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# Managing Dislocations of the Hip, Knee, and Ankle in the Emergency Department

December 2017
Volume 19, Number 12

**Authors**

**Caylyne Arnold, DO**
Clinical Faculty, Emergency Department, Naval Medical Center San Diego, San Diego, CA

**Zane Fayos, MD**
Resident Physician, Emergency Medicine, Naval Medical Center San Diego, San Diego, CA

**David Bruner, MD, FAAEM**
Staff Physician, Scripps Mercy Hospital San Diego, San Diego, CA

**Dylan Arnold, DO**
Assistant Professor of Military and Emergency Medicine, Uniformed Services University of the Health Sciences; Assistant Program Director, Emergency Medicine Residency, Naval Medical Center San Diego, San Diego, CA

**Peer Reviewers**

**Melissa Leber, MD, FACEP**
Assistant Professor of Emergency Medicine and Orthopedics, Director of Emergency Department Sports Medicine, Icahn School of Medicine at Mount Sinai, New York, NY

**Christopher R. Tainter, MD, RDMS**
Associate Clinical Professor, Department of Anesthesiology, Division of Critical Care, Department of Emergency Medicine, University of California San Diego, San Diego, CA

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## Abstract

Dislocation of the major joints of the lower extremities—hip, knee, and ankle—can occur due to motor-vehicle crashes, falls, and sports injuries. Hip dislocations are the most common, and they require emergent management to prevent avascular necrosis of the femoral head. Knee dislocations are uncommon but potentially dangerous injuries that can result in amputation due to the potential for missed secondary injury, especially if they are reduced spontaneously. Isolated ankle dislocations are relatively rare, as most ankle dislocations involve an associated fracture. This review presents an algorithmic approach to management that ensures that pain relief, imaging, reduction, vascular monitoring, and emergent orthopedic consultation are carried out in a timely fashion.

## Case Presentations

*A 25-year-old man is brought in by ambulance after being involved in a high-speed motor vehicle crash as an unrestrained driver. He is complaining of right hip pain and lower abdominal pain. During his primary trauma survey, you note that his right leg is shortened and internally rotated. You suspect a native hip dislocation and/or fracture and wonder which diagnostic studies you should obtain and whether you should attempt a reduction before consulting orthopedic surgery.*

*Later that evening, an elderly woman arrives with right hip pain, unable to ambulate. She states, "I was just bending over to put on my shoes when I felt a 'pop,' and then I fell to the ground." She then informs you that she recently underwent right total hip arthroplasty. You notice her right leg appears internally rotated, adducted, and shortened. You suspect a dislocation of her prosthesis and wonder whether you should involve orthopedics or reduce it yourself and, if reduction is successful, whether she can be discharged home.*

*19-year-old man arrives by EMS, saying that while he was playing a pick-up game of football, he was tackled and felt a "pop" in his right knee. His friend told EMS that his knee looked like it "bent backwards." His knee was immobilized by EMS, but it doesn't look deformed. You are concerned that he may have dislocated and spontaneously reduced his knee and wonder if any diagnostic studies are needed.*

*A 27-year-old man presents to the ED with right ankle pain and obvious deformity. He has severe pain and cannot stand after landing awkwardly in a hole with his right foot when he jumped down from a tree branch. He is unable to bear weight or move his ankle due to severe pain. He appears to have an ankle dislocation and possible fracture; you wonder which takes priority: reduction or imaging?*

## Introduction

Lower-extremity dislocations are less common in the emergency department (ED) than shoulder and elbow dislocations, and emergency clinicians' experience with evaluation and reduction techniques is often limited. Nonetheless, these dislocations can be serious because of their association with vascular injury. Rapid assessment and timely reduction can minimize pain and complications, but there are many circumstances when emergent orthopedic consultation is needed and surgical referral required. This issue of *Emergency Medicine Practice* discusses the mechanism of injury, diagnostic approach, treatment plans, and potential complications of dislocations of the hip, knee, and ankle.

## Critical Appraisal of the Literature

A literature search was performed in PubMed, EMBase, Medline®, Allied and Complementary Medicine Database, SportDiscus, and Google Scholar using the search terms *hip dislocation, anterior hip dislocation, posterior hip dislocation, knee dislocation, ankle dislocation, talar dislocation, subtalar dislocation, hip reduction, knee reduction,* and *ankle reduction*. A total of 163 articles were found regarding hip dislocations, 187 on knee dislocations, and 167 on ankle dislocations. The Cochrane Database of Systematic Reviews was searched, using the terms *hip dislocation, knee dislocation,* and *ankle dislocation*, resulting in 8 articles related primarily to knee dislocations. The American College of Emergency Physicians does not endorse any guidelines related to lower-extremity dislocations.

The majority of the applicable literature for lower-extremity dislocations is found in orthopedic and trauma surgery journals. ED-specific studies are limited, though the approach and initial management is the same, regardless of location or provider. Most of the articles in the literature are case reports, case series, and retrospective reviews; there are no large randomized trials assessing diagnosis or management strategies for lower-extremity dislocations.

## Etiology and Pathophysiology

### Hip Dislocation

Hip dislocations are the most common lower-extremity dislocation. The emergency clinician should be able to diagnose the various types of dislocations and assess for associated injuries and complications. Good ED management depends on knowing when to reduce a hip dislocation and gauging the urgency of orthopedic consultation for intraoperative closed reduction or open reduction and internal fixation.

The hip is a ball-and-socket joint, with the femoral head situated within the acetabulum. The hip joint is extremely stable, due to the cartilaginous labrum, ligamentous hip capsule, ligamentum teres, and large muscle groups of the lower extremity. For this reason, most native hip dislocations are caused by a high-energy traumatic mechanism, with motor-vehicle crashes (MVCs) being the most common etiology.[1] Over two-thirds of traumatic hip dislocations occur in MVC victims who were not wearing seatbelts.[2] Traumatic dislocations are also seen after falls from height, and in athletes involved in contact sports.[3]

Traumatic hip dislocations may be classified as either *simple* or *complex*. Simple dislocations are isolated dislocations without an associated fracture, whereas complex dislocations have an associated fracture of the femoral head, femoral neck, or acetabulum.[4] Approximately 90% of all native hip dislocations have an associated fracture.[5] Acetabular fractures are the most common and are seen in 70% of cases.[6] The more the hip is flexed at the time of dislocation, the lower the risk for associated fracture.[7]

Hip dislocations are further classified based on the direction of dislocation of the femoral head relative to the acetabulum, either *posterior* or *anterior*. Posterior dislocations are the most common, comprising 90% of all traumatic hip dislocations. These dislocations are the result of axial loading on the femur, with the hip flexed and adducted. This is also known as the classic "dashboard injury."[4] Anterior dislocations make up 10% of traumatic hip dislocations, and are subdivided into superior (10%) and inferior types (90%). The superior type of dislocation occurs when the hip is abducted, externally rotated, and extended, often resulting in a fractured femoral head. The inferior type of dislocation occurs when the hip is abducted, externally rotated, and flexed. The obturator can indent the femoral head, resulting in an indentation fracture.[3] These typically occur secondary to MVCs where the victim's leg is abducted, from falls from height, or a blow to the back while squatted.[8]

Understanding the anatomy surrounding the hip joint is important with regard to assessing for associated injuries and the potential for long-term complications. The primary blood supply to the femoral head is from an extracapsular arterial ring at the base of the femoral neck. **(See Figure 1.)** The sciatic nerve lies posteriorly to the hip joint; and the femoral nerve, artery, and vein are superior and medial to the hip joint.[4] While loss of blood supply to the femoral head is a concern in all cases of hip dislocation, other neurovascular injuries are dependent on the direction of dislocation.

## Knee Dislocation

Knee dislocation is a rare injury.[9] Spontaneously reduced dislocations may be unrecognized, but carry significant risk to adjacent structures.[10,11] The most frequent mechanism of injury resulting in knee dislocation is MVCs, accounting for over 50% of cases, but high-impact sports, such as football, also place patients at risk.[10]

There are 2 joints within the knee, the tibiofemoral joint and patellofemoral joint. *Knee dislocation* refers to a dislocation of the tibiofemoral joint, whereas a *patellar dislocation* refers to dislocation of the patellofemoral joint. For more information on patellar dislocation, see the "Special Circumstances" section, page 18.

The tibiofemoral joint consists of the medial and lateral femoral condyles articulating with the medial and lateral condyles of the tibia. **(See Figure 2.)** The medial and lateral meniscus provide cushioning between these articular surfaces. Four strong ligaments provide stability to this joint: The anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) prevent anterior and posterior displacement of the tibia relative to the femur, respectively. The medial collateral ligament (MCL) prevents valgus (apex medial) deviation. Finally, the lateral collateral ligament prevents varus (apex lateral) deviation.

There are 5 types of knee dislocation: anterior, posterior, lateral, medial, and rotational. There can be overlap between them, based on the mechanism of injury. Each type of knee dislocation is named after the displacement of the tibia relative to the femur. Anterior dislocations are the most common, followed by posterior dislocations.

Anterior knee dislocations are usually the result of extreme knee hyperextension mechanisms, usually greater than 30°. As the knee moves past 30° of hyperextension, the posterior capsule tears. Typically, the ACL and then the PCL are torn, yielding the instability necessary for the tibia to move anteriorly; however, it is possible for the PCL to remain intact. If the knee continues to hyperextend past 50°, the popliteal artery is at risk for injury.[12]

Posterior knee dislocations are usually the result

**Figure 1. Blood Supply of the Femoral Head**

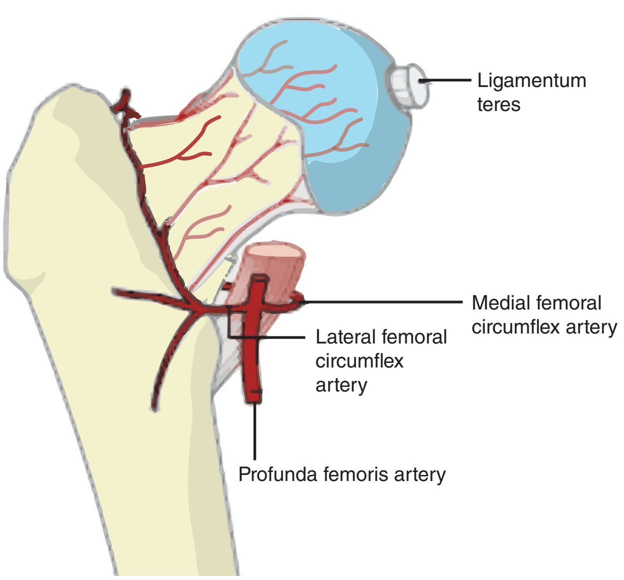
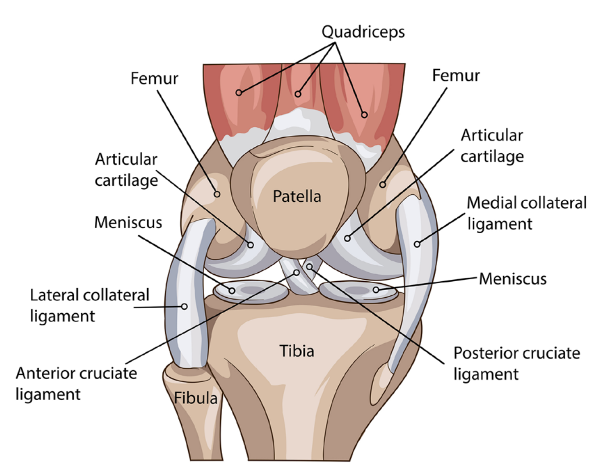



**Figure 2. Anatomy of the Knee**



of an axial load on the proximal tibia with the knee in flexion. This pattern of injury is commonly seen in the setting of an MVC. In these cases, the patient's momentum supplies a sufficient axial load when the flexed knee strikes the dashboard. As the tibia is forced posteriorly, the PCL tears, followed usually by the ACL. Approximately half of posterior dislocations have some form of popliteal artery injury, often with complete transection of the artery.

Lateral and medial knee dislocations are less common, and each can be caused by varus or valgus stress, depending on whether the strike occurred above or below the plane of the tibiofemoral joint. Typically, both the MCL and LCL are disrupted, along with at least 1 cruciate ligament, resulting in multidirectional instability.[12]

Lateral dislocations occur when the medial femoral condyle buttonholes through the medial capsule of the joint. These dislocations are potentially impossible to reduce with closed reduction. When this occurs, a dimple can be seen in the skin/soft tissue of the knee medially, and should alert the clinician that open reduction may be needed.[13] **(See Figure 3.)**

The major artery traversing the knee joint is the popliteal artery, which is anchored at both ends of the popliteal fossa, proximally at the adductor hiatus, and distally at the soleus. Any significant change in the length between these anchor points due to dislocation in any direction can cause a traction injury to the popliteal artery. Popliteal artery injuries—either from traction as the joint dislocates or by direct trauma—occur in all types of knee dislocation. Injury to the popliteal artery has been found to be present in 39% of anterior dislocations, 44% of posterior dislocations, 25% in medial dislocations, and 6% in lateral dislocations.[12]

**Figure 3. An Irreducible Lateral Knee Dislocation That Demonstrates Dimpling**

*Skeletal Radiology,* Volume 38, Issue 11. 2009, pages 111-1114. Ali Harb, Denis Lincoln, Jefferey Michaelson. © Springer. Reprinted with permission of Springer.

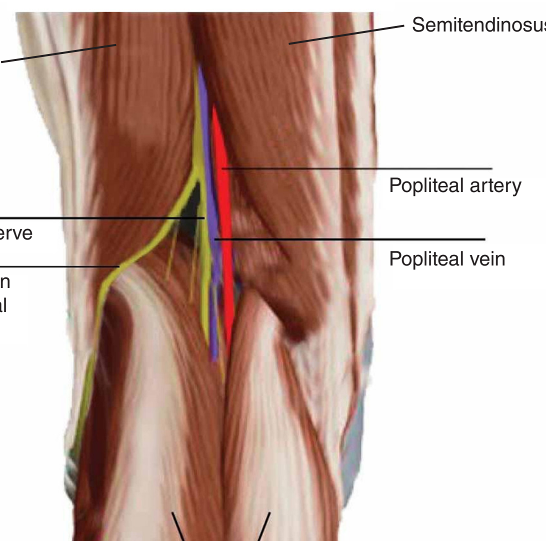
The major nerves running through the popliteal region are the tibial nerve and the common peroneal nerve. **(See Figure 4.)** When the knee dislocates, the classically injured nerve is the common peroneal nerve, which innervates the muscles of dorsiflexion and provides sensory innervation to the dorsum of the foot and over the proximal anterior/lateral aspect of the fibula.

Injury to the peroneal nerve is most likely to occur in the setting of lateral knee dislocations.[12] This is due to the anatomic course of the peroneal nerve, which wraps laterally around the head of the fibula. Traction on the peroneal nerve can lead to injury ranging from neuropraxia to complete transection. Apart from traction injury, peroneal nerve dysfunction can result from laceration, compression, or focal ischemia following knee dislocation.[14] The incidence of peroneal nerve injury following knee dislocation is as high as 50%.[15] Tibial nerve injury is much less likely, with only sporadic reports in the literature.[16]

## Ankle Dislocation

Ankle dislocations are dislocations of the tibiotalar joint. They rarely occur in isolation, although multiple case reports suggest that ankle dislocations without fracture do occur.[17-26] Wroble et al described 8 cases of ankle dislocation without associated fractures at their institution, but these were accumulated over a 28-year period.[26] The majority of ankle dislocations involve an associated fracture pattern, and up to half of all dislocations are open.[26] This is

**Figure 4. Major Nerves of the Knee**




Basem B Morcos, Sameh Hashem, Firas Al-Ahmad. Popliteal lymph node dissection for metastatic squamous cell carcinoma: a case report of an uncommon procedure for an uncommon presentation. *World Journal of Surgical Oncology.* DOI: https://doi.org/10.1186/1477-7819-9-130. Published under Creative Commons Attribution License 2.0.

due to the unique anatomy of the ankle joint mortise and the strong ligaments that provide ankle stability.

The ankle joint is comprised of the dome-shaped talus that articulates with the tibia superiorly and medially, and the fibula laterally, and it is bound by multiple strong ligaments. This structure helps the ankle provide both the flexibility and stability that are required for ambulation. The talus does not have any muscular insertions or origins, and 60% of its surface is covered by hyaline cartilage. The dorsalis pedis artery, posterior tibial artery, and peroneal artery provide the blood supply to the talus.[27,28]

The ankle ligamentous attachments include 3 lateral malleoli ligaments: the anterior talofibular ligament, the posterior talofibular ligament, and the calcaneofibular ligament. **(See Figure 5.)** The medial malleolar ligaments include the superficial deltoid ligament, which connects the medial tibia to the talus, calcaneus, and navicular bones; and the deep deltoid ligament, which joins the tibia to the talus and is the primary stabilizer of the ankle joint. The syndesmosis is the third ligamentous structure of the ankle joint and is the primary support of the ankle. It is comprised of 4 parts, all of which connect the tibia and fibula in different ways: (1) the interosseous ligament, (2) the anterior inferior tibiofibular ligament, (3) the posterior inferior tibiofibular ligament, and (3) the inferior transverse ligament.[29]

Patients most at risk for ankle dislocations include young adult men and those with a history of multiple ankle sprains or prior fractures.[30,31] Patients with peroneal muscle weakness and ligamentous laxity from connective tissue disorders are also at greater risk. One review of the combined case reports in the literature (total of only 8 patients) showed that > 80% of ankle dislocations occurred from falls from height, MVCs, or sports activities.[26]

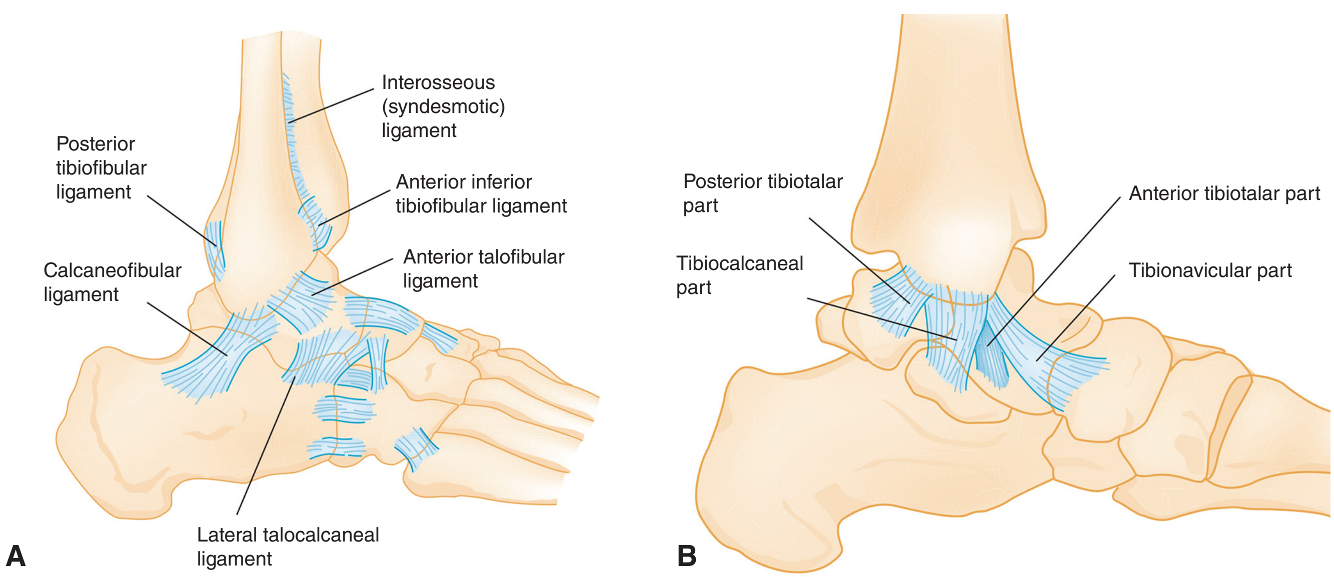
Ankle dislocations are described by the direction the talus moves in relation to the tibia: medial, posterior, posteromedial, anterior, superior, and lateral. Medial dislocations are considered to be the most common, though this is controversial and depends on the case series and literature reviewed.[26,32]

Posterior dislocations occur when the foot is plantar-flexed and the talus is forced posterior to the tibia, widening the ankle joint, disrupting the tibiofibular syndesmosis, and frequently causing a fracture of the lateral malleolus. Anterior ankle dislocations occur typically when the foot is forcibly dorsiflexed or a significant posteriorly directed force is applied to the tibia while the foot is in a fixed position.

Lateral dislocations invariably have an associated fracture of one or both malleoli and are the result of forced inversion, eversion, or rotation of the ankle.

Superior dislocations are uncommon, but are severe injuries, resulting in separation at the tibiofibular syndesmosis when the talus is pushed superiorly between the lateral malleolus and tibia, causing a diastasis. Significant axial loading force, such as a fall from height, is the most commonly reported cause of superior dislocations, and these are associ-

**Figure 5. Ankle Joint Ligaments**




View A: Anatomy of the lateral collateral and the syndesmotic ligaments of the ankle.
View B: Anatomy of the medial collateral (deltoid) ligaments of the ankle.

ated with other fractures of the long bones of the lower extremity as well as spinal column injuries.[26]

## Differential Diagnosis

### Hip Dislocation

Hip dislocations are often caused by high-energy mechanisms and should be considered in the trauma patient presenting with hip pain or inability to ambulate. Since most patients with hip dislocations will appear to have a shortened leg with either internal or external rotation, they are often suspected prior to radiologic confirmation. Hip mobility and stability should be tested in trauma patients because of the possibility of more severe distracting injuries or if the patient is altered or unresponsive. Additionally, this diagnosis should be considered in all elderly patients presenting with hip pain or inability to ambulate after a ground-level fall. Due to the stability of the hip joint, hip dislocation is unlikely to be the cause of atraumatic hip pain, except in patients who have undergone recent total hip arthroplasty. **(See Table 1.)**

### Knee Dislocation

In addition to the 5 types of knee dislocations, the differential includes ligamentous injuries (usually multidirectional instability), fractures, and neurovascular injury (eg, peroneal nerve and popliteal artery).

### Ankle Dislocation

The differential diagnosis of ankle injury involves fracture, fracture dislocation patterns, and isolated dislocations. These can involve any of the various attachments involving the ankle joint. The differential diagnoses that are most important to consider prior to reduction are total talar dislocation and subtalar dislocation. **(See Table 2.)**

On outward appearance, subtalar dislocations may appear similar to ankle dislocations. These are rare dislocations, comprising only 2% of major joint dislocations, but attempted reduction before imaging may actually lead to worsening of the subtalar dislocation.[33,34]

**Table 1. Differential Diagnosis for Traumatic Hip Pain**

- Hip dislocation
- Femoral head fracture
- Femoral neck fracture
- Trochanteric fracture (greater and lesser)
- Intertrochanteric fracture
- Subtrochanteric fracture
- Acetabular fracture
- Pubic ramus fracture
- Ipsilateral knee dislocation
- Ligamentous injury to the ipsilateral knee
- Sciatic nerve injury
- Injury to the femoral neurovascular bundle
- Hemarthrosis

## Prehospital Care

Prehospital care of the injured lower extremity is directed at stabilizing the extremity and pain control. The initial evaluation determines whether the patient has sustained any other more-significant injuries that could lead to death or permanent disability. Since dislocations or fractures are considered distracting injuries, emergency medical services (EMS) providers are often advised to immobilize the cervical spine if there is any potential for an unstable injury. Prehospital evaluation of neurovascular status should be performed for any suspected dislocation and, if there is evidence of neurovascular compromise (cold, pulselessness, loss of sensation, or discoloration), an attempt at immediate reduction should be considered, particularly for the knee or the ankle.[35]

If a hip dislocation is suspected, the patient should be immobilized. Splinting is typically unnecessary, unless the patient has an obvious deformity of the mid to distal femur, in which case a traction splint can be placed to improve alignment and alleviate pain. Caution is advised in placing traction splints, however, due to transport delays as well as the risk of injury to the pelvis, knee, patella, or tibia/fibula.[36] Since 25% of hip dislocations have associated knee injuries, the knee and lower leg should be assessed for an associated fracture or dislocation and splinted in the best anatomical alignment possible.[37]

Prehospital evaluation of knee dislocations involves considering a potential popliteal artery injury by assessing for the presence of the pedal pulse. Although presence of the pedal pulse does not sufficiently rule out vascular injury, the absence of a pulse should prompt immediate consideration for relocation of the knee in the field; this is best done under medical control and taking transport time into consideration.[38] Basic testing for peroneal nerve function can be achieved in the field by evaluating for weakness in dorsiflexion and objective numbness of the dorsum of the foot. The most basic step in prehospital care of a knee dislocation is immobi-

**Table 2. Differential Diagnosis of Ankle Dislocation**

- Subtalar dislocation
- Total talus dislocation
- Tibia fracture
- Fibula fracture
- Talus fracture
- Calcaneus fracture
- Ankle sprain

lization and splinting with prehospital techniques, depending on available equipment. Usually, the knee is immobilized in the field "as is," meaning in the position found, without attempt at reduction or realignment.[39] Many cases of knee dislocations may spontaneously reduce, which may cloud the picture when EMS communicates to the receiving ED.

## Emergency Department Evaluation

### Hip Dislocation

Because 95% of traumatic hip dislocations will have significant associated injuries, patients with a hip dislocation after an MVC should be evaluated according to Advanced Trauma Life Support (ATLS) guidelines or by a specialist trained in trauma evaluation.[3,6] **(See Table 3.)** Important historical data include the mechanism of injury, associated injuries, the time of the incident, the presence of weakness or paresthesia, a history of prior dislocation or arthroplasty, and comorbidities.

Without radiography, traumatic hip dislocations may be difficult to distinguish from hip fractures, but some physical examination findings can assist the emergency clinician in suspecting these injuries. Patients presenting with a posterior dislocation have a shortened, adducted, and internally rotated leg on the injured side.[4] Up to 10% to 14% of posterior dislocations result in sciatic nerve injury, which will present with loss of sensation to the posterior leg, inability to dorsiflex, and diminished deep tendon reflexes at the ankle.[7] Anterior dislocation will appear as a slightly shortened, abducted, and externally rotated leg. In superior-anterior dislocations, the femoral head is often palpable in the area of the anterior superior iliac spine, whereas in inferior-anterior dislocations, the femoral head may be palpated in the buttock region.[3] Superior dislocations should also raise concern for injury to the femoral artery, vein, or nerve. A large hematoma may suggest a significant vascular injury. Femoral nerve injury results in loss of sensation over the thigh, weakness of the quadriceps, and loss of deep tendon reflexes at the knee. If the hip is dislocated without obvious internal or external rotation on physical examination, an associated injury such as a femoral neck or shaft fracture or ipsilateral knee dislocation is likely.[8] Additionally, the ipsilateral knee needs to be examined closely due to the high incidence of associated knee injuries.

**Table 3. Injuries Associated With Traumatic Hip Dislocation[3]**

| Injury | Co-occurrence Rate |
|---|---|
| Acetabular fracture | 70% |
| Ipsilateral knee injury | 25% |
| Closed head injury | 24% |
| Upper-extremity fracture | 21% |
| Thoracic injury | 21% |
| Abdominal injury | 15% |
| Sciatic nerve injury | 10% |

Orthopedic surgery should be consulted emergently for all native hip dislocations. In the setting of a simple prosthetic hip dislocation, orthopedic consultation may be delayed, as avascular necrosis is no longer a concern.

### Knee Dislocation

Evaluation of the patient with a suspected knee dislocation focuses on the mechanism of injury, including the direction of force on the knee. Although most knee dislocations are due to high-energy mechanisms, knee dislocations from low-velocity mechanisms have been described. Specifically, there have been case reports of knee dislocations in morbidly obese patients resulting from falls from standing or from a single step.[40]

As soon as a knee dislocation is suspected, consultation with both orthopedic and vascular surgeons should be arranged while the patient is in the ED. Further information should be obtained to include prior knee injuries, changes in distal neurovascular symptoms, and any associated traumatic injuries. It is easy to anchor on an obviously deformed and dislocated knee, ignoring other subtle—but potentially more serious—injuries.

When evaluating undifferentiated knee pain following trauma, examination of the knee must include evaluation for ligamentous stability. Instability in any direction may be the only finding to suggest that a knee dislocation is present, whether spontaneously reduced or not. Deformity of the knee can help identify the direction of dislocation; however, extensive swelling or obesity may complicate the physical examination.[11] Once a knee dislocation is suspected, the evaluation should assess for popliteal artery injury. The simplest method for evaluating the popliteal artery is a pulse examination of the posterior tibial and dorsalis pedis pulses; however, the presence of these pulses may not sufficiently rule out an important injury. A 2002 meta-analysis showed that abnormal pedal pulses were only 79% sensitive for a popliteal artery injury requiring surgical intervention.[38]

Since the pulse examination is not definitive, it is recommended that all patients suspected of having a knee dislocation have an ankle-brachial index (ABI) test performed. The ABI is the measurement of arterial insufficiency based on the ratio of ankle systolic pressure to brachial systolic pressure (the ankle systolic pressure divided by the arm systolic pressure). Multiple studies have validated the use of the ABI in the setting of a traumatic knee dislocation. An ABI of < 0.9 is 95% to 100% sensitive and 80% to 100% specific for arterial injuries requiring operative management.[41] A prospective study of 38 patients with knee dislocations found that an ABI > 0.9 has a negative predictive value of 100% for surgical popliteal artery injuries, with zero missed surgical popliteal injuries.[42] Traditionally, the assessment for popliteal artery injury has been done with computed tomographic (CT) angiography or angiogram, although duplex ultrasound may see a growing role in the near future.

Following the assessment of arterial injury, the patient should be evaluated for peroneal nerve injury. Motor dysfunction can be evaluated by testing for loss of strength in ankle dorsiflexion, foot eversion, and toe extension. Peroneal nerve-associated motor dysfunction can be differentiated from a more proximal source (eg, L4-L5 radiculopathy) by testing quadriceps, hip adduction, and hip abduction strength.[15] Sensory innervation of the dorsum of the foot to the first web space should be tested as well. Confirmatory testing for neurologic injury occurs well after the ED evaluation, consisting of electromyography, nerve conduction velocity, and magnetic resonance imaging (MRI).

Lastly, serial evaluation for the development of compartment syndrome must be performed in any suspected case of knee dislocation. This complication can be easily misdiagnosed as the more common vascular and neurologic injuries discussed previously. Also, the impressive edema from a knee dislocation can mimic a compartment syndrome. A loss of pulses on examination must be assumed to be from popliteal artery injury rather than compartment syndrome until proven otherwise, and capillary perfusion will be compromised at a pressure much lower than that required to lose pulses. Sensory deficits in compartment syndrome are more likely to appear progressively and circumferentially rather than in a dermatomal distribution. Compartmental pressure readings may help to differentiate compartment syndrome from other complications of knee dislocation.[43]

### Ankle Dislocation

The initial evaluation of the patient with an ankle injury should include details of the mechanism of injury such as determining whether the injury is due to a fall from height, MVC, or from sports-related activity. Ascertaining the mechanism is important to predict the expected injury pattern as well as to help determine the type of force that will be required for reduction, as an opposite force from the injury will likely be needed to reduce the joint. Evaluation of the ankle should include a detailed assessment of the location of greatest pain, deformity, skin-tenting, and whether or not the joint is open. Vascular evaluation should be performed before and after reduction to assess for the presence and strength of posterior tibial and dorsalis pedis pulses as well as the quality of the distal capillary refill. Anterior ankle dislocations can impinge the dorsalis pedis artery, and a lack of pulse warrants emergent reduction to be able to fully assess arterial flow. Motor and sensory neurologic evaluation should follow, as appropriate, both before and after reduction attempts are made.

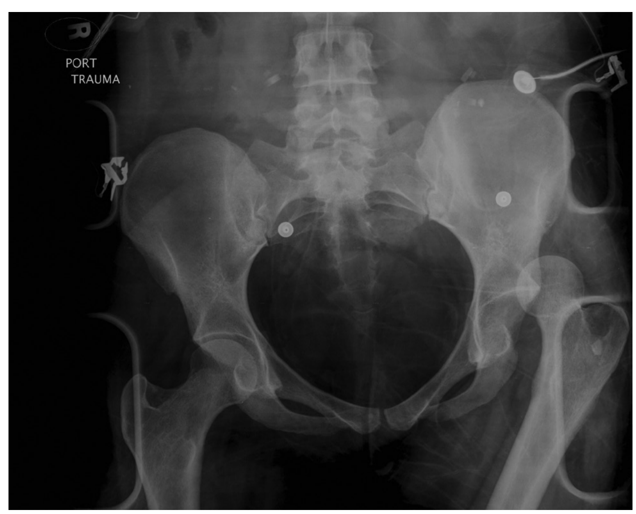
## Diagnostic Studies

### Hip Dislocation

Initial diagnostic testing for hip dislocations involves x-ray imaging. Trauma patients may be difficult to transport or transfer to an x-ray table for imaging. An initial bedside anteroposterior (AP) pelvis x-ray is appropriate in most cases and will reveal most hip dislocations. **(See Figure 6.)** Shenton's line, created by the inferior borders of the superior pubic ramus and neck of the femur, will be abnormal, suggesting dislocation or fracture. If the femoral head is superior to the acetabulum and smaller when compared to the contralateral side, this is likely a posterior dislocation. Alternatively, if the femoral head is inferior to the acetabulum and larger in appearance than the contralateral side, this is likely an anterior dislocation. The lesser trochanter will also be more apparent in anterior dislocations, due to external rotation.[4]

If the AP film is indeterminate, a lateral film may confirm the type of dislocation. Judet (internal and external oblique) views will help to evaluate for associated acetabular fracture, and are particularly useful in posterior dislocations, as 70% have an associated fracture of the posterior acetabulum.[6,8] If the Judet view shows a posterior acetabular fracture, a CT scan should be performed prior to reduction,

**Figure 6. Posterior Hip Dislocation With Fracture of Acetabular Wall**




From James F. Fiechtl, Michael A. Gibbs. An evidence-based approach to managing injuries of the pelvis and hip in the emergency department. *Emergency Medicine Practice.* 2010;12(12):1-24. © EB Medicine. Used with permission.

since a posterior acetabular fracture comprising more than 40% of the rim is considered unstable and requires open reduction and internal fixation. If < 20% of the posterior acetabular rim is fractured, the hip is considered stable, and emergent closed reduction by orthopedic surgery is indicated, followed by stability testing with fluoroscopy under general anesthesia.[4]

If the hip can be emergently reduced in the ED, postreduction radiographs are then obtained to confirm concentric reduction. Postreduction CT scan should be performed on all traumatic hip dislocations to assess for associated femoral head fractures, loose bodies, and acetabular fractures.[44]

When reduction in the ED fails, a prompt CT scan should be obtained to evaluate for occult fractures or loose bodies that were not appreciated on the initial plain films. In a complex fracture-dislocation, CT scan should also be considered prior to open reduction and internal fixation to assess the fracture pattern.[3]

MRI has a limited role in the initial workup and management of acute hip dislocation and can be performed at a later date to assess for avascular necrosis, labrum tears, or other ligamentous and soft-tissue injury.[45]

## Knee Dislocation

In acute knee trauma, the primary imaging modality is AP and lateral radiographs of the knee. **(See Figure 7.)** Plain films should not delay closed reduction if there is vascular compromise, but if the vascular examination is normal and imaging can be obtained at once, AP/lateral x-rays are recommended, as they may reveal osseous fractures or instability that may prevent stable reduction.[43] Repeat x-rays should be performed post reduction.

To evaluate for arterial injury, the initial test of choice is CT angiography, as it can reveal intimal injuries and has the added benefit of detailing the osseous anatomy. Historically, conventional angiography was the standard, and it remains an alternative to CT angiogram. In fact, it is still the most frequently used modality of evaluation for popliteal injury following knee dislocation.[46] Conventional angiography, however, is being left out of more recent diagnostic and treatment algorithms in favor of CT angiography, as trauma literature has shown its superiority.[41,46]

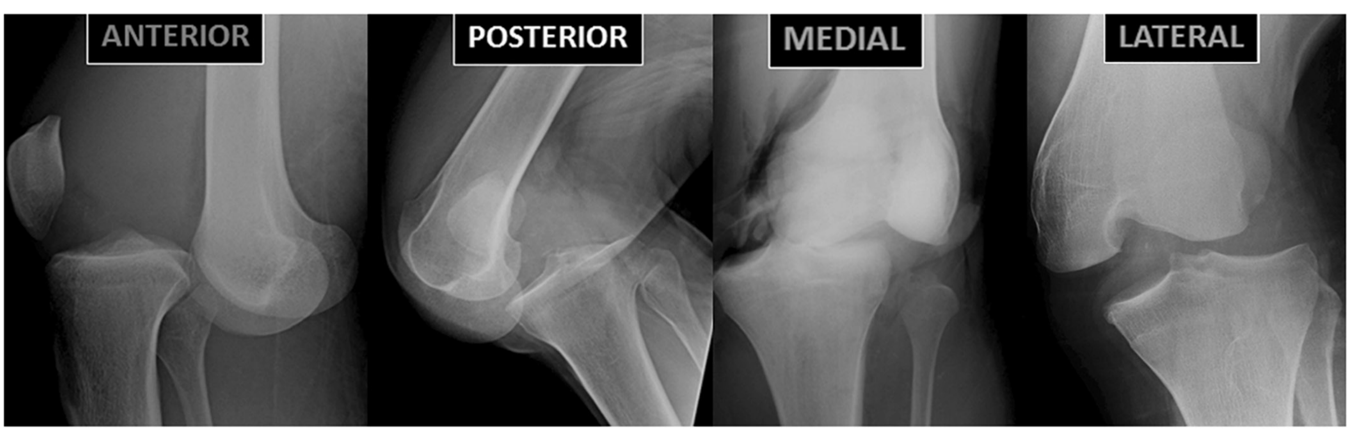
A 2004 retrospective study of 55 patients demonstrated that routine CT angiography on every patient with suspected knee dislocation is unnecessary. This study showed that, in patients with a normal vascular examination along with a normal ABI (using an ABI > 0.9 as normal), performing serial vascular examinations was an acceptable strategy, and no popliteal artery injuries in need of surgical intervention were missed.[47] Other studies have replicated this finding.[48] The 3 criteria for 24 hours of vascular check in lieu of vascular imaging include the following:[47]

1. Normal distal pulses
2. Well-perfused limb
3. Ankle-brachial index > 0.9

In the case of an abnormal pulse examination, even if it normalizes following initial closed reduction, this selective algorithm does not apply, and CT angiography should be performed. Conversely, if patients have hard signs of ischemia such as pulselessness, pulsatile hemorrhage, expanding hematoma, or palpable thrill/audible bruit following a knee dislocation, immediate surgical exploration and repair are indicated.

Magnetic resonance angiography (MRA) is another imaging option for evaluation of the popliteal artery, with the added benefit of excellent visualization of the osseous and ligamentous structures of the knee. MRA has practical limitations, however,

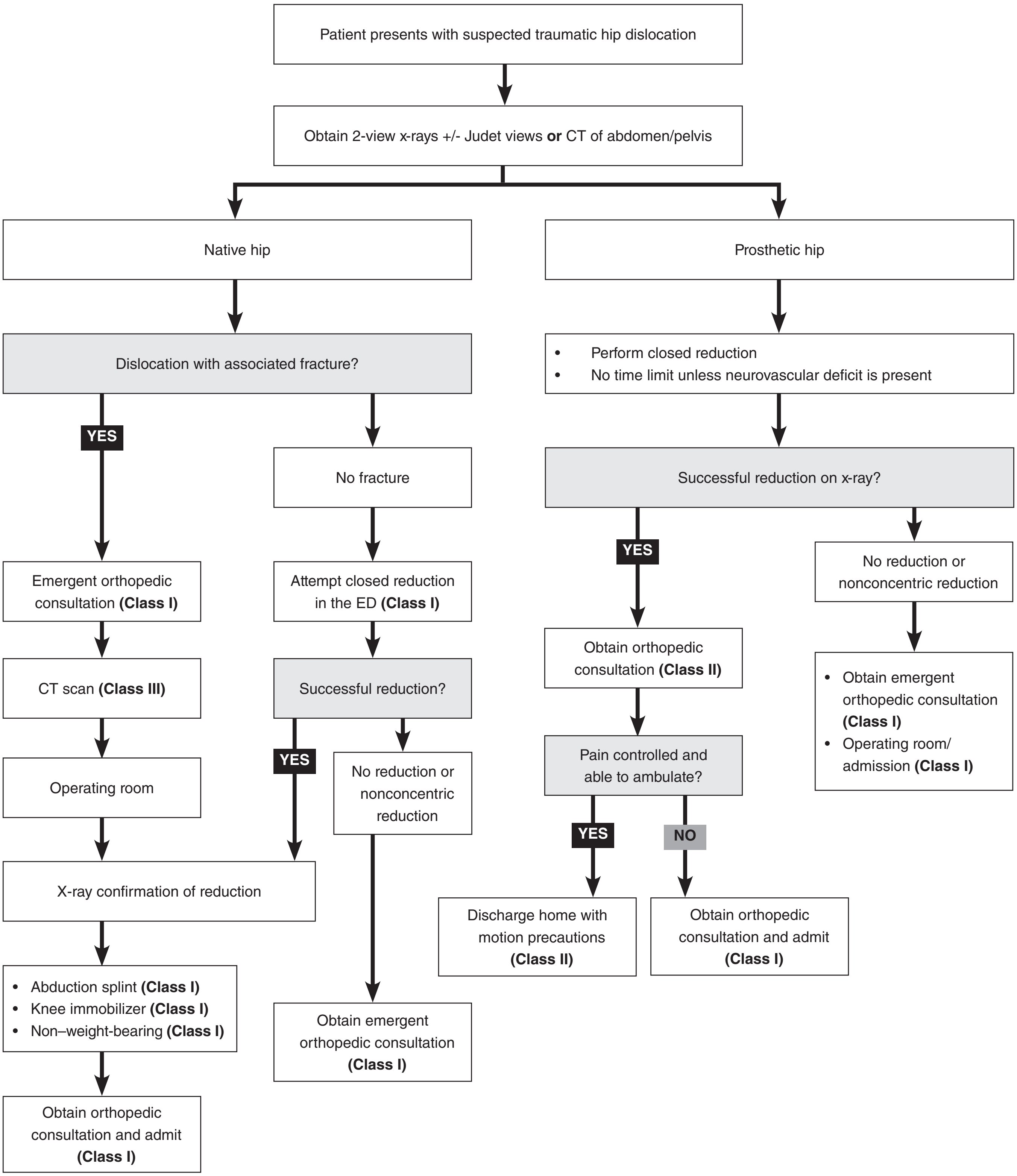
**Figure 7. X-Ray Images of Knee Dislocations**




From *Skeletal Radiology.* Multiligamentous injuries and knee dislocations. Volume 22, Issue 11. 2015, page 1559. Lana H. Gimber, Luke R. Scalcione, Andrew Rowan, et al. © Springer. Reprinted with permission of Springer.

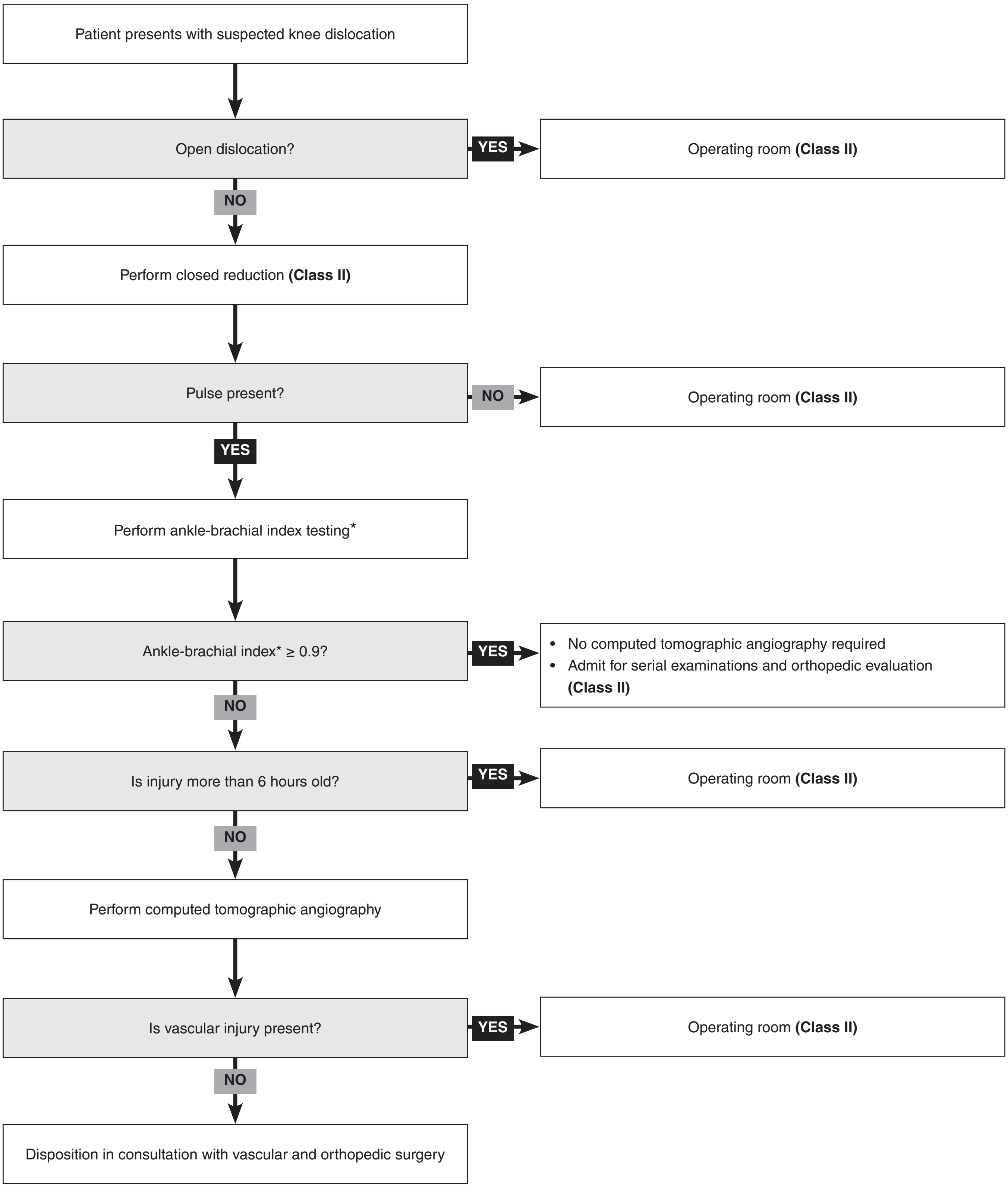
 

# Clinical Pathway for Emergency Department Management of Suspected Hip Dislocation




Appropriate Advanced Trauma Life Support trauma workup and adequate pain control should be initiated
Abbreviations: AP, anteroposterior; CT, computed tomography; ED, emergency department.
For Class of Evidence definitions, see page 12.

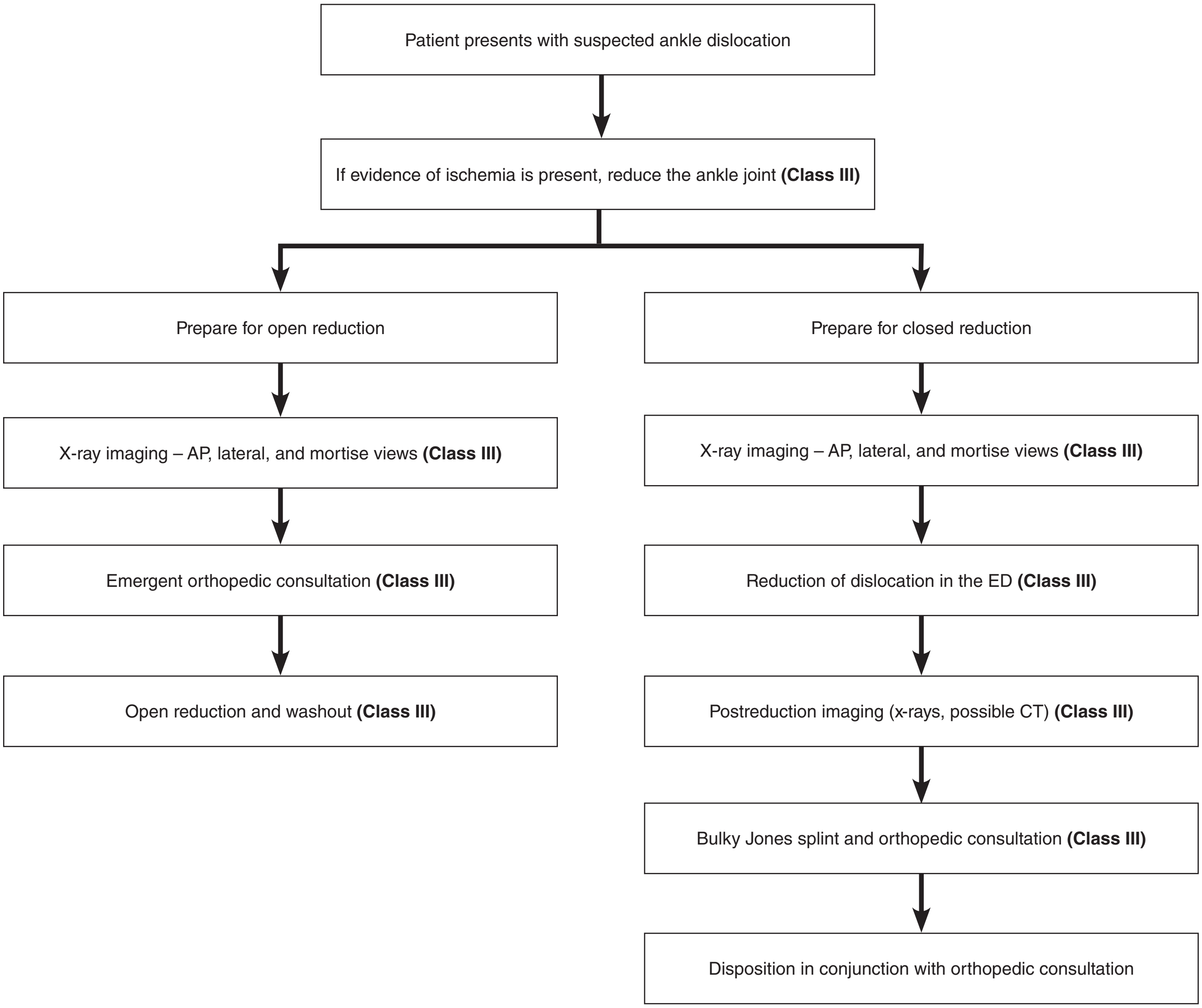
# Clinical Pathway for Emergency Department Management of Suspected Knee Dislocation




*Ankle-brachial index is calculated thus: brachial systolic pressure divided by ankle systolic pressure.
Appropriate Advanced Trauma Life Support trauma workup and adequate pain control should be initiated.
For Class of Evidence definitions, see page 12.

## Clinical Pathway for Emergency Department Management of Suspected Ankle Dislocation




Appropriate Advanced Trauma Life Support trauma workup and adequate pain control should be initiated.
Abbreviations: AP, anteroposterior; CT, computed tomography; ED, emergency department.

## Class Of Evidence Definitions

Each action in the clinical pathways section of *Emergency Medicine Practice* receives a score based on the following definitions.

**Class I**
- Always acceptable, safe
- Definitely useful
- Proven in both efficacy and effectiveness

*Level of Evidence:*
- One or more large prospective studies are present (with rare exceptions)
- High-quality meta-analyses
- Study results consistently positive and compelling

**Class II**
- Safe, acceptable
- Probably useful

*Level of Evidence:*
- Generally higher levels of evidence
- Nonrandomized or retrospective studies: historic, cohort, or case control studies
- Less robust randomized controlled trials
- Results consistently positive

**Class III**
- May be acceptable
- Possibly useful
- Considered optional or alternative treatments

*Level of Evidence:*
- Generally lower or intermediate levels of evidence
- Case series, animal studies, consensus panels
- Occasionally positive results

**Indeterminate**
- Continuing area of research
- No recommendations until further research

*Level of Evidence:*
- Evidence not available
- Higher studies in progress
- Results inconsistent, contradictory
- Results not compelling

This clinical pathway is intended to supplement, rather than substitute for, professional judgment and may be changed depending upon a patient's individual needs. Failure to comply with this pathway does not represent a breach of the standard of care.

as it is expensive and takes much longer to perform. The risk of the long scanning time for an MRA may outweigh the benefit of the test if it causes a delay in surgical management, and therefore increased likelihood of amputation.[41]

### Ankle Dislocation

Prereduction radiographic imaging of the injured ankle begins with AP, lateral, and mortise or oblique x-rays. Further imaging of the lower leg and foot is likely to be appropriate as well, depending on the extent of injury. **(See Figure 8.)** Postreduction imaging should also be obtained following reduction.[27] CT imaging of the dislocated ankle is reasonable following reduction to evaluate for fractures that are often present. CT imaging helps define the extent of these fractures and allows better operative planning by the orthopedic surgeon.[27,28]

## Treatment

### Hip Dislocation

The primary decision in hip dislocation management is whether or not to reduce the hip in the ED versus obtaining emergent orthopedic surgery consultation for reduction in the operating room. All complex hip dislocations (ie, those with an associated fracture) require emergent orthopedic surgery consultation. Other indications for surgical management include irreducible dislocation, nonconcentric reduction, neurovascular deficit after closed reduction, and associated proximal femur or acetabular fracture causing hip instability. Surgical management ranges from open arthrotomy to minimally invasive hip arthroscopy, which is popular for treating intra-articular hip pathology such as loose bodies, chondral defects, and labral tears.[4]

For a simple hip dislocation that does not show evidence of femur or acetabular fracture on plain films, prompt reduction should be attempted in the ED. If the decision is made to emergently reduce a native traumatic hip dislocation, it should be performed within 6 hours of the time of injury to decrease the risk of avascular necrosis.[49] No more than 3 attempts should be made in the ED, as this can also increase the risk of avascular necrosis and damage the articular cartilage.[4]

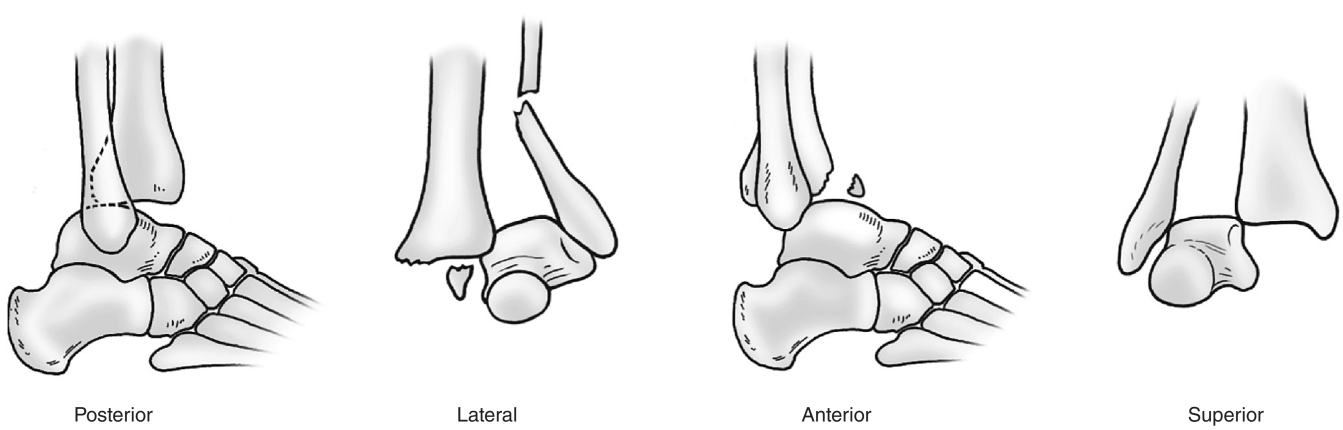
If the patient needs to be transferred to a trauma center, the emergency clinician should consider reducing the hip dislocation prior to transfer, not only because of the increased risk of avascular necrosis, but to reduce the risk of sciatic nerve injury. A retrospective study of 106 patients showed that there was a much higher risk of severe sciatic nerve injury in patients who were not reduced prior to transfer (16%) versus those patients who were reduced prior to transfer (4%).[50]

#### Reduction of Hip Dislocation

Prior to definitive reduction of a hip dislocation, pain control and muscle relaxation should be addressed. Ultrasound-guided fascia iliaca compartment block can be performed by the emergency clinician to achieve pain relief and may reduce the need for systemic analgesia.[51] Procedural sedation prior to reduction should aim for adequate analgesia and muscle relaxation. In one study, sedation was safely performed by a single-provider/single-nurse model, with low risk of adverse outcome and 96% success rate; however, each institution has sedation/analgesia policies that should be followed.[52]

Successful reduction of a dislocated hip must overcome the acetabular rim as well as the gluteal muscles.[53] There are multiple techniques that have been developed for closed hip reduction; the most well-known are the Allis and Bigelow methods,

**Figure 8. Ankle Dislocations**

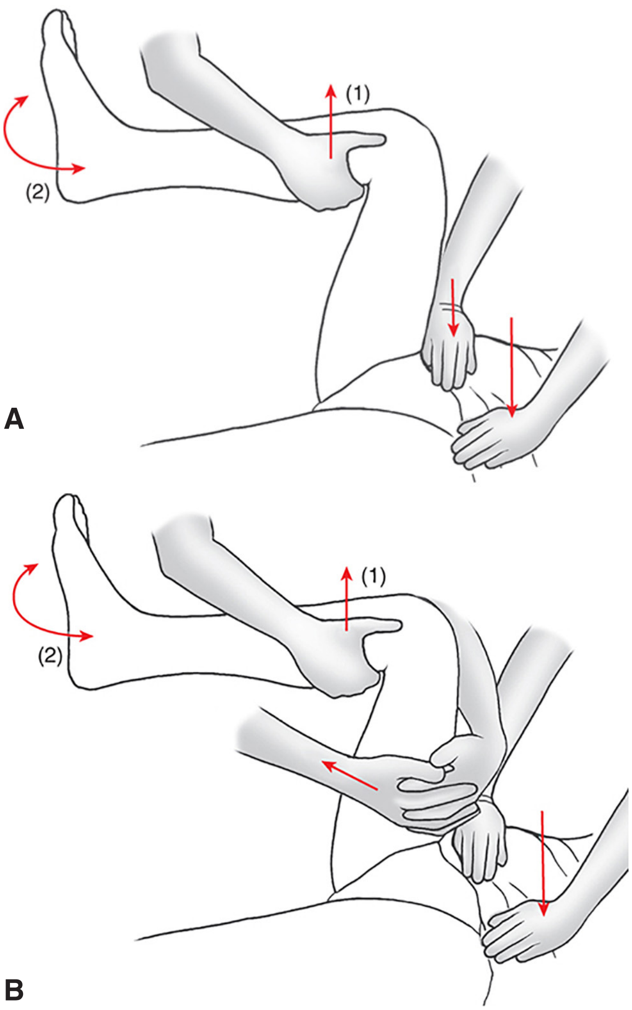



Source: Eric.Reichman: *Emergency Medicine Procedures, Second Edition:* www.accessemergencymedicine.com. Copyright © The McGraw-Hill Companies, Inc. Used with permission.

first described in the late 1800s. **(See Figures 9 and 10.)** Both of these techniques usually require that the clinician stand on the gurney to provide the appropriate traction. This is not only precarious, but can predispose the clinician to lumbar strain. More recently, several methods, such as the Captain Morgan technique, the Rocket Launcher technique, and the East Baltimore Lift, have been designed to be ergonomically safer and have also shown promising success rates in case studies. **(See Figures 11 and 12, page 15.)** No studies definitively recommend one technique over another. A clinician should consider his or her physical limitations, support staffing, and comfort level with each technique to decide which is right for the patient.

**Figure 9. The Allis Method**




As an assistant applies downward pressure on each anterior superior iliac spine, the provider exerts upward inline traction on the femur and flexes it to 90°, adducting and internally/externally rotating the femur until it reduces.[54] View B shows the maneuver with a second assistant applying lateral traction to the thigh.

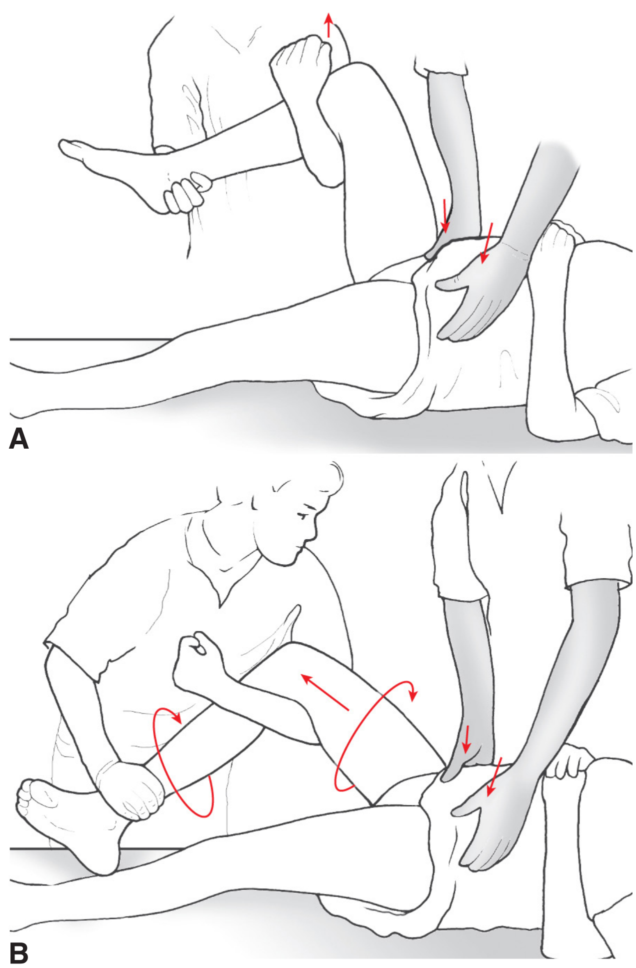
Source: Eric F. Reichman: *Emergency Medicine Procedures, Second Edition:* www.accessemergencymedicine.com. Copyright © The McGraw-Hill Companies, Inc. Used with permission.

## Knee Dislocation

Any confirmed or suspected knee dislocation necessitates emergent orthopedic and/or vascular surgery consultation, and they should be able to assist in the decision-making process. Progression through the treatment algorithm for knee dislocation must be achieved quickly and efficiently, with the key points being early reduction and identifying and treating surgical neurovascular injuries. Previous studies have shown that popliteal artery injuries in knee dislocation result in an 11% amputation rate if vascular repair is achieved < 8 hours postinjury, but the amputation rate is 86% if vascular repair is achieved > 8 hours post injury.[43]

If evidence of vascular compromise is seen on initial examination, immediate closed reduction should be attempted. Following reduction, repeat vascular examination and postreduction films should be performed. If a pulse examination on initial

**Figure 10. The Bigelow Method**




In view A, the provider applies upward traction on the femur while an assistant stabilizes the pelvis. In view B, the hip is externally rotated and extended while the femur is distracted.

Source: Eric F. Reichman: *Emergency Medicine Procedures, Second Edition*: www.accessemergencymedicine.com. Copyright © The McGraw-Hill Companies, Inc. Used with permission.

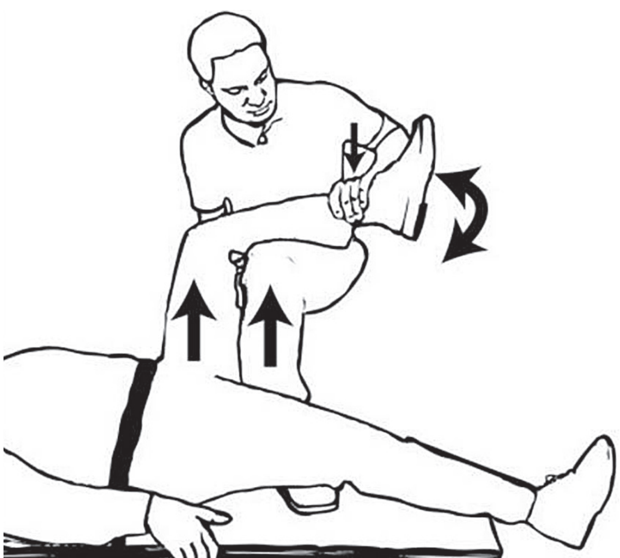
assessment is normal, prereduction films and ABI should be obtained, which will lead to the next decision point: Does the patient require imaging for arterial injury? Using the selective angiography criteria discussed previously, if the patient has normal distal pulses, a well-perfused limb, and an ABI > 0.9, a patient may be considered for a 24-hour admission for serial vascular examinations. If criteria are not met or admission is not feasible, vascular imaging is recommended. Although time to intervention is important to decrease the risk of amputation, it is reasonable to obtain angiography if the time from injury is < 6 hours and if the delay to the surgical intervention is negligible.[46]

### Reduction of Knee Dislocation

Reduction techniques for the knee are relatively simple compared to other joint reductions, with slight differences based upon the direction of dislocation.[58] Reductions are ideally performed by a clinician with 2 assistants. While one assistant applies steady, inline traction on the tibia distally, the other assistant will apply inline counter-traction on the distal femur. The clinician should hold the proximal tibia with both hands, applying force in the opposite direction of the dislocation until the knee reduces, being careful not to hyperextend the knee or overshoot the reduction. This can also be accomplished with 2 clinicians: one providing inline traction on the distal femur and the other applying the traction to the tibia while applying force in the opposite direction of the dislocation. Having appropriate traction and counter-traction will help to minimize the lateral and medial force necessary to perform these reductions.[58]

Once closed reduction has been achieved, the knee should be immobilized in approximately 20° of flexion, pending definitive management, in order to prevent posterior subluxation of the tibia.[59] Following closed reduction in the ED, multiligamentous injuries may be managed surgically or nonoperatively. A 2015 meta-analysis demonstrated that surgical treatment appeared to be associated with improved outcomes, defined as average range of motion, flexion contracture, and a subjective symptom scale (the Lysholm score). However, surgical intervention resulted in no difference from the patients' preinjury employment or athletic ability compared to nonoperative management, and the potential for significant disability remained whichever route was chosen.[60] When man-

**Figure 11. The Captain Morgan Technique**



As an assistant applies downward pressure on each anterior superior iliac spine, the provider flexes the patient's hip to 90°. The provider places one foot on the stretcher, with his knee behind the patient's knee. Downward force is applied to the patient's ankle. With the other hand under the patient's knee, the provider simultaneously lifts with his hand and knee to create upward traction. Gently rock the patient's hip, creating internal/external rotation to assist with reduction.[56]

Reprinted from *Annals of Emergency Medicine*. Volume 58, Issue 6. Gregory W. Hendey, Arturo Avila. The Captain Morgan technique for the reduction of the dislocated hip. Pages 536-540. Copyright 2011, with permission from Elsevier.

**Figure 12. The Rocket Launcher Technique**


As an assistant applies downward pressure on each anterior superior iliac spine, the provider stands on the side of the affected leg, facing the patient's feet, and flexes the affected hip to 90°. The provider places the patient's knee over his shoulder, with the inside hand on the patient's knee and the outside hand on the ankle. Assume a squat position, and lean toward the patient, while pulling the ankle laterally, to adduct and internally rotate the femur. Stand from a squatted position to provide upward traction. Once reduced to length, externally rotate and abduct the affected hip to reduce the deformity.[57] (T = traction, AD = adduction, IR = internal rotation.)

Michael Dan, Alfred Phillips, Marcus Simonian, Scott Flanagan. Rocket launcher: a novel reduction technique for posterior hip dislocations and review of current literature. *Emergency Medicine Australasia*. 2015. Volume 27, Issue 3. Pages 193-195. Reprinted with permission of John Wiley and Sons.

aged surgically, there is often delay to surgical ligamentous repair to allow for a vascular observation period, among other orthopedic advantages;[61] however, the timing of intervention is still a matter of debate. In 2015, a 12-study review was performed that showed no significant difference in clinical results when multiligamentous injury was repaired acutely (< 3 weeks after injury) versus delayed (> 3 weeks after injury).[62] This debate, of course, refers only to orthopedic repair of the multiligamentous injury, not vascular or neurologic repair.

No specific treatment of complicating peroneal nerve injuries is undertaken in the ED. Treatments after the ED setting are focused on the management of drop foot, aiming to restore normal heel-toe gait.[14]

### Ankle Dislocation

Control of pain should be instituted immediately for all ankle dislocations. In order to achieve good long-term outcomes, the goals of treatment for ankle dislocations are joint reduction with reimplantation of the talus and reversal of any neurovascular compromise.[22,31] Prompt reduction prior to imaging is warranted when there is concern for neurovascular compromise, but in most cases, prereduction imaging should be obtained.

#### Reduction of Ankle Dislocation

In the majority of patients, significant pain control or procedural sedation should be initiated prior to reduction attempts. Reduction of the dislocated ankle will require an assistant for counter-traction. The procedure involves having 1 person hold the patient's knee at 90° of flexion, which will help reduce the tension of the Achilles tendon. If only 1 provider is available, putting the patient's knee, bent to 90°, at the edge of the bed can provide counter-traction.

The clinician should hold the patient's foot in a plantar-flexed position. One hand grasps the distal foot and the other hand grasps at the heel. Axial traction is applied, and the talus is moved into an anatomic position, dependent upon the direction of the dislocation.[29,63] Often, there is a palpable "clunk" when the talus falls into the correct location inferior to the tibia. Prior to attempts at moving the talus, axial traction should be applied to the foot to help fatigue the musculature.

If reduction is unsuccessful after 2 or 3 attempts, open reduction may be required in the operating room. Fractures, foreign bodies, and tendon ruptures may be in the joint capsule, making reduction impossible. Repeated attempts at closed reduction may cause significant damage to the talar cartilage, as there may be an obstruction and may also cause greater soft-tissue injury and swelling.

Open dislocations still warrant reduction in the ED if vascular compromise is present, but these should have emergency orthopedic consultation for operative debridement/intervention. Operative reduction after washout and debridement is recommended if there is not vascular compromise in an open dislocation.[63] Although rare, severe skin tenting can open during reduction attempts, and even if the joint is successfully reduced and the laceration is small, operative management should be considered.[63]

Once the reduction has been completed, a neurovascular examination should be repeated to ensure good perfusion. The patient should be placed in a long-leg posterior splint with a sugar-tong splint in addition, for maximal stability and immobilization, with the ankle held in a 90° flexed position ("bulky Jones" splint).[63] Significant swelling can be present and worsen after reduction, and the splint should allow for this. Postreduction films should be obtained to include AP, lateral, and mortise views. Orthopedic consultation should be obtained in the ED because of the unstable nature of these dislocations and the risk of associated fractures and neurovascular injury, often requiring surgical intervention.[64,65]

## Disposition

### Hip Dislocation

After any reduction attempts in the ED, the patient's neurovascular status should be re-evaluated. The affected leg is then immobilized in extension, external rotation, and slight abduction. An abduction pillow or another object can be placed between the knees in order to avoid flexion, internal rotation, and adduction of the hip. The patient may also be placed in a knee immobilizer to prevent inadvertent flexion at the hip.[4] Radiographs should be repeated to confirm reduction, followed by a postreduction CT scan if concern exists for an incomplete reduction, occult fracture, or intra-articular loose bodies. A nonconcentric reduction is a surgical emergency due to the pressure on the articular cartilage, even though blood supply may have been restored to the femoral head. The affected hip may require traction and/or open reduction.[4] Orthopedic surgery consultation in the ED should be considered in most cases of hip dislocation. The patient may be admitted for pain control, and should remain non–weight-bearing until orthopedic consultation. Early passive range of motion and rehabilitation is recommended.[8]

### Knee Dislocation

All patients who present with a knee dislocation or with a presentation suspicious for a spontaneously reduced dislocation should be considered for serial vascular checks and compartment syndrome evaluation. Patients with a lower suspicion for dislocation and with vascular imaging showing no evidence of arterial injury can be considered for discharge. This decision should be made with input from specialist consultation.

## Ankle Dislocation

Orthopedic consultation should be obtained in the ED for all ankle dislocations, either after reduction or if the ankle is unable to be reduced. Because of the high rate of concomitant tibial, fibular, and talar fractures, which are often unstable injuries, many of these patients will require surgery. Delayed surgical intervention is, however, appropriate in certain cases. If the patient is stable, neurovascularly intact, and does not require open reduction or operative intervention, they may have the joint immobilized and be considered for discharge home. The patient should be kept strictly non–weight-bearing pending close orthopedic follow-up.

# Complications

## Hip Dislocation

Overall prognosis following a hip dislocation is dependent on a number of factors. Simple hip dislocations can range from a normal, functional hip to a severely painful, arthritic hip or permanent neurovascular injury.[3] Factors that lead to worse prognosis include increased time to reduction, posterior dislocation, cartilaginous injury to the femoral head, associated acetabular fracture, the presence of polytrauma, and pre-existing comorbidities.[3,66] These risk factors increase the patient's risk of developing long-term complications such as avascular necrosis, posttraumatic arthritis, sciatic nerve palsy, and heterotopic ossification.[3]

Time to reduction of the femoral head within the acetabulum, and therefore restored blood supply, is one of the most important factors affecting development of these complications, specifically avascular necrosis and posttraumatic arthritis. The accepted time to reduction is controversial. In 2016, Kellam and Ostrum published a comprehensive review of the existing literature on this topic and found that, for certain anterior dislocations and posterior hip dislocations, the severity of injury correlates with an increase in the development of avascular necrosis and posttraumatic arthritis. Posterior dislocations were more likely to develop avascular necrosis and posttraumatic arthritis, with posttraumatic arthritis being more common. The risk of avascular necrosis in hip dislocations reduced after 12 hours was significantly increased, up to 5.6 times more likely than those reduced in < 6 hours.[66] The incidence of posttraumatic arthritis is much lower in simple dislocations than in fracture-dislocations, 70% of which will develop posttraumatic arthritis.[67]

## Knee Dislocation

Neurovascular injury is the primary complication that can be minimized with appropriate and timely intervention. Specifically, popliteal artery injury must be assessed, due to the devastating consequences, including amputation, resulting from these injuries. A 2005 study performed in Australia demonstrated an amputation rate of 26% following popliteal artery injury, with prolonged ischemia time from delayed diagnosis increasing the need for amputation.[68]

## Ankle Dislocation

Vascular compromise and neurologic injury are the primary severe complications one should address with prompt reduction for ankle dislocations. Lack of blood flow to the talus can lead to avascular necrosis, and skin tenting and vascular compromise to the skin and soft tissues can lead to ischemic or soft-tissue necrosis and, potentially, gangrene. Rarely, amputations are required due to complications from ischemia. In open dislocations, the risk of infection is also a well-described complication and, in general, open dislocations have a higher rate of vascular injury. Long-term osteoarthritis is common after both open and closed dislocations.[26,29] **(See Table 4.)**

# Special Circumstances

## Hip Dislocation Following Total Hip Arthroplasty

Special consideration is necessary for patients presenting with dislocation of a prior total hip arthroplasty (THA). Approximately 2% of individuals who have undergone THA will present with hip dislocation, which typically results from minimal traumatic force.[69] These are usually due to activities such as bending over to pick something up off the floor, putting on shoes and socks, and getting into and out of bed.[70] Approximately 60% of dislocations following THA occur within the first 3 months, and 77% occur within the first year.[71]

Reduction techniques are similar to those described in the "Reduction of Hip Dislocation" section on page 13; however, the urgency of reduction is not as pressing, since there is no risk of avascular necrosis, since the femoral head has been replaced. Prompt reduction is still encouraged however, due to patient discomfort as well as the risk of sciatic nerve injury. Of note, forceful reduction of a dislocated hip prosthesis may dislodge the acetabular cup, fracture underlying osteoporotic bone, or loosen the

**Table 4. Complications of Ankle Dislocation**

- Fractures and risk of malunion or nonunion
- Osteoarthritis
- Avascular necrosis of the talus
- Entrapment of the tibialis posterior tendon
- Entrapment of fracture fragment
- Cartilaginous injury
- Talar dome osteochondral fractures
- Arterial injury/amputation

prosthesis. If reduction is unsuccessful after multiple attempts, orthopedic surgery should be consulted for reduction in the operating room.

Following successful reduction, plain films should be obtained to confirm concentric reduction. Abduction bracing following closed reduction of a hip prosthesis is ineffective in preventing recurrent dislocation, and is therefore unnecessary.[72] The patient may attempt to walk after sedation has worn off. Unlike native hip dislocations, patients with prosthetic hip dislocations often will not require hospital admission and may be discharged after discussion with the consulting orthopedic surgeon. These patients should be given precautions to avoid recurrent dislocation, such as avoiding sitting with the hips below the level of the knees, bending over to pick things up, or crossing the legs. They should sleep with a pillow between the legs. Follow-up with the patient's orthopedic surgeon within 2 weeks is recommended.[45]

### Knee Dislocation Following Knee Replacement

Unlike hip prostheses, knee replacements rarely dislocate.[73] The majority of the literature involves case reports and small case series. Prosthetic dislocations are more commonly posterior and can also have associated neurovascular injury.[74] Often, reduction may be difficult because prostheses often contain a vertical post which must be overcome. Due to their less familiar nature, expert consultation may be considered for assistance.

### Patellar Dislocation

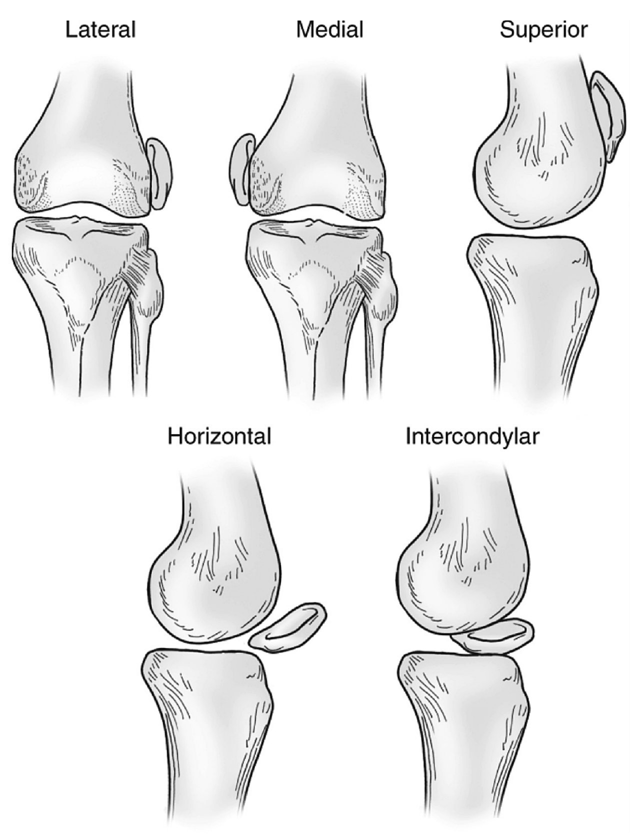
Patellar dislocations are simple to manage in most cases. These injuries are usually related to trauma, but they can result from a minor force. Risk factors include female gender, adolescence, vastus medialis atrophy, obesity, genu valgus, flat intercondylar groove, and a large quadriceps angle ("Q angle").[75,76] Most patellar dislocations are lateral, due to the upward and lateral pull of the quadriceps muscle; however, it can also dislocate medially, superiorly, horizontally, and intra-articularly. **(See Figure 13.)** The laterally dislocated patella is easy to identify, as the affected knee will be held in partial flexion, with a bulging deformity over the lateral aspect. Many of these dislocations will reduce spontaneously prior to ED evaluation. Palpate over the patellar tendon from the origin at the inferior patella to the insertion on the tibial tuberosity. Identifying a continuous, firm band ensures that the tendon has not completely ruptured; consider ultrasound to aid in confirming the continuity of the tendon.[77]

Obtain initial knee radiographs to look for patellar fractures or other bony injury. If the patient is not tolerating the dislocation, reduction before imaging may be appropriate. For a lateral or medial dislocation without other injury, there are seldom complications, and the reduction can be performed without analgesia or sedation. Anxiolysis can be considered for the anxious patient.

The reduction technique involves mild flexion at the hip to shorten the quadriceps, then slowly extending the knee. This usually reduces the dislocation. If still dislocated, apply gentle pressure to the patella toward the patellar groove. All uncommon types of patellar dislocations (intra-articular, horizontal, and superior) can be difficult to reduce by closed manipulations and may require operative reduction. Orthopedic consultation is recommended for these cases, and in cases where there is an associated fracture.[77,78]

Perform postreduction radiographs to include patellar views to confirm the reduction and evaluate for osteochondral fracture. Following the reduction, immobilize the patient in extension, with a knee immobilizer or long leg splint. The patient should be discharged with crutches, a 1-week follow-up with orthopedics, and instructions to remain non–weight-bearing. The patient will likely stay non–weight-bearing or partially weight-bearing for 2 to 4 weeks. Longer periods of immobilization are associated

**Figure 13. Patellar Dislocations**

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## Risk Management Pitfalls in Management of Lower-Extremity Dislocation

1. **"I didn't consider injuries other than hip dislocation."**
   Hip dislocation may be a distracting injury; 95% of patients have other associated injuries. Be sure to perform a thorough trauma evaluation, and maintain a low threshold for ordering imaging on any suspected injury.

2. **"The patient had a head injury, so she couldn't tell us that her hip was hurting."**
   Hip dislocations may be missed due to other distracting injuries, especially in high-speed MVCs, due to altered mental status, etc. Strongly consider pelvic imaging for any patient with a dangerous mechanism with distracting injury.

3. **"I couldn't get the patient comfortable enough to perform the reduction."**
   Adequate sedation and muscle relaxation is key to successful ED reduction. Sedatives such as benzodiazepines and propofol provide both sedation and muscle relaxation.

4. **"Did the patient have intact sensation and pulses after the reduction was completed?"**
   Check neurovascular status before and after reduction; sciatic nerve injury occurs in 10% to 20% of hip dislocations, popliteal artery injury is a risk with knee dislocations, and the vascular supply of the talus is at risk with ankle dislocations.

5. **"The patient still had a fair amount of pain even after reduction."**
   Pain should improve following reduction and immobilization, but pain medication may still be needed. If there is still a great deal of pain after reduction, examine the patient for neuromuscular compromise and assess the postreduction film to verify adequate reduction and to ensure that there are no fractures.

6. **"I didn't think I needed to consult orthopedics to see the patient before discharging him from the ED."**
   Even if reduction is successful, patients can still have complications from their injuries. If the patient's neurovascular status is abnormal, or there is a nonconcentric reduction, they may still require emergent orthopedic consultation and open reduction and internal fixation.

7. **"Did you realize the distal pulses were diminished on arrival?"**
   An immediate neurovascular examination is crucial, and may prompt timely evaluation with advanced imaging. Performing an ABI test can evaluate vascular status more objectively.

8. **"I was waiting for the CT read before performing the reduction."**
   Radiographs are typically sufficient for prosthetic hip dislocation, knee dislocations, and ankle dislocations. CT scans may ultimately be required, but they are not usually required prior to reduction.

9. **"The reduction went smoothly, and the pain was much relieved, so I didn't pursue further imaging."**
   Because of the risk of other, associated fractures, CT should be obtained following all native hip reductions to assess for loose fragments and femoral neck, femoral head, or acetabular fracture. CT should also be obtained for many ankle dislocations.

10. **"I tried to reduce the joint multiple times, but I was unsuccessful."**
    Repeated unsuccessful attempts at reduction or associated fractures should prompt orthopedic consultation.

with decreased range of motion, but lower rates of recurrence. The ultimate decision for surgical management versus physical therapy alone is decided on a case-by-case basis by the patient's orthopedic surgeon.[78,79]

### Knee Dislocation in Children

A knee dislocation in the pediatric population also carries a similar risk of neurovascular injury and compartment syndrome. The management of a knee dislocation in a child does not vary significantly from that of an adult.[80]

## Controversies and Cutting Edge

There is literature that challenges the accepted time to reduction of the dislocated hip and how much time truly increases the risk of avascular necrosis. Brav reviewed 262 patients and found that in patients reduced in < 12 hours, 22% developed avascular necrosis versus 52% in those reduced after 12 hours.[81] Hougaard and Thompsen reviewed 100 cases after 5-year follow-up and found that 4% of patients reduced in < 6 hours developed avascular necrosis, versus 58% reduced > 6 hours.[82] Dreinhofer et al evaluated 50 patients and reported that there was no difference in reduction < 1 hour as opposed to < 6 hours, all of which had a 12% risk of avascular necrosis.[5] As previously discussed, Kellam and Ostrum recently performed a meta-analysis of the existing literature, and found that reducing a hip in < 6 hours significantly reduces the risk of avascular necrosis, which confirms the current practice of most emergency clinicians and orthopedic practitioners.[66] It is likely that time to reduction represents a continuum of increasing risk, and for that reason, it is advisable to attempt reduction as soon as feasible.

### Ultrasound-Guided Procedural Sedation

In recent years, sonography has become an increasingly useful tool in the ED and its use is highly incorporated into the training of emergency clinicians. Multiple case reports suggest that an ultrasound-guided fascia iliaca compartment block by the emergency clinician improves patient comfort and increases the likelihood of successful reduction in the ED. This can reduce the complications of procedural sedation or general anesthesia, especially in the elderly population. The success of regional anesthetic techniques for hip fractures suggests that this technique may also be effective for joint reduction, but further study is warranted.[51]

## Summary

Ninety percent of hip dislocations are posterior and present with internal rotation and adduction, while 10% are anterior and present with external rotation and abduction. The initial physical examination and AP pelvic radiograph is usually sufficient to make the diagnosis; however, additional views, such as Judet views, may be needed to evaluate for associated fractures. Traumatic dislocations of the native hip should be reduced within 6 hours to reduce the risk of long-term complications such as avascular necrosis and posttraumatic arthritis. Due to the high incidence of associated injuries, a thorough trauma evaluation is necessary. There are multiple reduction techniques described; however, none have proven significantly superior. Some methods are designed to be ergonomically safer for the practitioner, such as the Captain Morgan and Rocket Launcher techniques. All fracture-dislocations should be deferred to orthopedic surgery and should be promptly reduced in the operating room under general anesthesia. Most native hip dislocations should be admitted to the hospital; however, uncomplicated reductions of prosthetic hips may be considered for discharge home.

Knee dislocations, although uncommon, require timely reduction and assessment for a limb-threatening neurovascular injury. Complicating the emergency clinician's evaluation, many knee dislocations spontaneously reduce, so maintaining a low threshold of suspicion for this injury is paramount, as missing an associated arterial injury can be catastrophic. With early consultation of orthopedic surgery and vascular surgery in all cases of obvious or suspected knee dislocation, as well as application of a selective approach to CT angiography, the risk of missing a clinically significant arterial injury is minimized. Two providers using a traction/countertraction technique can perform successful reduction of the dislocated knee.

Primary ankle dislocation in any direction without associated fractures are rare. They can be associated with significant neurovascular, skin, and soft-tissue complications, and they require immediate recognition and prompt reduction in the ED. If the dislocation is open, complicated, or unable to be reduced, emergent orthopedic consultation is required. A bulky Jones splint and strict non–weight-bearing should be maintained until evaluated by orthopedics.

## Case Conclusions

*The 25-year-old man with traumatic native hip injury after MVC underwent trauma surgery consultation, including a primary and secondary survey. The patient did not have any associated injuries. On the portable AP pelvis radiograph, the right femoral head was higher and smaller appearing than the left, suggesting posterior hip dislocation. A CT scan of the abdomen/pelvis confirmed this diagnosis and revealed a 40% acetabular rim fracture; therefore, orthopedic surgery was emergently consulted* *and the patient underwent open reduction and internal fixation in the OR.*

*The elderly woman with history of right hip prosthesis who presented after a fall had right hip and pelvis radiographs with Judet views, revealing a posterior dislocation of her right THA, without any associated fractures. After a successful closed reduction in the ED, repeat radiographs showed a concentric reduced hip joint. The patient was neurovascularly intact following reduction and could ambulate without pain. Orthopedic surgery was consulted and recommended discharge home with close follow-up.*

*The 19-year-old man was suspected to have suffered hyperextension resulting in an anterior knee dislocation that had spontaneously reduced. Initial distal vascular and neurologic examination was unremarkable; however, ABI was found to be 0.7. The knee was immobilized in 20° of flexion as orthopedic and vascular surgery were consulted. A CT angiogram was performed and identified a popliteal artery disruption. The patient was taken for surgical repair by vascular surgery, with the aid of orthopedic surgery.*

*The 27-year-old man who jumped out of a tree was found on x-ray to have a posterior ankle dislocation without an associated ankle fracture. He required sedation for reduction, but was successfully reduced on the first attempt and had an intact neurovascular exam after reduction. A bulky Jones splint was applied, and orthopedics was consulted for further care. CT scan revealed small osteochondral fractures to the talar dome, but he did not require surgery and recovered after a prolonged period of remaining non–weight-bearing.*

## Time- And Cost-Effective Strategies

- Reducing a native hip in < 6 hours reduces risk for avascular necrosis and posttraumatic arthritis, ultimately reducing future medical expenses.
- Though less emergent due to the lack of risk for avascular necrosis, decreased time to reduction of prosthetic hips reduces risk of sciatic nerve injury and pain, and may help prevent hospital admission.
- An ultrasound-guided fascia iliaca compartment block may decrease the amount of sedation necessary and increase likelihood of successful reduction of both native and prosthetic hip dislocations in the ED, thereby reducing time to reduction, preventing need for operative intervention, and reducing length of stay.
- Reduction of knee or ankle dislocations, either closed in the ED or open in the operating room, should be achieved in < 8 hours in order to minimize the risk for significant limb ischemia and subsequent amputation. Not only is this a limb-saving measure, but it will significantly reduce both the short-term and long-term costs of care.

## Key Points

- Native hip dislocations may require admission to the hospital after reduction, but most patients with prosthetic hip dislocations can be safely discharged home with abduction restrictions following ED reduction.
- Complete hip radiographs are usually sufficient prior to reducing both native and prosthetic hip dislocations, and reduction should not be delayed for CT. Postreduction radiographs are sufficient following successful prosthetic hip reductions; however, CT scan should be obtained in the setting of a native hip reduction.
- Immediately reduce knee dislocations that have distal pulse deficits. Do not delay immediate closed reduction to obtain ABI or x-rays, as this will not alter management yet, and it can be performed after reduction. Knee dislocations for longer than 8 hours have a much higher incidence of amputation.
- Following reduction of a dislocated knee, a vascular examination alone is insufficient to determine the presence of a popliteal artery injury that will require surgical intervention. Admission for 24 hours of serial vascular examinations or vascular imaging is recommended. Admission will also allow for monitoring for compartment syndrome, which can present as a delayed complication after a knee dislocation.
- Many dislocated ankles still require surgical intervention, even after closed reduction. Emergent orthopedic consultation and postreduction CT are necessary after reduction of a dislocated ankle.

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Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study is included in bold type following the reference, where available. In addition, the most informative references cited in this paper, as determined by the authors, are noted by an asterisk (*) next to the number of the reference.


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1. **What is the most common type of hip dislocation?**
   a. Lateral
   b. Medial
   c. Anterior
   d. Posterior

2. **Delaying a native hip reduction can result in which of the following complications?**
   a. Compartment syndrome
   b. Further blood loss
   c. Avascular necrosis
   d. Infection

3. **Which of the following hip dislocations should not be reduced by an emergency clinician without an orthopedic surgeon present?**
   a. Dislocation with associated fracture
   b. Dislocation with a prosthetic hip
   c. Dislocation without fracture
   d. No dislocation should be reduced without orthopedic consultation

4. **To avoid complications, what should be the goal time-to-reduction of a native hip dislocation?**
   a. Less than 1 hour
   b. Less than 6 hours
   c. Less than 24 hours
   d. Less than 72 hours

5. **Which of the following tests should not be used to assess for popliteal artery injury?**
   a. X-ray series of the knee
   b. Duplex ultrasound
   c. CT angiogram
   d. Arteriogram

6. **The common force that is applied in the reduction of all types of knee dislocation is:**
   a. Axial loading
   b. Anterior force on the proximal tibia
   c. Posterior force on the proximal tibia
   d. Traction/counter-traction

7. **When should a knee or ankle joint be reduced in the field by EMS before transport?**
   a. Significant deformity
   b. Severe and unremitting pain
   c. Open dislocation
   d. Concern for ischemia distal to the injury

8. **What type of knee dislocation is the most common?**
   a. Medial
   b. Anterior
   c. Posterior
   d. Lateral
   e. Rotational

9. **What other injury should be excluded before attempting reduction of an ankle dislocation?**
   a. Hip fracture
   b. Calcaneal fracture
   c. Subtalar dislocation
   d. Tibial shaft fracture

10. **What potential complication from a dislocated ankle is the primary reason for timely reduction of the talus?**
    a. Postoperative infection
    b. Avascular necrosis of the talus
    c. Long-term osteoarthritis
    d. Compartment syndrome

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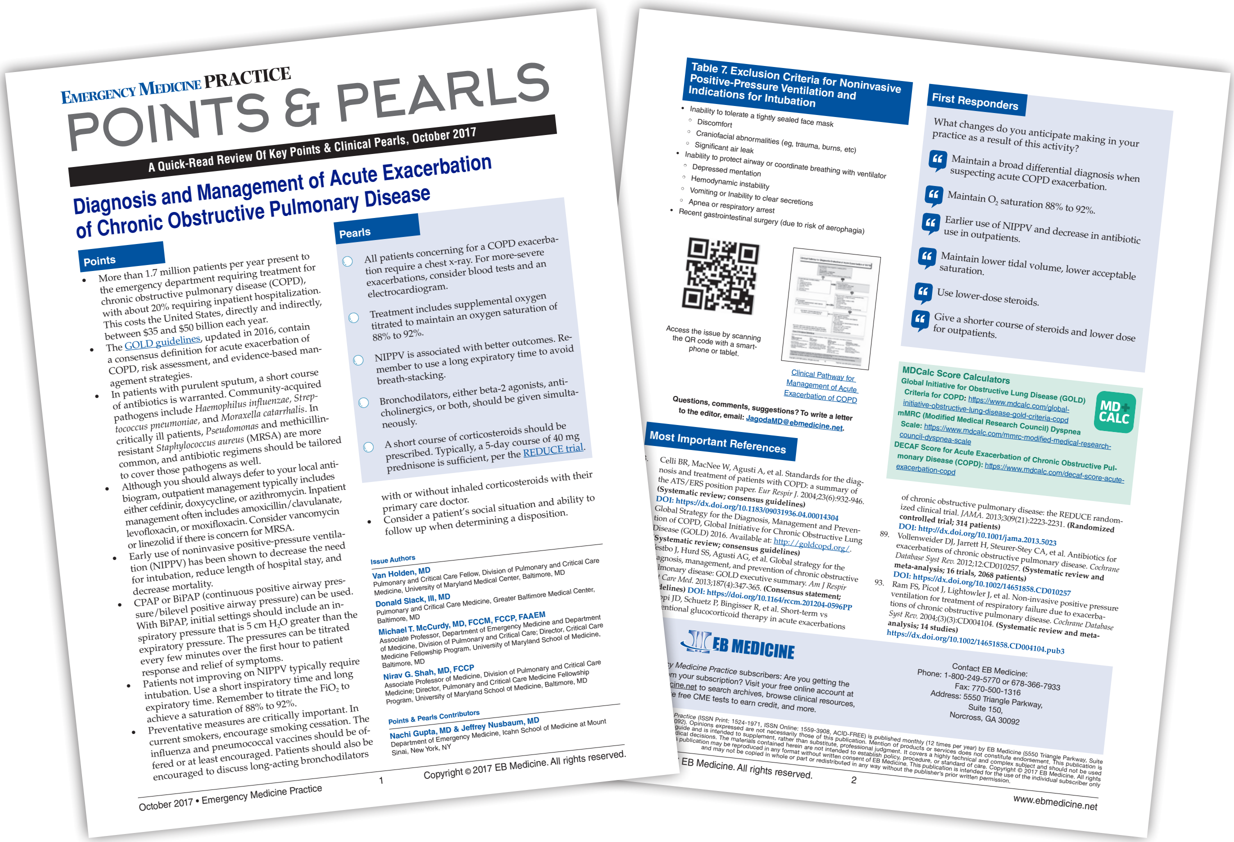


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**Target Audience:** This enduring material is designed for emergency medicine physicians, physician assistants, nurse practitioners, and residents.

**Goals:** Upon completion of this activity, you should be able to: (1) demonstrate medical decision-making based on the strongest clinical evidence; (2) cost-effectively diagnose and treat the most critical presentations; and (3) describe the most common medicolegal pitfalls for each topic covered.

**Objectives:** Upon completion of this activity, you should be able to: (1) assess different types of lower-extremity joint dislocations based on physical examination and radiographic studies; (2) choose the most appropriate methods for reduction of dislocation, based on staff resources and patient needs; and (3) describe the circumstances when it is necessary to obtain specialist consultation for a lower-extremity dislocation.

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**Commercial Support:** This issue of *Emergency Medicine Practice* did not receive any commercial support.

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**EB Medicine**
Phone: 1-800-249-5770 or 1-678-366-7933
Fax: 1-770-500-1316
5550 Triangle Parkway, Suite 150
Norcross, GA 30092
E-mail: **ebm@ebmedicine.net**
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