Traumatic Hip Dislocation in Athletes

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Introduction

Acute traumatic hip dislocations occur uncommonly during sporting activities; however, the resultant morbidity can be significant. Therefore, immediate recognition and early treatment are essential to the proper management of these injuries.

Hip dislocation is generally associated with severe trauma, with 70% of these injuries seen in motor vehicle accidents. These “dashboard injuries” occur as the femur is driven posteriorly past the acetabulum [1•,2,3•]. Falls contribute to a number of these injuries, but the incidence of dislocation due to sporting injuries is unclear in the available literature. Hip dislocation injuries on the athletic field usually occur during high-energy sports such as American football, rugby, skiing, and bicycling [4–6], although isolated injuries occurring in a basketball game and during a gymnastic vault have been described [7,8].

Anatomy

The hip joint is the true ball and socket joint in the human body. The thick fibrous capsule and joint-deepening labrum provide for the significant stability inherent in this joint. The femoral head, which forms two thirds of a sphere, is attached to the femoral neck which is three quarters its size. The ligamentous condensations form the hip capsule and attach to the femoral neck. They consist of the iliofemoral and pubofemoral ligaments anteriorly, and the ischiofemoral ligament posteriorly. Much of the femoral neck is intracapsular and not covered with periosteum, which explains the poor healing of femoral neck fractures without surgical intervention. The ligamentum teres is a ligamentous attachment of the inferior aspect of the femoral head to the acetabulum at the cotyloid fossa. Many muscles cross the hip joint and provide the multidirectional positioning of the leg in space. The iliopsoas is a condensation of the iliacus and psoas muscles. They originate on the inner aspect of the iliac wing and sacrum and attach to the lesser trochanter, and act together to flex and externally rotate the hip. The abductor musculature consists of the gluteus medius and minimus which originate on the posterior aspect of the iliac wing and attach to the greater trochanter. The key external rotators of the hip include gluteus maximus, piriformis, obturator externus and internus, quadratus femoris, and the superior and inferior gemelli. All three adductors, adductor brevis, longus and magnus, originate on the pubic ramus and attach to the medial aspect of the distal femur along the linea aspera just above the knee. Several other hip flexors are worth mentioning and cross the anterior aspect of the hip joint including the direct and reflected heads of rectus femoris, sartorius, and pectineus muscles.

The blood supply to the femoral head has been well studied and is composed of several major vessels. An extracapsular vascular ring is formed at the base of the femoral neck. The posterior contribution originates from the profundus femoris artery through the medial femoral circumflex artery. The lateral femoral circumflex artery provides the anterior contribution and has the same origin. A small vascular supply travels directly to the head through the artery of the ligamentum teres originating from the obturator artery. The femoral artery lies anterior and medial to the joint, providing nearly all the blood supply to the lower extremity.

Three significant nerves course through the hip region. Anteriorly, the femoral nerve travels next to vascular bundle providing the innervation to the quadriceps musculature. The lateral femoral cutaneous nerve travels mostly in the subcutaneous plane exiting just medial to the anterior superior iliac spine, and provides the sensation to the
lateral aspect of the thigh. The key nerve posteriorly is the sciatic nerve, which originates from nerve roots L4 to S3 and exits the greater sciatic foramen just inferior to the piriformis muscle. Several other nerves exist posteriorly, including the inferior gluteal, superior gluteal, and pudendal nerves. The sciatic nerve is injured in approximately 5% to 10% of posterior hip dislocations.

Mechanism of Injury
Posterior dislocations occur when a large force is directed against the flexed knee, with hip flexed, adducted, and internally rotated. Such forces are most common as a result of motor vehicle accidents, when the flexed knee is driven into the dashboard, or in field sports when the athlete's knee is driven into the ground during a tackle. Anterior dislocations typically occur when the flexed hip is forced into abduction and external rotation in a splits-type injury. These injuries may be seen in sports such as gymnastics and track and field events. Exceptions to these rules have been reported; one case study reports a 13-year-old female gymnast who sustained a posterior dislocation and acetabular fracture with the hip flexed and internally rotated when her foot only impacted the springboard as she set up for a vault. Tennant et al. reported a case of a 22-year-old basketball player who sustained a posterior dislocation injury after landing from a jump onto a wet floor when his hips were forced into abduction splits. Understanding the mechanism of injury is important, because it must be applied in a controlled reversed fashion when reducing the hip.

Classification System
Traumatic dislocations can be divided into two basic categories: anterior and posterior. Posterior dislocations predominate, comprising more than 70% of all hip dislocation injuries, and 90% of those occurring sports. Anterior dislocations are reported to occur only 8% to 10% of the time. Various classification systems of posterior hip dislocations have been proposed over the years. The Thompson-Epstein classification, proposed in 1951, is used to describe primary posterior hip dislocation in terms of radiographic pathology (Fig. 1):

1. A pure dislocation with, at most, an insignificant posterior wall fracture
2. A single large fracture of the posterior acetabular rim
3. A comminuted posterior acetabular fracture, with or without a major fragment
4. A fracture of the acetabular rim and floor
5. A femoral head fracture

Stewart and Milford’s classification is similar, but based on functional stability of the hip. This system has the advantage of providing more practical information regarding management decisions [3•]:

1. No fracture or insignificant fracture
2. Associated with a single or comminuted posterior wall fragment, but the hip remains stable through a functional range of motion
3. Associated with gross instability of the hip joint secondary to loss of structural support
4. Associated with a femoral head fracture

These classification systems can be used to predict outcomes. The primary question is whether surgery would be required to provide a stable reduction. Closed reduction may be attempted with all dislocations, except those associated with femoral neck fractures [3•].

Reigstad [2] found that type I dislocations were by far the most common, comprising over 50% in their investigative series. Only a very small percentage (2%–4%) of these are likely to be unreducible with closed techniques. However, multiple attempts at closed reductions are contraindicated [1•,2,12]. In these difficult cases, reduction should be performed under general anesthesia. Most studies appear to indicate that primary open reduction and subsequent stabilization should be advocated for all unstable dislocations [1•,2].

On-field Management

The astute team physician will quickly recognize that an injury has occurred, and rapidly attend to the player. The standard on-field history should be applied determining the player’s level of consciousness and cervical health. Next, it is key to identify the location of the injury and the player’s interpretation of what happened. Noting the player’s body position on the field provides further information. The athlete with the dislocated hip usually prefers a “fetal position” with the dislocated hip facing upward [13•]. Palpation of the area reveals significant buttock and abductor muscular spasm. If a dislocation is suspected, checking the thigh lengths at the knee will help confirm the diagnosis. The neurovascular status of the extremity should be examined, including an evaluation of extensor hallucis longus strength, tibialis anterior strength, gastrocnemius strength, and sensation to light touch. The pulse cannot readily be checked on the field without removing the player’s shoe. The patient must be rolled into the supine position while maintaining control of the injured extremity, and minimizing movement at the hip. The position of the injured extremity position is then re-examined to determine if the dislocation is either anterior or posterior. The player with an anterior dislocation prefers an extended, externally rotated, and abducted hip position. The player with a posterior dislocation prefers a flexed internally rotated and adducted position.

Classic Reduction Techniques

The Allis technique is the traditional method for reduction of a dislocated hip [14]. An assistant is required to stabilize the pelvis of the supine patient. The orthopedic surgeon administers sedation in a controlled setting, such as an emergency room, where airway support equipment and narcotic reversal agents are available. Once the patient is sleepy yet easily aroused, the orthopedist should get into a mechanically advantageous position, preferably standing on the gurney, and begin applying a steadily increasing traction force. The hip is then gently flexed to a 60° to 90° position and adducted. The assistant may provide counterforce on the pelvis with the palms of his hands placed on the anterior superior iliac spines. The relaxed and unobstructed hip should reduce with a palpable “thud.”

An alternative technique described by Stimson [15] applies the same forces but the patient is prone with his entire lower extremity off the end of the bed and flexed 90° at the hip and knee. This position allows the surgeon to apply traction in line with gravity instead of against gravity. The potential disadvantage of this prone technique is that airway management is more difficult.

Bigelow’s reduction method, which requires forced internal and external rotation, is not recommended because it is associated with an increased risk of femoral neck fracture.

If the hip cannot be reduced with conscious sedation, the patient must be placed under general anesthesia. Prior to entering the operating room, the surgeon must prepare for open reduction in case attempts at a closed reduction fail.

On-field Reduction Technique

A simple on-field reduction technique was presented at a recent NFL Physician’s Society meeting [13•]. This technique requires that the player lie supine with the hip supported and flexed at 90°. Anterior hip dislocations should not be addressed on the field because they are more difficult to reduce. The key to successful reduction is encouraging the player to relax the hip muscles despite the pain. The physician should place his bent knee under the player’s injured leg and apply gentle traction (approximately 15 pounds) in line with the femur. The physician maintains the hip in an internally rotated position. The femoral head will pop back in to place once the musculature fully relaxes. If the hip does not reduce over several minutes, the player should be placed on a back board and brought to the locker room or emergency room for further evaluation with radiographs. To prevent further injury, a reduction should not be forced. There is a small risk of concurrent...
Hip dislocation and femoral neck fracture, and by applying only gentle traction, risk of displacement of the hip fracture is essentially eliminated.

Postreduction Management
Once the hip has been reduced, the player must be placed on a backboard and transferred to the locker room or the emergency room, wherever the nearest radiographic equipment exists. It is necessary to radiographically confirm concentric reduction with anteroposterior (A/P) and lateral of the hip and an A/P view of the pelvis. The sclerotic border of the acetabulum must be closely inspected and compared with the opposite side. After this is confirmed, the player must be made non-weight bearing on the injured extremity through the use of crutches. The athlete must be given detailed hip dislocation precautions. Recurrent dislocation is a risk because the capsulolabral tissue has been avulsed from the acetabular rim. Although the bony acetabulum provides most of the mechanical stability to the hip joint, the hip capsule and labral tissue provide restraints at the limits of the ranges of motion. The athlete with a simple posterior hip dislocation must avoid any internal rotation, flexion greater than 90°, or any adduction at the hip. More severe motion limits must be implemented when concurrent acetabular fractures exist.

Imaging Evaluation
The primary roentgenographic assessment should be made with A/P views of the pelvis. A/P pelvis films provide all the information needed to assess for the presence of a dislocation, and provide enough information to the trained observer to determine the anterior-posterior relationship of the femur to the acetabulum. In a normal hip the femoral heads should appear symmetrical in size, and the joint spaces should be symmetric throughout the arc and in relation to both sides. The posteriorly dislocated femoral head will appear smaller than the uninjured side, and the anteriorly dislocated femoral head will appear larger than the normal side. The arched line between the base of the femoral neck at the level of the lesser trochanter, and including the inferior aspect of the superior pubic ramus (Shenton’s line), should be smooth and continuous in the normal hip. The relationship between the greater and lesser trochanters will change accordingly with external or internal rotation due to dislocation. Abduction or adduction of the femur will also be evident on the A/P pelvis views. The A/P films may reveal concurrent femoral neck fracture, however, the true A/P of the femoral neck, taken with 15° of internal rotation, is recommended to best evaluate that lesion [3•].

Additional views are recommended with an acetabulum fracture. The standard 45° oblique Judet views should be obtained to better evaluate the anterior and posterior columns and walls of the acetabulum. If a fracture is suspect on the pelvis, inlet and outlet views of the pelvis should also be obtained. The current accepted standard of care generally calls for radiologic assessment prior to any attempt at closed reduction. However, the preponderance of literature suggests that the earlier the reduction, the better the outcome. Some even recommend immediate, on-field reduction in certain patients prior to imaging.

The hip should be radiographically assessed after an apparent successful closed reduction attempt in order to verify concentric reduction. A/P and lateral films of the involved hip and a routine A/P pelvis film are recommended. The films should be critically compared with the prereduction imaging. Any postreduction hip joint asymmetry implies either incarcerated bony fragments, or soft tissue interposition. Nonconcentric reduction necessitates an urgent computed tomography (CT) scan for preoperative planning for removal of the interposed tissue. Axial CT scanning of the acetabulum allows the surgeon to understand the size of the acetabulum fracture and the amount of comminution. The orthopedist must also understand the location and number of incarcerated fragments prior to operative intervention. Urgent removal of the intraarticular bodies prevents further chondral injury and minimizes early arthritis [16].

Magnetic resonance imaging (MRI) of the hip is important to obtain after successful closed reduction to evaluate cartilage integrity and surrounding soft tissue injury, especially in the professional athlete. It is important to evaluate the key muscle origins and insertions around the hip for injury or avulsions such as the abductor musculature, rectus origins, and psoas integrity. This knowledge helps to direct early rehabilitation efforts. For the professional athlete, a case could be made for surgical repair of a significant muscle avulsion [17]. The MRI also provides a baseline for later comparison. Poggi et al. [18] proposed an algorithm for the recognition of early avascular necrosis of the femoral head following posterior dislocation of the hip. They recommend an MRI at 4 to 6 weeks, and if abnormal marrow signal is present on the T1- and T2-weighted images, then another MRI should be performed at 3 months or sooner if significant symptoms develop. Patients who do not have femoral head marrow changes at 4 to 6 weeks have a low risk of developing osteonecrosis. The sports medicine physician can intervene early with this information, possibly preventing the severe complications of avascular necrosis (AVN).

The managing physician should follow the athlete with serial radiographs during the recovery phase, as well, to evaluate for possible development of AVN or arthritis. Radiographic changes include subchondral lucency, loss of femoral head sphericity, and collapse. Radiographs should be obtained at 2 weeks, 6 weeks, 3 months, and 6 months after the injury. MRI is recommended if the athlete has persistent or new-onset pain during the rehabilitative phases with no radiographic changes.
Rehabilitation of the Grade I Hip Dislocation

Aggressive early rehabilitation is necessary, even in cases of simple posterior hip dislocation. Traditionally, non-weight bearing for 4 to 6 weeks after injury has been recommended. However, review of recent literature indicates that early weight bearing does not increase the incidence of avascular necrosis [19]. In fact, Reigstad [2] felt that “prolonged non-weight bearing to avoid further stress of an already more or less ischemic femoral head is not likely to influence the occurrence of AVN and should not be recommended in any degree of dislocation.” Early detection of AVN with radiograph or MRI is imperative. If there is any evidence of femoral head ischemia, prolonged non-weight bearing to full weight bearing may require longer periods of time in grade II to IV dislocations.

The athlete should progress symptomatically through a rehabilitation protocol focused on managing pain, achieving range of motion (ROM), and maintaining strength of the surrounding musculature. Light passive ROM exercises in the functional range should begin after pain and swelling is controlled (day 2–4). By about day 4, the athlete should be able to partially bear weight with crutches comfortably. First week exercises should consist of table heel slides, ankle proprioceptive neuromuscular facilitation, dual leg ground standing, balance board routines, quad sets, and manual resistance knee flexion and extension exercises. Basic gait training should be initiated by week 2, along with SwimEx (Warren, RI) hip exercises against the current. By week 3 the athlete should be comfortable weight bearing fully with crutches. Use of the upper body ergometer will help to promote cardiovascular fitness. ROM and strengthening exercises should continue.

In week 4, functional weight bearing exercises should be initiated, such as shallow squats using the physioball, short arc leg press, and standing dips with sport cord resistance. At this point the athlete can also return to full upper body isotonic lifting.

An MRI should be obtained in the subsequent 1 to 2 weeks. If there is any evidence of femoral head ischemia, the rehabilitation program must be reduced to ROM only, and the player must be non-weight bearing again. Progression of exercises can continue if there is no femoral head abnormalities. The athlete will advance from step-ups, balance board with ball toss, and stair climbing to light jogging and sport-specific exercises over the ensuing 4 weeks. The athlete can resume competition once he has obtained symmetric lower extremity strength and dexterity. Details of this program for the professional athlete has been presented elsewhere [13•].

Complications

High-energy mechanisms are usually required to dislocate the hip joint. Multiple complications may follow, especially if there are associated fractures. Complications reported include: post-traumatic arthritis, avascular necrosis, heterotopic ossification (myositis ossificans), sciatic neuropathy, deep vein thrombosis, and recurrent dislocation [7,20•,21].

Osteoarthritis

Post-traumatic degenerative changes are probably the most prevalent complications. Primary insult to the articular cartilage heralds the onset of a more generalized degenerative process resulting in post-traumatic arthritis. Disruption of the blood supply to the femoral head leads to marginal degeneration and cortical collapse in AVN. The endpoint of these complications are variable and depend on their definition and time to follow-up. Epstein [1•] reported that in a series of 426 hip dislocations of all types, 23% developed post-traumatic arthritis and 13% developed avascular necrosis. Upadhyay et al. [20•] followed 74 patients with type I dislocations only and reported that only 43% recovered without any consequence, 8% developed AVN, and 16% developed post-traumatic arthritis.

Avascular necrosis

Numerous authors have reported the incidence of AVN is correlated with length of time of reduction of the dislocation. Reduction should certainly be completed within 24 hours, and optimally within 6 hours, to significantly reduce the risk of this disabling complication [13•,22]. Hougaard and Thomsen [22] followed 100 patients after hip reduction for 5 years and reported only 4.8% of those reduced within 6 hours developed AVN, whereas 52.9% of the hips reduced after more than 6 hours developed AVN. There is little chance the risk can be completely eradicated, even with immediate reduction, as a case of AVN following a subluxation only injury has been reported [21].

Heterotopic ossification

Heterotopic ossification occurs about 2% of the time and primarily develops when trauma is severe with associated fractures [4]. Prophylactic use of low-dose radiation therapy and/or oral indomethacin, 25 mg three times daily for 6 weeks, has proven effective in reducing the development of this complication. Heterotopic ossification prophylaxis is not recommended after simple dislocation injuries.

Thromboembolism

Thromboembolism is always a risk after any high-speed injury to the hip and pelvic region. Virchow’s triad of endothelial injury, stasis, and a hypercoaguability provides sufficient condition to form peripheral clotting. Pneumatic compression stockings and chemoprophylactic medicines are recommended with major trauma, after lower extremity surgery, and when there is sufficient immobilization. Low molecular weight heparin compounds (eg, Lovenox...
prefer to manage their gait disability with the AFO than to considered for at least 1 year [3•]. In fact, most patients reserved for the most refractory cases and should not be as tendon transfers to correct equinus deformity, are only because recovery is so variable, surgical interventions, such rehabilitation and an appropriate ankle-foot orthosis (AFO). Proper management of sciatic neuropathies is essential for maximizing the patient’s functional capacity. Patients with significant foot drop will benefit from aggressive rehabilitation and an appropriate ankle-foot orthosis (AFO). Because recovery is so variable, surgical interventions, such as tendon transfers to correct equinus deformity, are only reserved for the most refractory cases and should not be considered for at least 1 year [3•]. In fact, most patients prefer to manage their gait disability with the AFO than to undergo definitive surgery.

Sciatic nerve injury
The sciatic nerve lies in very close proximity to the posterior aspect of the hip joint, and therefore is quite susceptible to stretch, compression, and tearing injury during posterior hip dislocation. The resultant neuropathy can result in catastrophic motor impairment and neuropathic pain. Associated injuries to the sciatic nerve are probably rare. They are most commonly reported to occur in 5% to 10% of all posterior dislocations [1•,24], although some examiners have reported the incidence to as high as 30% [25]. No reports of sciatic injury with anterior dislocations are reported. Epstein [1•] reported 53 sciatic nerve injuries in his series of 559 hip dislocation injuries, and 15 of these occurred with uncomplicated type 1 injuries.

The peroneal division of the sciatic nerve is already anatomically distinct at the hip level and due to structural and positional factors is much more susceptible to injury than the tibial division [26]. Therefore, most compression or stretch injuries to this nerve are typically associated with a foot drop presentation. Electromyography will aid in the diagnosis and prognosis for recovery. Recovery from sciatic neuropathy is variable and dependent on the severity of nerve injury and length of time the nerve is compressed. In a series of 14 patients with sciatic injury after acetabular fractures, Fassler et al. [27] reported that although most patients had at least fair recovery, 11 had continued residual deficits by 27 months. Epstein [1•] reported that 64% of observed sciatic nerve injuries recovered fully; however, maximal recovery required several months to several years. The time to recovery appears to correlate with the time to hip reduction [1•,3•,7]. Early reduction is recommended to prevent this potentially disabling complication.

Surgical exploration is rarely recommended for acute sciatic neuropathies. The possible exception being cases with onset of sciatic neuropathy occurring only after reduction attempts, in which the nerve may have become compressed by a fracture fragment or in the joint itself. Late sciatic compression neuropathies due to compressive hematomas, scar encasement, and heterotopic ossification have been reported. Surgical exploration and decompression is recommended in these cases.

Proper management of sciatic neuropathies is essential for minimizing the patient’s functional capacity. Patients with significant foot drop will benefit from aggressive rehabilitation and an appropriate ankle-foot orthosis (AFO). Because recovery is so variable, surgical interventions, such as tendon transfers to correct equinus deformity, are only reserved for the most refractory cases and should not be considered for at least 1 year [3•]. In fact, most patients prefer to manage their gait disability with the AFO than to undergo definitive surgery.

Pain Management
The primary effort to reduce the pain of hip dislocation is to reduce the hip as soon as possible. Closed reduction is usually attempted in a controlled environment with the aid of analgesic and anxiolytic/amnestic medications. However, Collins et al. [13•] have demonstrated that closed reduction may be successfully completed on the field and without any analgesia. The key is early reduction, before severe muscle contraction has become established. Ice will help reduce potentially painful swelling. Thereafter, relatively little pain should be expected.

One can usually manage postreduction pain with a short course of oral combination analgesics; for example, Tylenol [McNeil, Ft. Washington, PA] with codeine or codeine analogs. Nonsteroidal anti-inflammatory drugs (NSAIDs) are also helpful. Pain management only becomes a primary issue when there are associated severe injuries or complications after the primary hip dislocation injury. These may include osteoarthritis, AVN, heterotopic ossification, myositis ossificans, and sciatic nerve injury.

Joint degeneration either due to post-traumatic arthritis or AVN is a rather common complication of traumatic hip dislocation. The resultant pain may be treated as in any degenerative joint condition. The American College of Rheumatology recommends acetaminophen as the first-line treatment of pain due to degenerative joint diseases [28,29]. Total daily dosage should not exceed 4 g/d (8 extra strength Tylenol tablets) because of the risk of acetaminophen toxicity. NSAIDs are the next line of treatment and may be started independently or in addition to acetaminophen. Liver and kidney function should be monitored regularly in long-term users or in those at risk. The newer Cox-2 selective anti-inflammatory drugs should be considered for patients over age 65, those who at risk for gastrointestinal ulcers, and those on chronic antiocoagulation therapy. Narcotic analgesics may be used sparingly for acute periods of increased pain, and are generally discouraged for chronic pain management unless progressive degeneration has become severe enough to cause constant disabling pain and all other options have been exhausted.

Intra-articular injections of anesthetic and corticosteroid can be extremely effective in the treatment of severe hip pain. Injections are guided fluoroscopically in most institutions to ensure accuracy and safety. However, results are temporary in progressive degenerative disease. Repeated injections of more than three in a 6-month period are contraindicated because of the potentially deleterious side effects. Intra-articular viscosupplementation has been considered in several reports [30].

Glucosamine and chondroitin combination compounds have long been advocated for treatment of degenerative joint conditions. There appears to be evidence indicating mild analgesic or perhaps anti-inflammatory action and possibly cartilage protective effects [31,32•,33].
Management of neuropathic pain
Controlling neuropathic pain that commonly occurs after injury to the sciatic nerve is challenging. The goal is adequate pain control such that the patient may continue functional rehabilitative efforts. NSAIDs, acetaminophen, and even combination oral codeine derivatives may not prove adequate.

Gabapentin has proven useful in the treatment of neuropathic pain; it is most effective against sharp, lancinating, and burning pain. Usual starting dosage is 100 mg twice to three times daily. Dosage is then titrated to maximal effect, occasionally up to 1800 mg/d in divided doses. It has a favorable side-effect profile and there is little risk of cross reactivity with other medicines [34–36].

Tricyclic antidepressant medicines (amitriptyline and nortriptyline) have been used successfully to treat chronic neuropathic pain. These medicines may work by stabilizing pain pathways and by inducing restorative sleep. They also treat the depression that is almost universal to those suffering from chronic pain. Note that the selective serotonin reuptake inhibitors are probably more effective antidepressants than the tricyclics, but they do not seem to be as effective in the treatment of pain syndromes. In many circumstances, these medicines may be used in combination [35–37].

Conclusions
Traumatic hip dislocations in athletes are rare injuries that carry a significant morbidity. Prompt recognition, reduction, and rehabilitation of these injuries optimizes outcome and minimizes potentially devastating complications.

References and Recommended Reading
Papers of particular interest, published recently, have been highlighted as:
• Of importance
**Of major importance

The first article documenting on-field reduction of a dislocated hip in a professional football player.


