting physical activity.

TREATMENT – The treatment of hip osteoarthritis (OA) is **aimed at relieving pain, improving function, and helping patients maintain an active lifestyle**. There is no cure for OA, so the focus is on managing symptoms and preventing further joint damage. Treatment can be divided into non-pharmacologic approaches, medications, injections, and, in some cases, surgery.

1. Non-Pharmacologic Treatments:

- **Weight Loss**: Reducing body weight can significantly reduce stress on the hip joint, helping to alleviate pain and slow the progression of OA. **Even a modest weight loss can have a positive impact.**
- **Activity Modification:** Patients should be encouraged to stay physically active, but it's important to **avoid activities that cause excessive pain** or joint strain, such as high-impact sports. **Low-impact activities like walking, swimming, and cycling** are recommended. Activity is key to maintaining mobility and improving overall joint function.
- **Physical Therapy:** Physical therapy is a cornerstone of OA management. **Targeted exercises** can help strengthen the muscles around the hip, improving **joint stability and reducing pai**n. **Stretching and exercises** aimed at improving range of motion are also important for maintaining mobility.
- **Use of Assistive Devices:** A **cane or walker** can help improve stability and reduce stress on the hip joint, especially during walking or when standing for long periods.

2. Medications:

- **Oral Anti-Inflammatory Drugs (NSAIDs):** Nonsteroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen or naproxen, are commonly used to reduce pain and inflammation. These should be used at the lowest effective dose for the shortest period possible to minimize side effects, especially gastrointestinal or renal issues.
- **Acetaminophen:** For patients who cannot take NSAIDs, acetaminophen (Tylenol) may be used to manage mild pain. It is not an anti-inflammatory but can provide pain relief with fewer side effects than NSAIDs.

3. Injections:

- **Corticosteroid Injections:** These can provide **short-term pain relief by reducing inflammation in the hip joint**. Steroid injections are typically used when oral medications are not sufficient, but their **use is limited due to potential side effects with repeated use (e.g., cartilage damage).**

- **Regenerative Injections:** Some patients may opt for i**njections of platelet-rich plasma (PRP) or stem cells.** These treatments aim to stimulate tissue healing and regeneration, though their effectiveness for OA is still under investigation and can vary between patients.

4. Surgical Treatments:

- **Hip Joint Replacement:** When **conservative treatments no longer provide relief** and the patient's quality of life is significantly impaired, surgery may be considered. **Total Hip Replacement (THR)** involves removing the damaged parts of the hip and replacing them with artificial components. This is **typically reserved for patients with severe OA** who have failed other treatments and experience debilitating pain or loss of function.

Gluteal Tendinopathy/Greater Trochanter Bursitis

OVERVIEW – **Gluteal tendinopathy** is responsible for most **lateral hip pain** in adolescents and adults. It is typically due to p**oor functional mechanics of the gluteal musculature** (Figure 5) putting stress on the distal tendons near their insertion around the greater trochanter. Historically this problem has been called **greater trochanteric bursitis**. However, actual bursitis (inflammatory fluid within a bursa sac) is very rare in this clinical presentation due gluteal tendinopathy is far more common.

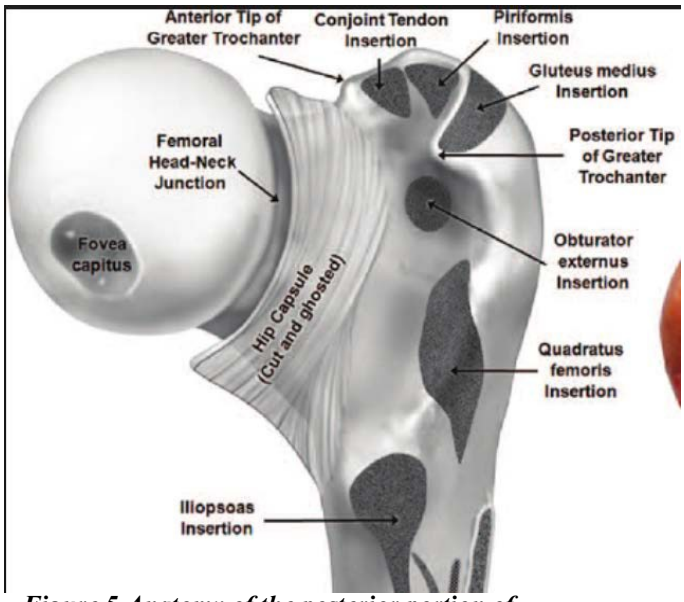


Figure 5 Anatomy of the posterior portion of the greater trochanter region

Tendinopathy is a process of **chronic, degenerative changes of tendon** characterized primarily by **pain and loss of function**. It should be distinguished from the commonly used term tendinitis. "**-itis" connotes an inflammatory process** and outside of the acute injury stage tendons contain very few, if any, inflammatory cells.

PRESENTATION – Gluteal tendinopathy typically presents with **gradual onset of lateral hip pain**. Typically, this is **worse with activity** and often **pain is noted when lying on the affected side**. **Pain and weakness** are commonly seen with testing of **hip abduction** as is **tenderness** in the region of the **greater trochanter.**

IMAGING – **Imaging is not typically necessary for the diagnosis of gluteal tendinopathy**. If the diagnosis is in question or if additional information is needed in cases

refractory to initial treatment, then diagnostic **ultrasound or MRI are the imaging modalities most helpful for evaluating gluteal tendons and bursae.**

TREATMENT – Treatment should initially be focused on **correcting biomechanical deficits of the gluteal muscles through rehabilitation exercises**. Activity modification during the initial phases of rehabilitation can play an important role in speed of return to activity. Oral anti- inflammatory medications can be used to help with severe symptoms, but long-term use should be avoided given systemic side effects as well as the inhibition of tendon healing. Corticosteroid and other injections can be used but long-term functional improvement and pain relief results with these are mixed.

Hamstring Tear/Tendinopathy

OVERVIEW – **Injury to the hamstring tendons or muscles is** responsible for most **posterior hip pain** in adolescents and adults. The **hamstring muscles** (Figure 6) include the **biceps femoris, semitendinosus and semimembranosus**, which are crucial for **bending the knee and extending the hip**. Movements including running, jumping or sudden accelerating activities can lead to acute tears or overuse injuries resulting in degenerative changes in the tendons. Contributing factors include inadequate warm-up, inflexibility and muscle imbalances that lead to overload of a specific muscle or tendon.

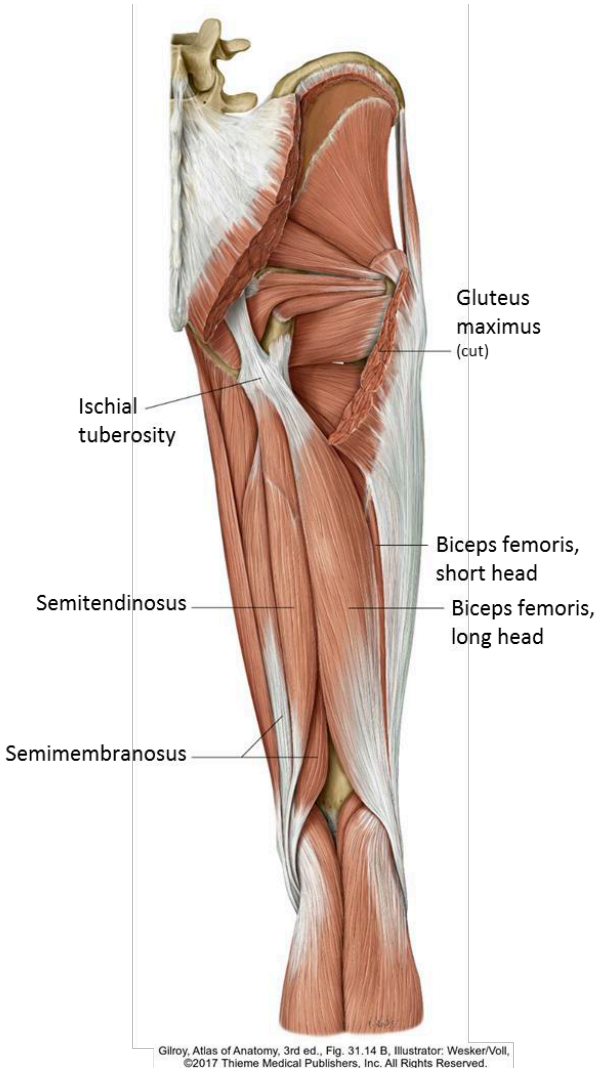


Figure 6 Anatomy of the posterior hip and thigh

Acute injuries will **result in tear of the tendon at its attachment to the ischial tuberosity or at the musculotendinosis junction**. **Tendinopathy** is a process of chronic, **degenerative changes of tendon characterized primarily by pain and loss of function**.

PRESENTATION – Hamstring tear or tendinopathy typically presents with **pain in the posterior hip or posterior thigh.** Typically, this is **worse with activity** and if severe, can lead to an inability to weight bear

on the injured limb. **Pain and weakness** are commonly seen with testing of **hip extension and knee flexion** as is **tenderness** in the region of the **hamstring muscle or tendons.**

IMAGING – **Imaging is not typically necessary for the diagnosis of a hamstring tear**. If the diagnosis is in question or if additional information is needed in cases refractory to initial treatment, then diagnostic **ultrasound or MRI are the imaging modalities most helpful for evaluating gluteal tendons and bursae.**

TREATMENT – Treatment should initially be focused on **correcting biomechanical deficits of the gluteal muscles through rehabilitation exercises**. Activity modification during the initial phases of rehabilitation can play an important role in speed of return to activity. Oral anti- inflammatory medications can be used to help with severe symptoms, but long-term use should be avoided given systemic side effects as well as the inhibition of tendon healing. Corticosteroid and other injections can be used but long-term functional improvement and pain relief results with these are mixed.

Legg-Calve-Perthes Disease

OVERVIEW — **Legg-Calve-Perthes' disease, or Perthes' disease**, is a presentation of **hip pain in children.** It is uncommon and usually occurs in the **4-8 year-old** age range, though it can occur at older ages as well. It is **more common in boys than girls.** The condition is a result of **avascular necrosis of the femoral head (Figure 7).**

Figure 7. Flattening of left femoral head (www.orthobullets.com)

PRESENTATION – The typical presentation of Perthes' is **child with subacute onset limp**. It can be associated with **anterior hip pain or knee pain**. Patients **typically do not have any history of known trauma or injury**. Some patients present with **thigh or knee pain** making this diagnosis important to remember in the appropriate clinical context with this location of pain. Often the affected **individuals are healthy and besides the pain-free limp** have an unremarkable history and presentation.

IMAGING – The diagnosis of Perthes' can be made on plain radiographs in most cases. AP pelvis and frog-leg views should be obtained for comparison between the two sides, which is how most cases are most easily seen. The **classic appearance on x-ray (Figure 8 – 9) is a flattening of the femoral head and occasionally the femoral head can appear to be fragmented**. Initially flattening of the femoral head on x-ray can be subtle and difficult to appreciate on x-ray.

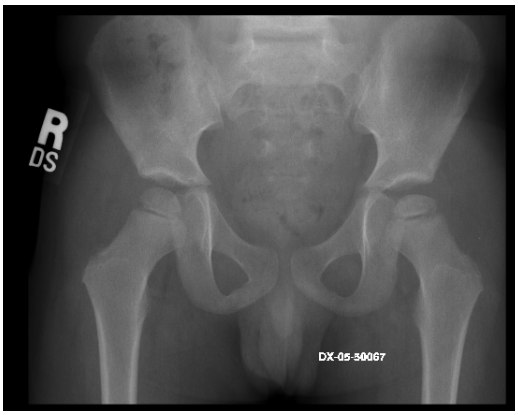


Figure 8. Initial imaging of 6yo boy with Perthes (left hip)

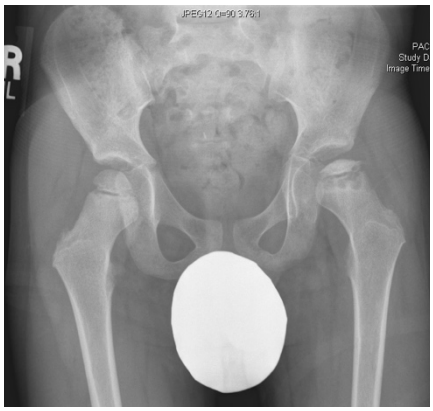


Figure 9. Follow-up imaging of 6yo boy with Perthes' (left hip)

TREATMENT – Treatment of Legg-Calve-Perthes' disease is quite variable. The **goal of treatment is to allow the femoral head to reconstitute as roundly as possible.** Legg-Calve- Perthes' is a **self-limited condition, with re-ossification and remodeling occurring after the initial resorption and fragmentation phases. Resolution usually takes 2-5 years**. Treatment options include observation, activity modification (ranging from non-weightbearing status to activity as tolerated but limited by pain) and surgery (about 40% of patients will eventually require surgery).

The prognosis is also variable. Many patients will have near complete resolution of symptoms while about one half of patients will eventually develop early degenerative changes due to an aspherical femoral head. These degenerative changes can lead to surgery, typically hip joint salvage procedures or hip replacement. Younger patients have a much better prognosis than those presenting at a later age. Patients diagnosed under 6 years of age have the most favorable prognosis.

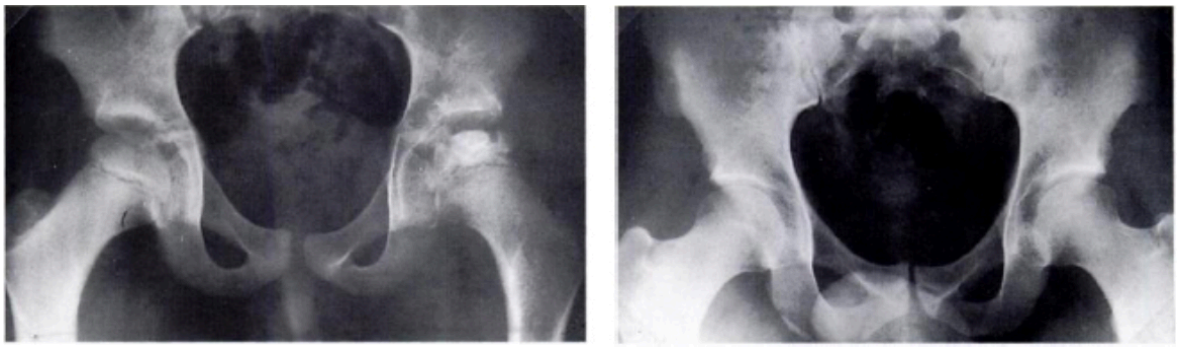


Figure 10 Initial radiographs of 8yo boy with Perthes' (left hip). Follow up radiographs at age 28yo showing near complete resolution. (www.orthobullets.com)

Slipped Capital Femoral Epiphysis

OVERVIEW — **Slipped capital femoral epiphysis (SCFE)** is a common presentation of hip pain in **early adolescence (peak incidence at 12 years old in girls and 13.5 years old in boys**). It results in the **separation of capital femoral epiphysis from the femoral neck through the physeal plate**. (Figure 11) **Obesity** is a significant risk factor for the development of SCFE.

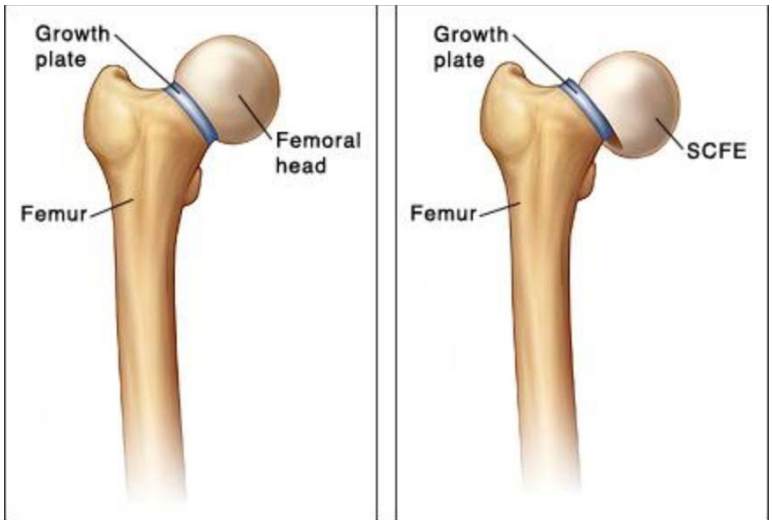


Figure 11

PRESENTATION – The typical presentation of SCFE is an **obese adolescent with subacute onset anterior hip pain and limp**. An acute SCFE can occur but is less likely than the chronic presentation and typically involves some type of trauma. Some patients will present with **thigh or knee pain** making this diagnosis important to remember in the appropriate clinical context with this location of pain. In addition, while the obese patient with SCFE is most common, **tall and thin adolescents, often indicating a rapid growth phase**, are also at higher risk. The type of **limp** at the time of presentation can vary based on the severity of the slip and whether it is unilateral or bilateral (up to 40% of cases).

IMAGING – The **diagnosis of SCFE can be made on plain radiographs** (Figure 12-13) in most cases. AP pelvis and frog-leg views should be obtained for comparison between the two sides. **Widening and/or blurring of the appearance of the physis is the most**

common AP view finding while a step off between the physis and the femoral neck are most seen on the lateral views. Slips can be small and difficult to see on x-ray. If clinical suspicion is high then MRI should be obtained for better visualization of the physis.

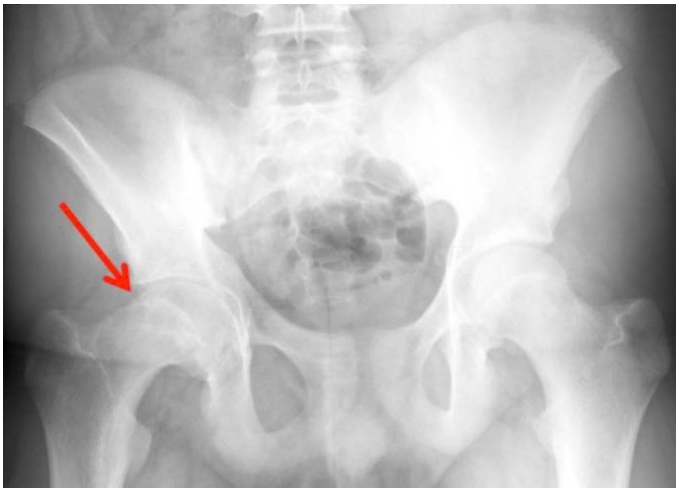


Figure 12 AP x-ray left slipped capital femoral epiphysis

Figure 13 "Frog leg" x-ray left slipped capital femoral epiphysis

Figure 14 AP x-ray right SCFE with screw fixation and subsequent healing and growth plate closure

TREATMENT –When diagnosed, patients should be made non-weight bearing (via crutches or wheelchair) due to risk for further slippage. **Prompt referral to an orthopedic surgeon or emergency department should follow diagnosis**. **Operative fixation of the slip (Figure 14) is the necessary and definitive treatment of SCFE**

Hip Fracture

OVERVIEW – **Hip fractures can occur at any age due to trauma.** In **older patients**, hip fractures can occur due to relatively **low- level trauma,** they are a very important cause of hip pain in older patients given the significant morbidity and mortality involved with this fracture. Broadly defined, "**hip fracture", can involve any structure from the femoral head through the femoral neck to the intertrochanteric region of the proximal femur**. The **blood supply to the head of the femur** is complex and tenuous, including the **foveal artery via the ligamentum teres and the extracapsular vascular ring circling the base of the femoral neck**. Hip fractures are at significant **risk for disrupting this blood supply** and impacting fracture healing. Presentation, management and outcome of hip fracture vary by the anatomical location of the fracture.

PRESENTATION – Nearly all **hip fractures i**nvolve a history of **trauma.** As noted above, in **elderly patients,** or those with other reasons for **low bone density,** the trauma may be minimal, e.g. fall from a chair. **Some patients with hip fractures which are minimally displaced may continue to bear weight and complain only of hip pain**.

IMAGING – For most patients, **plain radiographs of the hip and pelvis are adequate for evaluation of hip fractures. (**Figure 15-18) There are situations in which a non-displaced fracture, particularly of the femoral neck, are not seen on x-ray and MRI is necessary if clinical suspicion for hip fracture is high.

Figure 15 AP x-ray of right intertrochanteric femur fracture with significant displacement

Figure 16 Frog leg x-ray of intertrochanteric femur fracture with minimal displacement

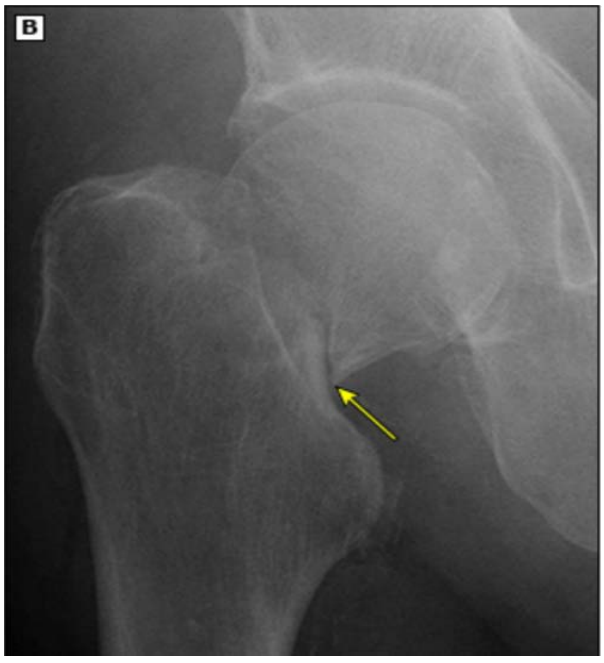


Figure 17 AP x-ray of right femoral neck fracture (displaced)

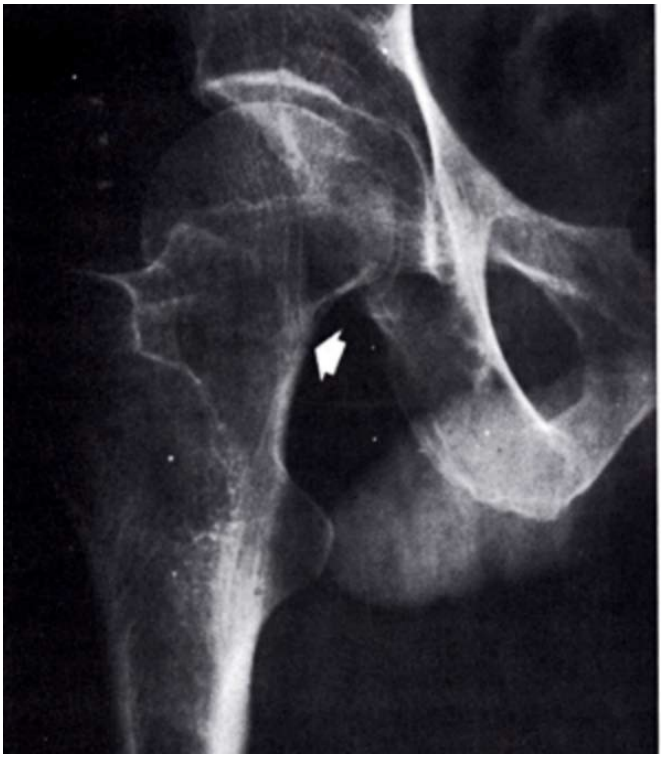


Figure 18 AP x-ray of right femoral neck fracture (compaction)

DIAGNOSIS	AGE	SYMPTOMS	PHYSICAL EXAM	IMPORTANT STRUCTURES
Hip Osteoarthritis	Middle Age to Elderly	Hip and Groin Pain	Limited hip range of motion. Pain with manipulation of hip	Femoral – Acetabular Joint
Gluteal Tendinopathy	Any	Lateral hip pain	Tenderness over the greater trochanter and weakness on hip abduction	Distal gluteal tendons, greater trochanter of the femur
Hamstring Tendinopathy	Any age, most common in young and middle aged adults	Posterior hip/gluteal region pain	Weakness with flexion of the knee and extension of the hip	Hamstring muscles Semimembranosus Semitendinosus Biceps femoris
Legg-Calve-Perthes' disease	Children (4-8 years)	Limp +/- hip pain	Limp. Pain with manipulation of the hip	Femoral Head
Slipped capital femoral epiphysis	Adolescents (12-14 years), overweight	Groin/ant thigh pain made worse with activity	Loss of internal hip rotation	Developmental structures of the femoral head, femoral neck, greater and lesser trochanters of the femur
Hip Fracture	Any, more common in elderly	Acute pain after trauma	Antalgic gait, hip may be held in abducted and externally rotated position	Femoral head, femoral neck, greater and lesser trochanters of the femur, extracapsular vascular ring

KNEE

Knee pain is another common presenting complaint in primary care offices and is an important cause of functional limitations in athletes and other highly physically active individuals. Onset, acute vs chronic, is a very important component of the history of knee pain, as is the presence or absence of swelling which is more perceptible and externally visible in the knee compared with other large joints. There are more stability issues to consider in the knee than in most other joints given the load it is responsible for and its inherent ligamentous structure. (Figure 19)

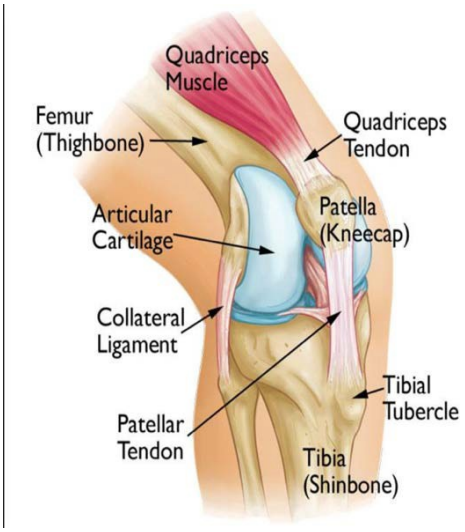


Figure 19 Key structures involved in patellofemoral pain

Patellofemoral pain

OVERVIEW – **Anterior knee pain** is the most common location of knee pain seen in primary care offices. This pain location can be present in many knee pathologies but most commonly emanates from the extensor mechanism of the knee – the **quadriceps tendon, the patellofemoral joint, and the patellar tendon/ligament**. Of these, the most common etiology of anterior knee pain is patellofemoral arthralgia. **Etiology of this pain can range from ill-defined pain due to poor tracking of the apex of the patella in the intercondylar notch to frank arthritis** at the patellofemoral compartment of the knee.

PRESENTATION – Patients will typically present with pain w**ell localized to the anterior portion of the knee**. Most commonly the **pain is insidious** in onset although people may remember a particular incident which made the pain worse. P**atients involved in running and jumping activities** are most commonly affected by patellofemoral pain. Another

common issue and group which presents with this pain are **those new or returning to exercise after being inactive for a period of time.**

IMAGING – **Most patellofemoral pain does not require imaging initially** as a diagnosis can be made on clinical grounds. Those with pain refractory to conservative therapy and/or with a joint effusion should be evaluated with advanced imaging including x-rays (Figure 20) or MRI. (Figure 21)

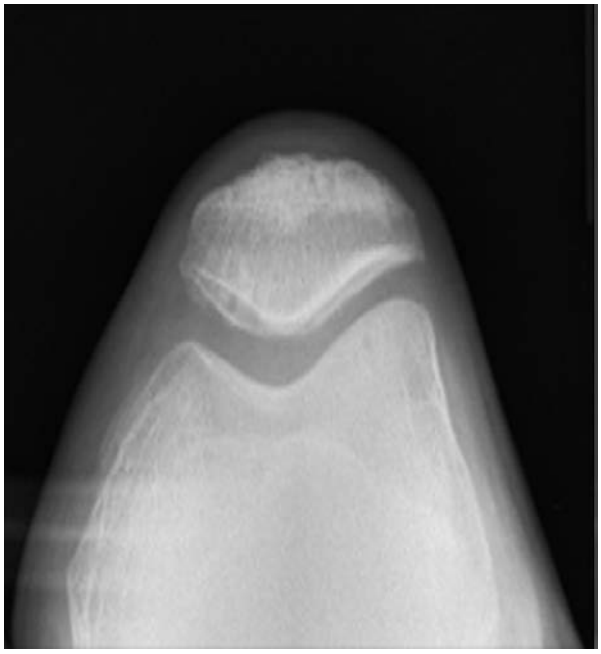


Figure 20 "Sunrise" view x-ray of the patella

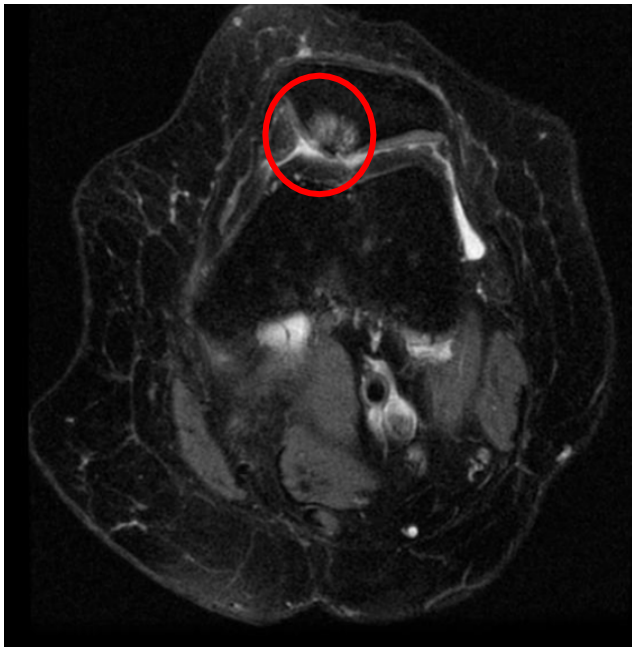


Figure 21 Axial MRI image of knee showing loss of patellar cartilage (red circle)

TREATMENT – **Standard care for patellofemoral arthralgia is physical therapy with an ongoing home exercise program** to address range of motion and more importantly strength deficits about the hip and knee. Weakness in abduction of the hip is a common source of additional stress through the patellofemoral region of the knee. There are advanced surgical techniques for treatment of patellofemoral arthritis such as resurfacing and tibial tubercle transfers. These are typically only considered after extensive conservative therapy has been attempted and failed.

Osgood-Schlatter Disease

OVERVIEW – **Osgood-Schlatter disease is an apophysitis occurring at the attachment of the distal patellar tendon to the tibial tubercle.** (Figure 22) This occurs primarily in **adolescent athletes** who are typically involved in **rapid growth phases**, e.g. before the tibial tubercle growth plate has closed.

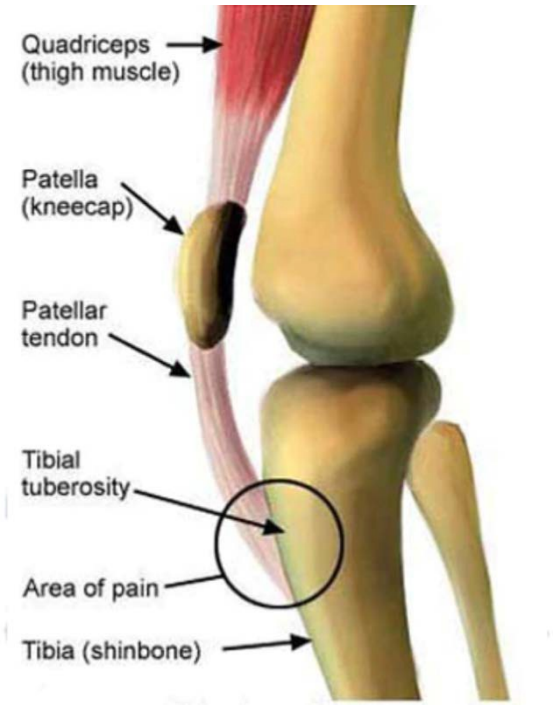


Figure 22 Structures involved in Osgood-Schlatter disease

PRESENTATION – **Adolescents** present to clinic with **insidious onset of anterior knee pain, rarely involving any joint swelling, instability or locking**. There is typically no specific incident but rather have an **activity profile consistent with overuse**. Patients will have **pain over the distal patellar tendon and tibial tubercle** as well as pain and **potential weakness with extension of the knee.**

IMAGING – **Classic presentation of Osgood-Schlatter disease, as noted above, does not require any specific imaging.** If there are concerns for other issues such as intra-articular knee issues or bony tibia issues plane radiographs (Figure 23) should be obtained with further imaging, such as MRI, only as indicated.

TREATMENT – **Treatment for Osgood-Schlatter disease is largely based upon activity modification.** This often involves an extended period of rest. **Physical therapy can also be helpful to optimize the stresses around the knee, including the hip**. Patients can participate in activities to pain tolerance and anti-inflammatory medications can be helpful in mitigating pain during activities. This is also a time to discuss with patients and families appropriate levels of participation and necessary rest in youth sports.

Figure 23 Lateral x-ray of the knee showing soft tissue swelling adjacent to the tibial tubercle

Osteochondritis Dissecans

OVERVIEW — **Osteochondritis dissecans (OCD) (Figure 24) is a lesion involving articular cartilage and subchondral bone**. It most commonly affects the **knee**. OCD is also seen in the **elbow** and **talus**, though less frequently. The etiology is unknown, though there is some thought that it occurs due to **impaired blood flow to an area of subchondral bone, possibly from overuse and repetitive microtrauma**. **Juvenile** OCD usually occurs from **ages 10-15,** while the **physes remain open**. Lesions that occur after skeletal maturity, when the physes are closed, have a much poorer prognosis. Younger age of onset, in general, predicts, a better prognosis. The **most common site is in the knee,** specifically the **lateral aspect of the medial femoral condyle**. Lesions of the lateral femoral condyle and patella are less common and have worse prognoses. **Elbow capitellar OCD lesions** are often thought to occur due to **overuse from overhand throwing or repetitive weightbearing (gymnastics**).

Figure 24. Displaced, unstable OCD lesion of the lateral aspect of the medial femoral condyle

PRESENTATION – The **presentation** of OCD in patients is **variable**. Most often patients present with **chronic, insidious onset of pain.** Occasionally the OCD lesion can be found incidentally while evaluating a child for an acute injury. **Recurrent effusions or even mechanical symptoms, such as locking or catching**, can occur particularly in advanced cases. OCD can also occur **acutely** in the case of an injury that results in a **sudden disruption of the articular surface**. Lateral elbow pain in **throwers** is a common presentation for **elbow capitellar OCD**. **OCD of the talus** can occur as a late sequalae of a **lateral ankle sprain**.

IMAGING – The **diagnosis of OCD can be suggested on plain radiographs by the appearance of a lucency in the subchondral bone (Figure 25-27).** This lucency can have surrounding sclerosis or even small subchondral cysts. Due to the common anatomical location (posterolateral aspect of medial femoral condyle of the knee), tunnel (notch or Rosenberg) views of the knee may be needed to see the lesion. Sunrise or Merchant views of the patella can be helpful in identifying lesions of the patellar facets. **Once suspicion of a possible OCD lesion is raised on plain film, an MRI is usually obtained to establish the definitive diagnosis and to assess for stability of the lesion and overlying articular cartilage**.

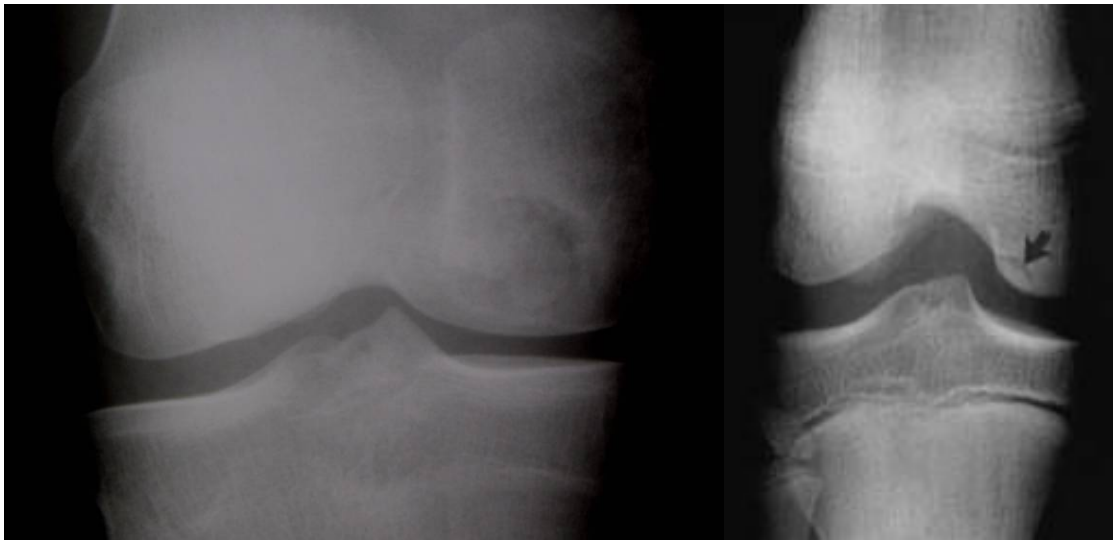


Figure 25a AP and tunnel views of a medial femoral condyle OCD lesion. Note the increased visibility on the Tunnel view.

Figure 25b OCD of the medial femoral condyle, AP view

Figure 26 OCD of the medial femoral condyle, Tunnel view

Figure 27 MRI of OCD of Knee, note the increased signal of the subchondral bone, the plane of separation indicated by the arrows, and the bone marrow edema extending beyond the lesion

TREATMENT – **Treatment of OCD is dependent on the stability of the lesion and skeletal age of the patient. Stable OCDs can be treated initially with a combination of observation and activity modification.** Activity will usually be restricted to avoid impact to that area—e.g. no running or jumping for lower extremity lesions, no throwing for elbow OCD. Sometimes bracing will be used to reinforce the activity modification and to prevent shear forces along the articular cartilage. Physical therapy is also commonly used, particularly after immobilization. **Unstable lesions require surgical management for stabilization or articular cartilage salvage procedures.**

Cruciate Ligament Tears

OVERVIEW – **The anterior and posterior cruciate (Figure 28) ligaments are major sources of stability for the knee joint.** Issues with these ligaments are typically due to tears arising from **acute trauma.** Stability of the knee is the primary issue that needs to be assessed and addressed during evaluation and treatment following these injuries.

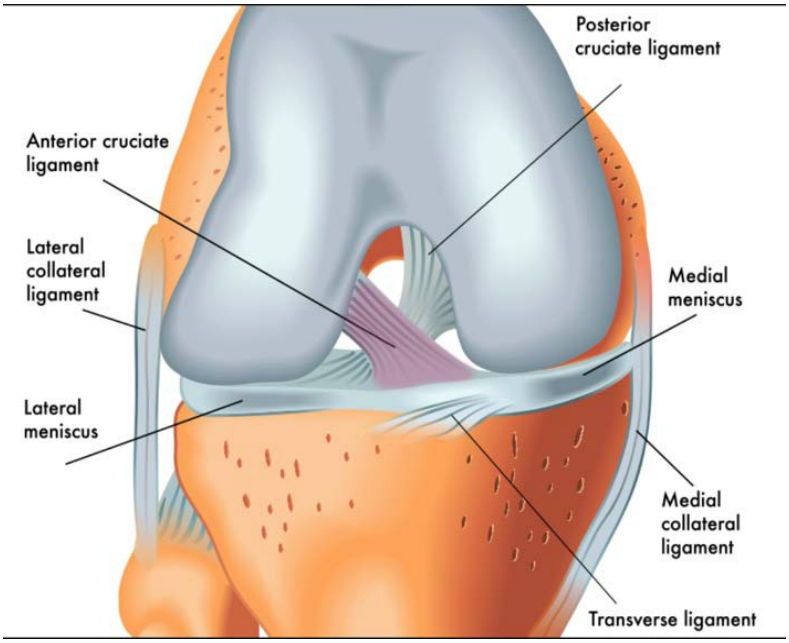


Figure 28 Ligaments of the knee

PRESENTATION – **ACL and PCL tears** occur almost exclusively with **trauma.** **Typical ACL injury involves valgus stress of the knee and internal rotation of the tibia**. This can occur either due to a **contact injury or a noncontact injury, specifically landing from a jump**. Patients typically **hear and/or feel a pop i**n the knee and **swelling** in the knee occurs rapidly due to the vascular nature of the ACL. At the time a patient seeks care in the office setting the pain is often minimal however swelling and a sense of **instability** typically persist. **PCL injuries** typically occur when an **object hits the anterior portion of the tibia driving it posterior relative to the fixed femur.** Two examples of this are **dashboards hitting the anterior portion of the knee during a car accident** or another **player sliding into the patient during an athletic event**. The **PCL is not as vascular** as the ACL and therefore **swelling is often less prominent.**

IMAGING – **Plain radiographs are typically obtained in the evaluation of trauma and swelling in the knee**. This is largely to rule out fracture or other underlying etiology of knee swelling such as osteoarthritis. **Most cruciate ligament injuries should be evaluated with MRI.** (Figure 29-30) This allows for evaluation of the cruciate ligaments as well as other structures in the knee, such as the menisci, which are commonly injured during trauma.

Figure 29 Sagittal view MRI of the knee showing intact ACL

Figure 30 Sagittal view MRI of the knee showing torn ACL

TREATMENT – The treatment of **cruciate ligament injuries varies widely depending upon the ligament torn, associated trauma and activity level of the patient. ACL injuries more commonly need reconstruction via surgery**. This should be done primarily to provide stability to the knee. In almost all patients a period of rehabilitation for an isolated ACL tear is warranted as results in restoring stability and function of the knee are quite good. Patients with associated injuries such as meniscal tears and those involved in high-level sports requiring rotational motions about the knee should consider early surgery. **PCL injuries almost never need surgical intervention as rehabilitation will typically restore full function and stability of the knee**.

Meniscal Tears

OVERVIEW – **The menisci (Figure 31) are fibrocartilaginous partial rings that sit between the femoral condyles and tibial plateau**.
They are crescent shaped with a wider portion near the periphery tapering to a thin inner rim. The typical knee has a **medial and a lateral meniscus**. They are **minor knee stabilizers and serve to manage loading force**s through the knee.

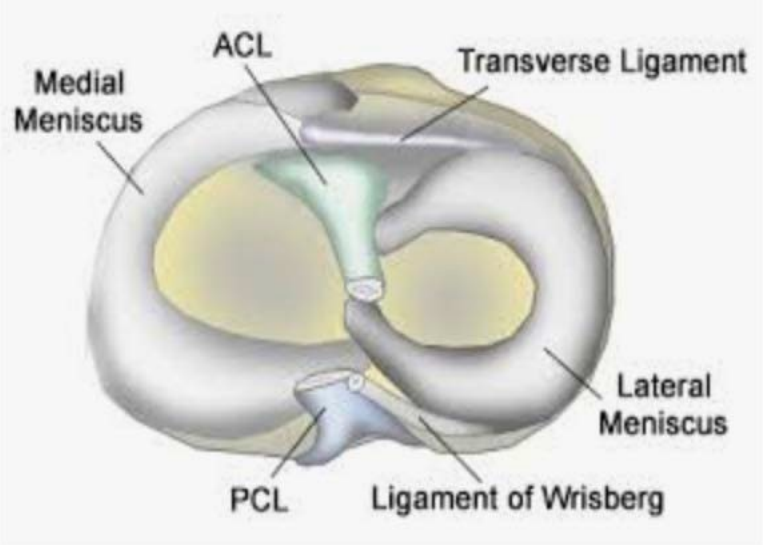


Figure 31

PRESENTATION – M**eniscus tears** typically occur after a **rotational injury to the knee.** Most commonly this occurs during a **sport or athletic activity.** The trauma/rotation can lead to a variety of symptoms including **swelling, pain, buckling or locking.**
Tears are characterized by the type and location of the tear (Figure 32). **Older individuals** often have **degenerative changes of the meniscus** which make them prone to tearing.

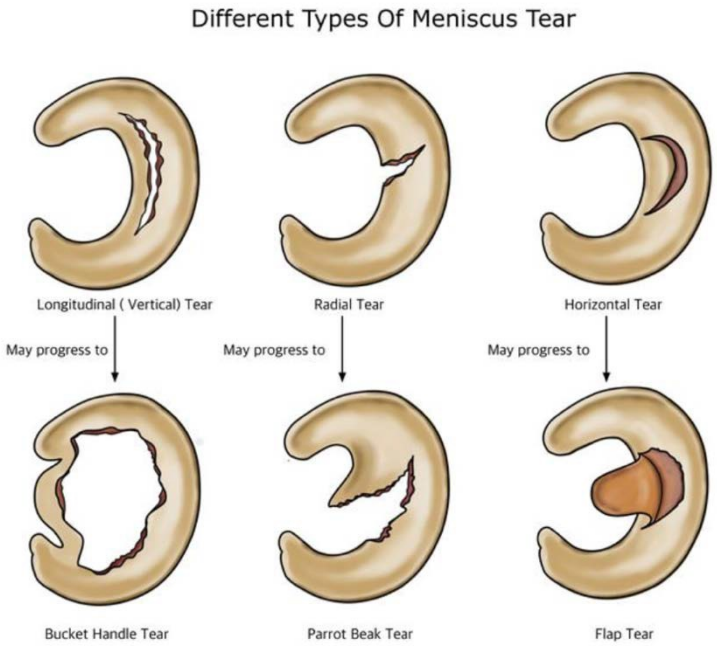


Figure 32

IMAGING – **As with any other traumatic injury plain radiographs are typically indicated on initial evaluation. Menisci are best assessed with MRI**. (Figure 33) If the patient is not having symptoms due to a displaced meniscus tear (typically locking or profound clicking in the knee) a period of conservative treatment with physical therapy is warranted. Advanced imaging is warranted when mechanical symptoms or pain and swelling do not improve with conservative therapy.

Figure 33

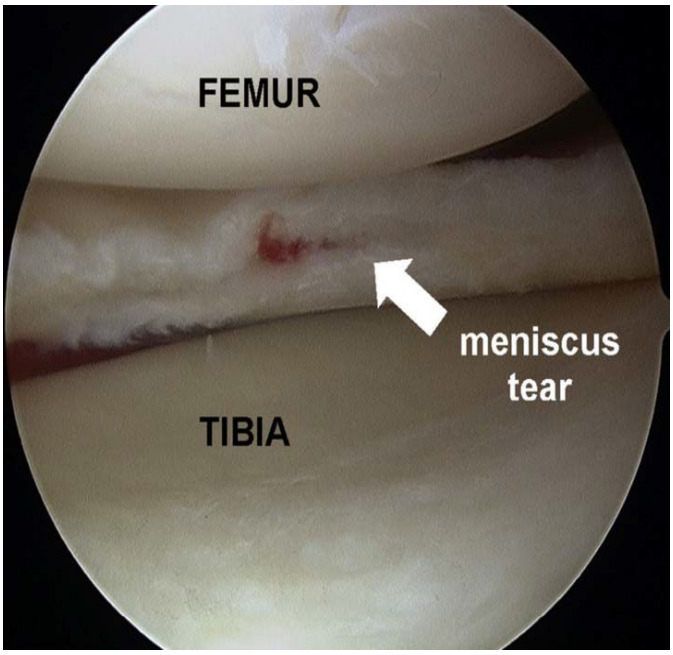


Figure 34

TREATMENT – As noted above, in the **absence of mechanical symptoms a trial of conservative treatment with physical therapy is warranted for most meniscal tears**. **Meniscal tears causing locking in the knee or that have not improved with conservative therapy may be considered for surgery**. (Figure 34) Surgery typically involves either partial excision or primary repair of the tear, depending on both the location and type of tear. An exception to this is a suspected meniscal tear in the setting of osteoarthritis of the knee.

Symptoms due to meniscal tear with osteoarthritis present are typically due to the underlying degenerative process. It is recommended that patients undergo a full course of conservative therapy for osteoarthritis prior to imaging or surgical intervention for meniscus tear.

Knee Arthritis

OVERVIEW – **Knee osteoarthritis (OA)** is the most common cause of knee pain in adults, especially as they age. It is a type of degenerative joint disease that occurs when the **cartilage in the knee gradually wears down over time**, leading to **pain, stiffness, and swelling**. While knee OA is often linked to aging, it can also develop after a knee injury, or as a **result of factors like obesity, abnormal joint alignment, or certain diseases that affect the whole body, such as rheumatoid arthritis.** OA should be considered when evaluating knee pain, particularly in **older adults or those with a history of knee injury**.

PRESENTATION – The pain from knee OA usually **develops slowly** and can be described as a dull ache in the knee. The pain tends to get w**orse with activity, especially after long periods of sitting or standing**, and is often most noticeable when standing up from a chair or climbing stairs. Patients may also notice that their **knee feels stiff, especially after rest**. The knee may also swell, and some people feel a **"grinding" or "catching" sensation when they move their knee.** As the disease progresses, patients may have **difficulty with everyday activities** like walking, squatting, or bending down to tie their shoes. In some cases, pain may radiate (or spread) from the knee to the thigh or shin, making it harder to distinguish knee OA from hip or lower leg problems.

On physical exam, patients with knee OA may have **tenderness along the joint line** and sometimes there is **swelling or warmth around the knee**. The knee's **range of motion** will often **be reduced**, meaning the patient may have **difficulty fully straightening or bending their knee**. You may also feel a "grating" or "creaky" sensation when the knee moves, known as **crepitus**. Strength is usually normal unless pain affects the patient's ability to move the knee fully. In more advanced cases, the patient might have a limp due to pain.

IMAGING – **Radiographs of the knee** are the main imaging tool used to diagnose knee OA. The **typical findings (Figure 35 a / 35 b) include narrowing of the joint space (the gap between the bones), the formation of bone spurs (called osteophytes), thickening of the bone underneath the cartilage (called subchondral sclerosis), and cysts in the bone (subchondral cysts)**. These changes can usually be seen in standard knee X-rays taken in different views, like the anteroposterior (AP), lateral, and sunrise views. If knee OA is clearly visible on X-ray, further imaging (like MRI) is usually not needed, unless there is concern about other injuries, such as a torn meniscus, or to check for soft tissue problems.

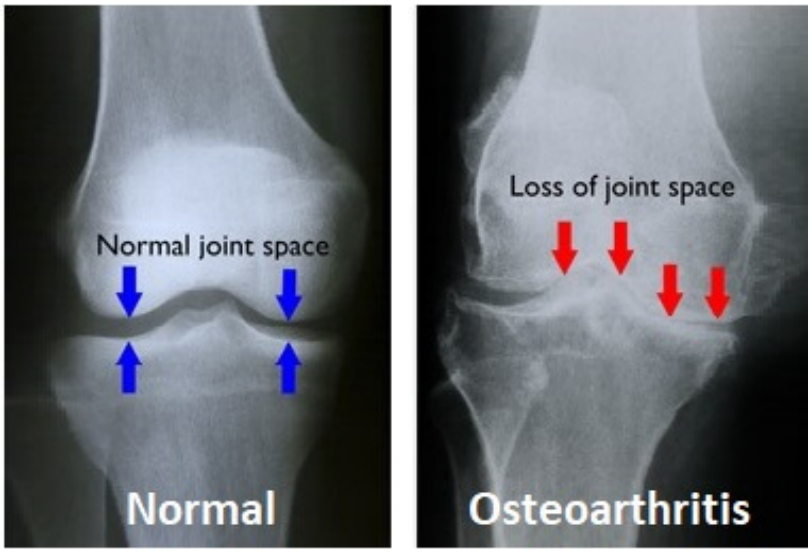


Figure 35 A (normal) Figure 35 B (osteoarthritis)

TREATMENT – The treatment of knee osteoarthritis (OA) is **aimed at relieving pain, improving function, and helping patients maintain an active lifestyle**. There is no cure for OA, so the focus is on managing symptoms and preventing further joint damage. Treatment can be divided into non-pharmacologic approaches, medications, injections, and, in some cases, surgery.

1. Non-Pharmacologic Treatments:

- **Weight Loss**: Reducing body weight can significantly reduce stress on the knee joint, helping to alleviate pain and slow the progression of OA. **Even a modest weight loss can have a positive impact.**
- **Activity Modification:** Patients should be encouraged to stay physically active, but it's important to **avoid activities that cause excessive pain** or joint strain, such as high-impact sports. **Low-impact activities like walking, swimming, and cycling** are recommended. Activity is key to maintaining mobility and improving overall joint function.
- **Physical Therapy:** Physical therapy is a cornerstone of OA management. **Targeted exercises** can help strengthen the muscles around the knee, improving **joint stability and reducing pai**n. **Stretching and exercises** aimed at improving range of motion are also important for maintaining mobility.

-Use of Assistive Devices: A **cane or walker** can help improve stability and reduce stress on the knee joint, especially during walking or when standing for long periods.

2. Medications:

- **Oral Anti-Inflammatory Drugs (NSAIDs):** Nonsteroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen or naproxen, are commonly used to reduce pain and inflammation. These should be used at the lowest effective dose for the shortest period possible to minimize side effects, especially gastrointestinal or renal issues.
- **Acetaminophen:** For patients who cannot take NSAIDs, acetaminophen (Tylenol) may be used to manage mild pain. It is not an anti-inflammatory but can provide pain relief with fewer side effects than NSAIDs.

3. Injections:

- **Corticosteroid Injections:** These can provide **short-term pain relief by reducing inflammation in the knee joint**. Steroid injections are typically used when oral medications are not sufficient, but their **use is limited due to potential side effects with repeated use (e.g., cartilage damage).**
- **Viscosupplementation: Hyaluronic acid injections** (also known as viscosupplementation) are sometimes used to help lubricate the joint and reduce pain. These injections **aim to restore the joint's natural fluid, improving mobility and reducing friction.**
- **Regenerative Injections:** Some patients may opt for i**njections of platelet-rich plasma (PRP) or stem cells.** These treatments aim to stimulate tissue healing and regeneration, though their effectiveness for OA is still under investigation and can vary between patients.

4. Surgical Treatments:

- **Knee Joint Replacement:** When **conservative treatments no longer provide relief** and the patient's quality of life is significantly impaired, surgery may be considered. **Total Knee Replacement (TKR)** involves removing the damaged parts of the knee and replacing them with artificial components. This is **typically reserved for patients with severe OA** who have failed other treatments and experience debilitating pain or loss of function.

DIAGNOSIS	AGE	SYMPTOMS	PHYSICAL EXAM	IMPORTANT STRUCTURES
Patellofemoral pain	Any	Aching anterior knee pain with activity	Pain with manipulation of the patellofemoral joint, weakness of hip abduction	Hip abductors, patellofemoral compartment of the knee joint
Osgood-Schlatter disease	Adolescents	Pain near the patellar tendon insertion with activity	Tenderness over the tibial tubercle, pain with knee extension	Patellar tendon and tibial apophysis
Osteochon-dritis Dessicans	Juvenile and adolescents	Pain and loss of motion of the joint	Manipulation of the joint (e.g. knee) causing pain	Femoral condyle (knee)
Cruciate ligament tears	Any	Pain swelling and instability of the knee after acute trauma	Effusion of the knee joint, instability with cruciate ligament testing	Anterior cruciate ligament, posterior cruciate ligament
Meniscal tears	Any	Pain, swelling in the knee. Clicking, locking of the knee	Knee joint effusion, pain and clicking with McMurray's testing	Medial and lateral meniscus of the knee
Osteoarthritis Knee	Middle Age to Elderly	Knee Pain	Limited knee range of motion. Pain with manipulation of knee	Femoral – Tibial Joint Patellofemoral Joint

FOOT AND ANKLE

Calcaneal apophysitis

OVERVIEW – in the **adolescent patient** population **posterior heel/Achilles region pain** is nearly always attributed to calcaneal **apophysitis.** (Figure 36) This is also known as **Sever's disease**. As with other apophysitis issues discussed, this is a condition self-limited to the adolescent growth phase with open growth plates.

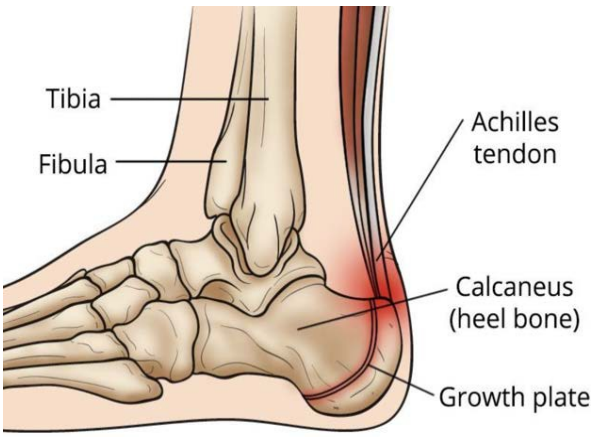


Figure 36

PRESENTATION – **Typically insidious onset of aching, activity limiting pain in the posterior heel.** Often patients complain of **increased pain with wearing shoes** as the **pressure of the shoe** worsens the symptoms. **Swelling and redness** are common in the area due to the apophysitis itself as well as the pressure noted above. As with patellar apophysitis **individuals participating in running or jumping sports** are more likely to develop this condition.

IMAGING – The **diagnosis of Sever's disease is clinical therefore imaging is not typically required to make the diagnosis**. Depending on the severity of symptoms at the time of presentation, x-ray (Figure 37) may be warranted to exclude other conditions. Inability to bear weight, constitutional symptoms, or lack of improvement with conservative therapy are indications for imaging. Typically, plain radiographs are first obtained if imaging is warranted followed by MRI.

Figure 37

TREATMENT – **Calcaneal apophysitis treatment is conservative in nature**. Treatment should include relative rest from painful activities, changes in shoe wear and anti-inflammatory medications. Consideration can also be made to place a heel cup in the patient's shoe which may help to

mitigate the stress of heel impact into the calcaneus. If symptoms are severe enough a period of immobilization in a walking boot may be indicated.

Achilles tendon rupture

OVERVIEW – **Rupture of the Achilles** tendon (Figure 38) is a significant risk for athletic populations over the course of their lifetime. Most Achilles's tendon ruptures occur during sporting activity. Additionally, those who rupture their Achilles tendon typically have **tendinopathy (chronic degenerative changes the tendon) prior to rupture.** Clinicians must be alert to this condition in the setting of **acute ankle trauma** as delayed diagnosis can have significant impact on morbidity and long-term function.

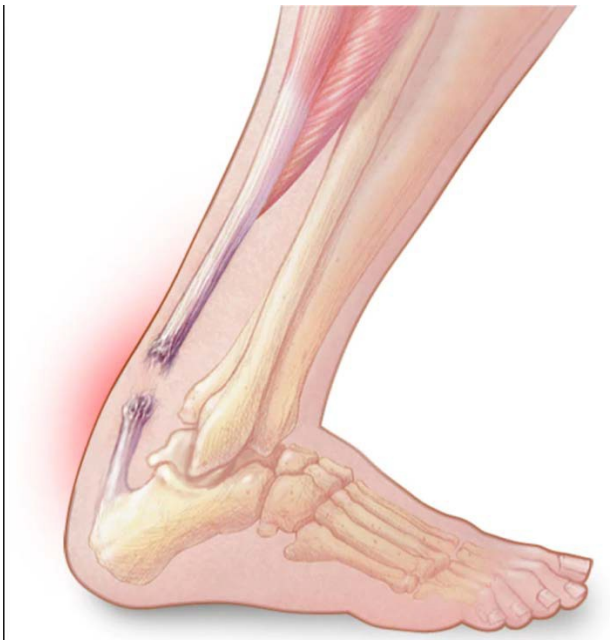


Figure 38

PRESENTATION – Most Achilles tendon ruptures occur in the **acutely in the sport participation setting.** Patients typically describe a **sensation** that they were **kicked or hit from behind in the Achilles** tendon but then realized that no external trauma has actually occurred. **Swelling and mild pain** are typically present and patients are usually walking with a **limp**. Keys to the **exam are having the patient lie supine, ankle held off the table with knee in flexion. The foot will lose its typical resting plantar flexion and no movement of the foot will be seen with squeezing of the leg (Thompson's squeeze test). (**Figure 39)

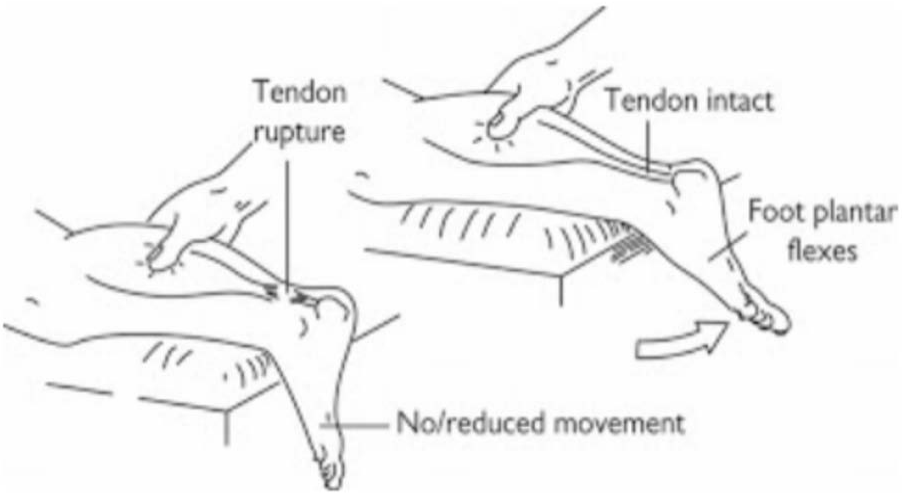


Figure 39

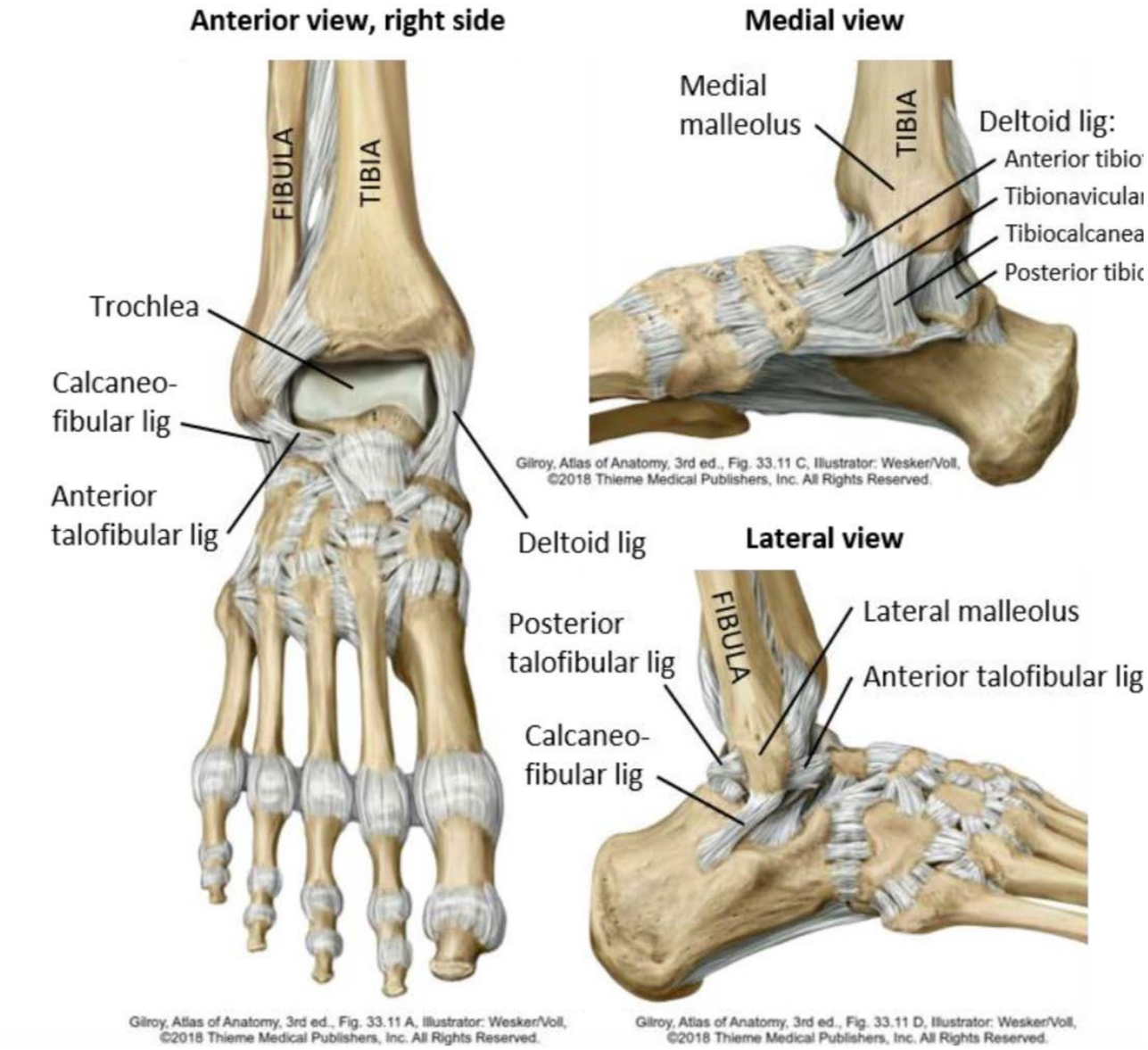
IMAGING – **Imaging should be obtained if there is a suspicion for an Achilles tendon rupture**. This should be done to assess for the severity of the rupture, including full versus partial width and amount of retraction. **Depending on the clinical setting, diagnostic ultrasound or MRI can be used**. (Figure 40)

Figure 40

TREATMENT – There are **operative and non-operative treatment options for Achilles tendon ruptures.** Non-operative treatment involves non-weight bearing status in a boot or cast with the foot in plantarflexion followed by progressive dorsiflexion in the boot and advancing weight bearing. Operative therapy involves approximation of the torn ends of the Achilles via suturing, followed by similar progressive dorsiflexion and weight bearing. Studies have shown similar outcomes in terms of pain and function with both treatment options. Re-rupture rates are lower with operative therapy, however, complication rates are higher.

Ankle sprain

OVERVIEW – **Ankle sprains** are the most common presenting injury to emergency departments and primary care clinics. They involve an acute trauma to the ankle causing **injury to the stabilizing ligaments** of either the **medial or lateral ankle**. These ligaments are responsible for **structural support** of the ankle as well as **proprioceptive information**. **Sprains of the lateral ankle,** most commonly, involve the **anterior talofibular ligament, calcaneofibular ligament, and posterior talofibular ligament.** (Figure 41) **Sprains of the medial ankle involve the deltoid ligament**. **Recurrent ankle sprains** can lead to significant **instability** in the ankle resulting in **limited function** and morbidity.


Anterior view, right side
FIBULA
TIBIA
Trochlea
Calcaneo-
fibular lig
Anterior
talofibular lig
Deltoid lig
Medial view
Medial
malleolus
TIBIA
Deltoid lig:
Anterior tibio
Tibionavicula
Tibiocalcanea
Posterior tibio
Gilroy, Atlas of Anatomy, 3rd ed., Fig. 33.11 C, Illustrator: Wesker/Voll,
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Lateral view
Posterior
talofibular lig
FIBULA
Lateral malleolus
Anterior talofibular lig
Calcaneo-
fibular lig
Gilroy, Atlas of Anatomy, 3rd ed., Fig. 33.11 A, Illustrator: Wesker/Voll,
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Gilroy, Atlas of Anatomy, 3rd ed., Fig. 33.11 D, Illustrator: Wesker/Voll,
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Figure 41

PRESENTATION – Patients typically present after an **acute trauma** to the ankle. Causes of this trauma can vary widely from high velocity sport injury to a subtle stumble on a sidewalk. **Inversion** of the ankle leads to stress on the **lateral ankle ligaments. Eversion** of the ankle relates to stress on the m**edial ankle ligaments**. Patients often complain of **pain with bruising** and **swelling,** which can be quite profound in some instances. (Figure 42)

Figure 42

IMAGING – The initial imaging modality for evaluation of an acute ankle injury is a plain radiograph. The **Ottawa Ankle Rules (Figure 43) provide guidance for when imaging is indicated**.
According to these rules x-**ray should be obtained when there is pain in the malleolar region and the patient has tenderness in the posterior portion of the distal medial or lateral malleolus.**

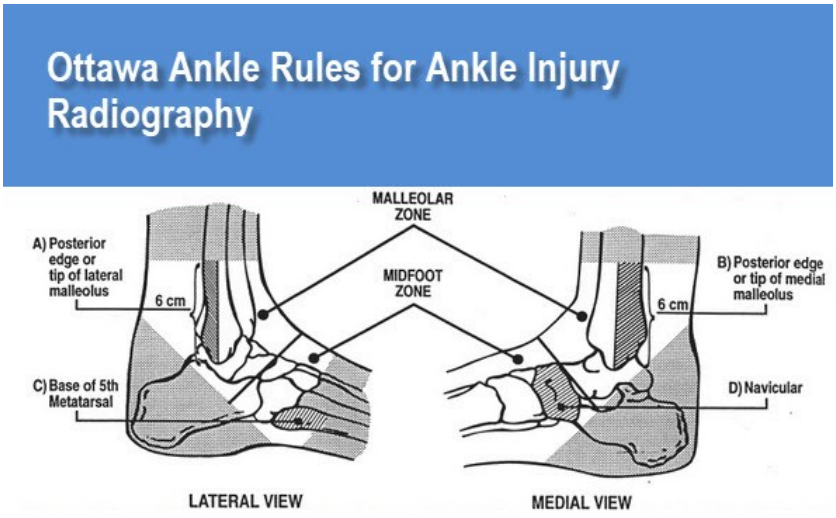

Figure 43

Additionally, **x-ray is indicted with pain in the malleolus region and inability to bear weight immediately after the injury**. Fracture of the proximal fifth metatarsal is another possible sequela of acute ankle injury. **X-rays of the foot should be obtained if patients have pain in the midfoot zone and tenderness at the base of the fifth metatarsal or are unable to bear weight immediately after injury**. Despite these rules there are situations in which concern for fracture is significant, subsequently superseding imaging guidelines. (Figure 44)

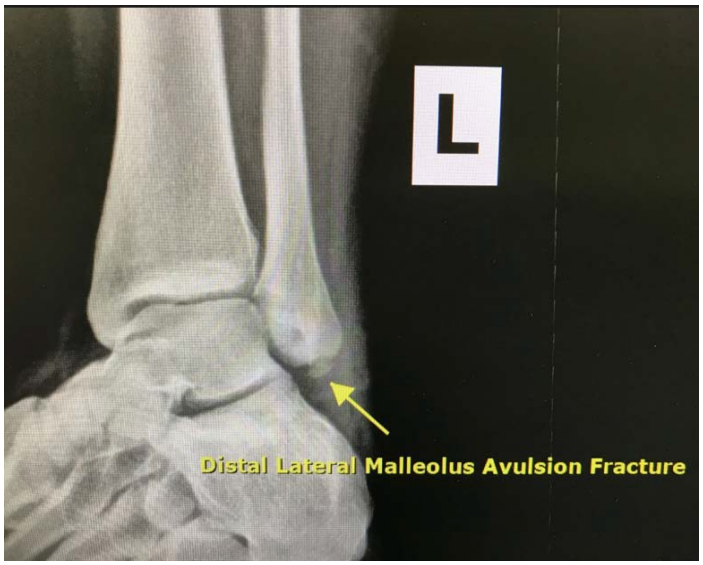

Figure 44

TREATMENT – **Initial treatment of ankle sprains is conservative in nature.** Generally, patients can weight-bear as tolerated and should be encouraged to engage in regular range of motion exercises. **Early mobilization has been shown to decrease the length of symptoms and accelerate return to activity in acute ankle sprains.** A subset of patients will have pain that limits weight-bearing activity and for symptom management only, immobilization in a walking boot and the use of crutches may be indicated. The boot and crutches should be used for as short a period as possible. Anti-inflammatory medications and ice may be used for symptom management.

Compartment syndrome

OVERVIEW – **Compartment syndrome** is a phenomenon of **increased pressure within a fascial compartment** leading to **vascular, neurologic, and muscular injury**. **Acute** compartment syndrome, usually due to **trauma,** is a **medical emergency requiring prompt surgical evaluation and treatment**. **Chronic exertional compartment syndrome** is a more **insidious onset** issue with more complex diagnostic and treatment options

PRESENTATION **- Acute compartment** syndrome presents in the **posttraumatic setting**. In the leg this often occurs as a **sequalae of a tibia fracture.** The **"6 Ps"** are typically described as the signs of compartment syndrome: **pain out of proportion to injury, pallor, paresthesias, pulselessness, paralysis and poikilothermia.** However, most of these are late consequences of compartment syndrome and any large trauma to the leg should trigger serial neurovascular evaluations. (Figure 45) Chronic exertional compartment syndrome typically presents with one or more of the Ps with progressive onset with exercise. Suspicion for compartment syndrome in either of these contexts can be **confirmed with intracompartmental pressure testing** while the patient is symptomatic.

Figure 45

IMAGING – **Imaging is typically obtained in the context of acute trauma**, however, there are no specific imaging criteria for the diagnosis of compartment syndrome. It should be diagnosed based on clinical suspicion and confirmatory compartment pressure testing as indicated.

TREATMENT – **Acute compartment syndrome is a medical emergency and should be treated with emergent fasciotomy** to preserve function of the contents of the compartment affected. **Chronic exertional compartment syndrome can typically be managed with activity modification, but non-emergent fasciotomy can be considered in refractory cases.**

DIAGNOSIS	AGE	SYMPTOMS	PHYSICAL EXAM	IMPORTANT STRUCTURES
Calcaneal apophysitis	Adolescence	Pain near the Achilles insertion with activity	Tenderness to palpation over the Achilles insertion, positive calcaneal squeeze test	Achilles tendon, calcaneal apophysis
Achilles tendon rupture	All ages	Pain and deformity in the Achilles region after trauma	Loss of resting plantarflexion of the ankle, positive Thompson's squeeze test	Achilles tendon
Ankle sprain	All ages	Pain, swelling, ecchymosis after acute ankle trauma	Swelling, ecchymosis, limited range of motion about the ankle joint	Deltoid ligament, anterior talofibular ligament, calcaneofibular ligament, posterior talofibular ligament, fifth metatarsal
Acute compartment syndrome	All ages	Pain out of proportion to injury after acute trauma	Pain, pulselessness, pallor, paresthesia, poikilothermia, paralysis distal to the site of injury	Anterior, lateral, posterior, deep posterior compartments of the leg and contents
Chronic exertional compartment syndrome	All ages	Pain, paresthesias, pallor, poikilothermia with extended exertion	Often no findings unless patient is symptomatic after activity	Anterior, lateral, posterior, deep posterior compartments of the leg and contents