Hip Dislocation: Current Treatment Regimens

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Abstract

Dislocation of the hip occurs only with high-energy trauma, and concomitant injuries are common. Early diagnosis and institution of treatment are necessary to obtain the best possible results. Treatment protocols include emergent reduction of the femoral head to reestablish perfusion, postreduction radiography and computed tomography to look for associated fractures and to judge the concentricity of the reduction, stability testing, and early mobilization. Open reduction may be required if a concentric reduction cannot be obtained in a closed manner. Despite appropriate management, posttraumatic arthritis and avascular necrosis may occur, with reported rates as high as 15% to 30%. Patients who sustain a hip dislocation should be made aware of these potential complications at the time of initial treatment.

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The hip is an inherently stable joint, and hip dislocation requires substantial force. For this reason, associated injuries are common, and their presence must be sought. The outcome is dependent on many variables, including time to reduction, associated injuries, postreduction management, and the classification of the injury.[1-4] Pure dislocations should be considered a separate entity from fracture-dislocations.[1,5,6] Although the prognosis for pure dislocations is better than that for fracture-dislocations, recent reports have indicated that unsatisfactory long-term results can be expected in as many as 50% of patients.[4,5] The treatment of hip dislocations is directed toward the avoidance of complications. In this review, we will discuss the treatment of hip dislocations that do not require surgery for associated femoral head or acetabular fractures.

Anatomy

The hip joint is a true ball-and-socket joint in which the head is incompletely covered. Because of the depth of the acetabulum, which is enhanced by the labrum, and the thick capsule and strong muscular support, the osseous structures of the hip are less likely to dislocate than those of any other joint in the body. More than 400 N of force (90 lb) is required just to distract the femoral head from the acetabulum.[7] The ligamentous support of the joint is provided by strong capsular ligaments that run from the acetabulum to the femoral neck and the intertrochanteric region. The iliofemoral, or Y, ligament is located anteriorly. The ischiofemoral ligament is located posteriorly. The short external rotators adhere to the capsule posteriorly, providing additional stability.

The blood supply to the femoral head has been well described.[8] In adults, the main arterial supply is derived from the cervical arteries, which originate from an extracapsular ring at the base of the femoral neck. This ring is formed by contributions from the medial circumflex artery posteriorly and the lateral circumflex artery anteriorly. The capital branches pass through the capsule close to its insertion to lie on the femoral neck. They then ascend the neck and enter the femoral head just below the articular surface. The superior and posterior cervical arteries are derived primarily from the medial circumflex artery. They are larger than and outnumber the anterior vessels. A lesser contribution to the head comes from the foveal artery via the ligamentum teres. This artery is present and of sufficient size to make a contribution in approximately 75% of hips.[9]

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Mechanism of Injury

The most common mechanism of injury is high-energy trauma from a motor vehicle accident. Unrestrained occupants are at significantly higher risk for hip dislocation than those wearing safety belts.[10] The direction of dislocation is dependent on the position of the hip and the direction of the force vector applied, as well as on the anatomy of the femur.[11,12]

Using cadavers, Pringle demonstrated that anterior dislocations were the result of abduction and external rotation forces.[11] If these forces are applied with the hip flexed, the femoral head dislocates inferiorly (an obturator dislocation); with hip extension, the result is pubic dislocation.

Posterior dislocations outnumber anterior dislocations by a factor of at least nine.[2,4,5,13] These dislocations usually occur from a longitudinal force in line with the femur acting on an adducted hip. Whether this produces a pure dislocation or a fracture-dislocation that includes part of the posterior acetabular wall depends on where the head is directed. Increased flexion and adduction at the time of injury favors pure dislocation over fracture-dislocation.[9,10,12] Likewise, Upadhyay et al[12] demonstrated decreased anteversion in patients who sustained fracture-dislocations compared with normal control subjects and even less anteversion in patients who had pure dislocations. This is consistent with the theory that the direction of the head at the time of impact determines the injury pattern.

Associated Injuries

Due to the mechanism of injury, concomitant injuries are the rule rather than the exception. In one series,[14] 95% of the patients who presented with hip dislocations had other injuries necessitating inpatient treatment. Associated injuries include those directly related to the hip dislocation and those due to the traumatic incident itself. Ipsilateral injuries that commonly occur include femoral head, neck, or shaft fractures; acetabular fractures; pelvic fractures; sciatic nerve injury; knee injuries; and foot and ankle injuries.[14-16] Knee injuries, including patellar fractures and ligament ruptures and dislocations, are most commonly associated with posterior dislocations due to direct trauma to the knee. In rare instances, an anterior dislocation injures the femoral vessels. Intra-abdominal, head, and chest trauma have also been widely reported. An association with injury to the thoracic aorta due to the deceleration typically involved in hip dislocations was also described recently.[17]

A high index of suspicion must be maintained for all of these possibilities, and careful trauma evaluation is necessary for all patients who suffer a hip dislocation. It should also be noted that the frequency of severe associated injuries often causes delay in the diagnosis of dislocation. Hip dislocations in conjunction with femoral shaft fractures are frequently missed, as the fracture obscures the physical examination findings.[18] In cases of blunt trauma, radiographic evaluation of the entire lower extremity and spine should be considered to avoid missed injuries.

Pathoanatomy

When there is a hip dislocation, the capsule and ligamentum teres must be disrupted. Labral tears and muscular injury occur as well.[19] The exact nature of the soft-tissue disruption immediately about the hip has been examined in cadavers.[11] The capsule may be split by direct pressure or stripped off the acetabulum or femur as a cuff secondary to rotational forces. L-shaped lesions may result from a combination of these mechanisms. In anterior dislocations, the psoas is the fulcrum for the hip, and the capsule is disrupted anteriorly and inferiorly. Posterior dislocations tear through the capsule either inferoposterior or directly posteriorly, depending on the amount of flexion present. The Y ligament is usually intact, and the capsule is stripped from its acetabular attachment posterior to it. In some cases, however, the Y ligament may be avulsed from the acetabulum with a fragment of bone.[20] In the dislocated position, the head is dorsal to the obturator internus muscle.

Fractures of the femoral head are common and may be the result of impaction injuries, avulsions, or shear fractures. Impaction injuries commonly occur in anterior dislocations.[21] Shear fractures merit a longer discussion than is possible in this review; they often benefit from surgical treatment. Avulsed fragments of bone are frequently found attached to the ligamentum teres and lying in the fovea. They can be of varying size and will be discussed later.

Classification

The first part of any description is the specification of whether the direction of dislocation is anterior or posterior. The term “central dislocation” refers to an acetabular fracture and is outdated. Many classification schemes have been devised. Those of Stewart and Milford[1] and Thompson and Epstein[2] are the most commonly used (Table 1). These classifications have been found to have prognostic significance, as fractures associated with operative acetabular or femoral head fractures have a worse prog-

Table 1
Systems for Classifying Hip Dislocation

Stewart-Milford System[1]	
Type I	Simple dislocation without fracture
Type II	Dislocation with one or more rim fragments but with sufficient socket to ensure stability after reduction
Type III	Dislocation with fracture of the rim producing gross instability
Type IV	Dislocation with fracture of the head or neck of the femur
Thompson-Epstein System[2]	
Type I	Dislocation with or without minor fracture
Type II	Dislocation with single large fracture of the posterior rim of the acetabulum
Type III	Dislocation with comminuted fracture of the rim with or without a large major fragment
Type IV	Dislocation with fracture of the acetabular floor
Type V	Dislocation with fracture of the femoral head

nosis than others.[1-3,5,6,13,22] For the purpose of this review, only pure dislocations that do not require fixation of a fracture will be discussed. Included are pure dislocations without fracture (Stewart-Milford type I and Thompson-Epstein type I dislocations) and those with a fracture not requiring repair (Stewart-Milford type II and some Thompson-Epstein type II and type III dislocations). It should be noted that the determination of whether a posterior-wall fracture requires fixation cannot be determined until after stress testing has been performed. The treatment methods discussed in this article apply to posterior dislocations with posterior-wall fractures.

Diagnosis

In the absence of femoral shaft or neck fractures, the position of the leg is the key to diagnosis. In posterior dislocations, the leg is flexed, adducted, and internally rotated. In anterior dislocations, the leg is externally rotated with varying amounts of flexion and abduction. As stated earlier, a careful examination of the entire lower extremity is required to rule out concomitant injury.

A single anteroposterior plain radiograph is all that is needed to confirm the diagnosis (Fig. 1). The head will not be congruent in the acetabulum. In posterior dislocations, the head will appear small and will lie superiorly, overlapping the roof. In anterior dislocations, it will appear large and will either lie inferiorly near the obturator foramen or overlap the medial acetabulum. Abnormal rotation is also discernible on the anteroposterior radiograph, based on the position of the trochanters. This initial radiograph must be of adequate quality to assess the femoral neck and head, the acetabulum, and the pelvis for fractures before a closed reduction is attempted. The rest of the standard radiographic workup is generally done after reduction of the hip.[10]

Treatment

The treatment of hip dislocations is aimed at the avoidance of complications. This begins with an emergent reduction. The incidence of avascular necrosis (AVN) increases if reduction is delayed.[1,13,23-27] (The data regarding the incidence of AVN will be discussed subsequently in the section on complications.) A closed reduction should always be attempted first unless there is an associated hip or femoral neck fracture. In the best of circumstances the patient should be completely paralyzed to avoid further cartilage injury during the manipulation. This may be achieved with a paralytic agent during general anesthesia or with a spinal anesthetic. Paralyzation may not always be possible due to other considerations. If that is the case, the reduction can be performed under conscious sedation.

Closed Reduction

Many reduction maneuvers have been described for the hip. The common thread among these is traction in line with the thigh, countertraction exerted by an assistant holding the pelvis, and reversal

Fig. 1 Partial oblique view demonstrating posterior hip dislocation. Leg is clearly seen to be adducted and internally rotated.

of the injury force. For posterior dislocations, traction in the flexed position, followed by gentle rotation and adduction to slip the head in place, works well. Once the reduction has been felt (and often heard), the leg is externally rotated and extended to maintain the reduction. This reduction can be done with the patient prone (Stimson method), but if there are associated injuries, it is usually done with the patient supine (Allis method). The recent suggestion that the assistant push the head medially and anteriorly from the buttocks area is useful.[28] For anterior dislocations, traction is applied in line with the femur, with gentle rotation and lateral pressure on the medial thigh. After reduction, the leg is internally rotated and adducted.

Regardless of the direction of dislocation, traction should be applied in a steady manner to overcome muscular spasms and elastic restraints. Forceful jerky motions will not be successful. In addition, femoral neck fractures may be caused by overly enthusiastic reduction maneuvers.[29] If two or three attempts at closed reduction fail, the hip should be considered irreducible by closed means.[27] Further attempts at closed reduction will serve only to cause more injury to the cartilage and increase the risk of arthritis.

Irreducible Dislocations

Approximately 2% to 15% of hip dislocations are irreducible.[9] The usual cause is an anatomic obstacle. In anterior dislocations, this may be buttonholing through the capsule or interposition of the rectus, capsule, labrum, or psoas. In posterior dislocations, the piriformis, gluteus maximus, capsule, ligamentum teres, or labrum or a bone fragment may prevent reduction.[30]

If a hip is irreducible, open reduction is required. If possible, Judet views, inlet and outlet views of the pelvis, and a computed tomographic (CT) study should precede the procedure. If the examination is well organized, the extra CT sections can be obtained during the CT study of the abdomen ordered by the trauma surgeon to rule out intra-abdominal injury. The purpose of these studies is to identify coincident bone injury and possible obstructions to reduction. However, substantial delay should not be accepted. If time does not allow for the CT study, the open reduction should be performed, including, as in all cases, a full inspection of the joint and intraoperative radiographs to confirm the concentricity of the reduction before closing the wound. (The technique of open reduction will be described later in this article.)

Nonconcentric Reduction

After the hip has been reduced into the acetabulum, the reduction must be analyzed critically. Complete and concentric reduction is required. To fully assess this, the standard views of the pelvis and a CT study must be obtained. The plain radiographs include anteroposterior, iliac oblique, obturator oblique, inlet, and outlet views. The CT study should be performed by obtaining 2-mm sections through the acetabulum, so that small intra-articular fragments are not overlooked.[31,32]

Assessment of congruence is sometimes difficult. On the plain films, the joint space and the distance measured from the head to the ilioischial line medially should be equal to those in the normal hip. Any widening of the joint may indicate a block to reduction (Fig. 2, A-C). On the CT scan, the distance from the anterior articular surface to the head should be equal to that on the other, noninjured side. A difference of 0.5 mm indicates subluxation (Fig. 2, D).[33] The head should be visualized as a centered bull's-eye on the sections obtained through the roof of the acetabulum, where the joint appears to almost fully surround the femoral head (Fig. 2, E). In a reduced hip, all of the CT sections should demonstrate a congruent relationship between the head and both the anterior and posterior articular surfaces (Fig. 2, F).

Magnetic resonance (MR) imaging is sensitive to soft-tissue injury about the hip and may be more useful in identifying ligament and muscle damage, labral tears, and joint effusions than CT.[19] However, it is not as sensitive in depicting bone fragments within the joint. Nonconcentric reductions can be caused by a fragment of bone or cartilage or by soft tissue or blood. Because small fragments of bone or cartilage are difficult to see on plain films but are easily seen on CT scans, it is essential to obtain a CT study after reduction of all hip dislocations.[31,33]

Surgical Treatment

The absolute indications for surgery include irreducible dislocations and nonconcentric reductions with free intra-articular fragments of bone or cartilage. Irreducible dislocations should be treated as surgical emergencies. As stated earlier, preoperative identification of concomitant fractures of the femoral head, femoral neck, and acetabular wall and intra-articular fragments of bone on a standard radiographic series or a CT study is helpful if logistics allow. However, time is of the essence, and excessive delays should not be permitted.

Open reduction should be performed from the direction that the

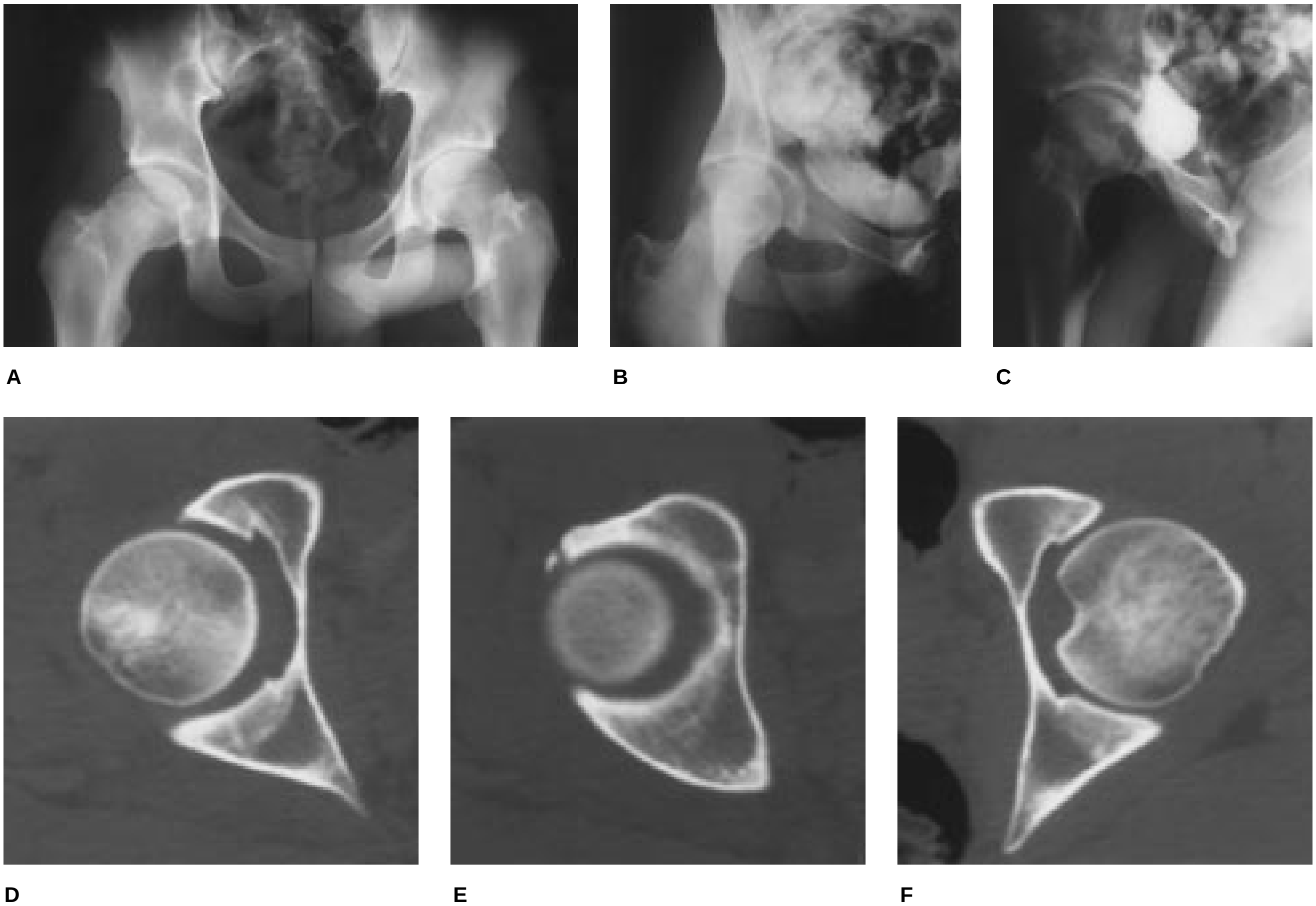
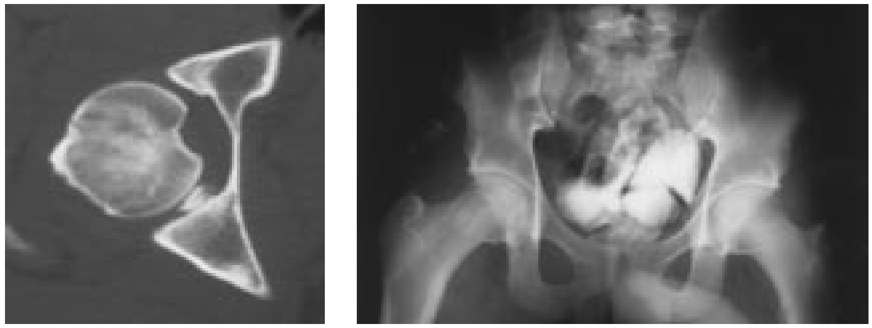


Fig. 2 Images of a patient with nonconcentric reduction (same patient as in Fig. 1). Anteroposterior **(A),** obturator oblique **(B),** and iliac oblique **(C)** views of the hip after a closed reduction was performed in the emergency room. The joint space is clearly widened, and the distance from the head to the ilioischial line is increased compared with the normal left hip. Although not obvious, a fragment of bone is visible in the inferior aspect of the joint on the anteroposterior radiograph. **D,** Postreduction CT scan demonstrates a widened joint with incongruity between the head and the articular surfaces. **E,** On CT section through the top of the head and the roof of the acetabulum, the head is positioned laterally, not centered within the articular surface. (A concentric reduction has a bull's-eye appearance.) **F,** In the normal contralateral hip, the head is congruent with both the anterior and posterior articular surfaces and is concentrically reduced.

hip dislocated. Therefore, posterior dislocations are addressed via a standard posterior approach. In this manner, the sciatic nerve can be protected, and direct access to the impediments to reduction is provided. The capsular disruption may require extension, and interposed soft tissue must be removed from the joint. It is paramount that the acetabulum be fully examined for loose bodies before the hip is reduced. This may require temporary placement of a femoral distractor to get full exposure. Forceful and copious lavage is also useful. The ligamentum teres often has a fragment of bone attached to it; this can be excised with a rongeur. After the joint has been cleaned out, the hip is reduced. If an associated posterior-wall fracture exists, stability testing is required. After confirmation of reduction, the capsular and soft-tissue injuries are repaired. If the labrum is torn, it should also be repaired.

Irreducible anterior dislocations are addressed via an anterior or anterolateral approach. There are advantages to both. The direct anterior approach will allow better visualization of the front of the joint, but the anterolateral approach allows access to the posterior hip through the same skin incision if needed. The approach used depends on the associated lesions. For example, a direct anterior incision would be better if a coincident anterior femoral head fracture required fixation.



A B

Fig. 3 **A,** On CT scan, a fragment of bone is clearly seen interposed between the articular surfaces of the head and the acetabulum, preventing congruent reduction. **B,** After removal of the fragment, the postoperative anteroposterior radiograph demonstrates congruent reduction.

Removal of intra-articular fragments of bone or cartilage, especially if the reduction is not concentric, is another indication for surgery.[1,2,10] Unlike irreducible dislocations, nonconcentric reductions should be treated on an urgent, not emergent, basis. Arteries that are not thrombosed or torn restore some or all of the vascular supply to the head once the head is within the confines of the acetabulum[34]; thus, the time needed for proper evaluation is available. Therefore, formal assessment of the hip joint with previously described radiographs and CT scans should be performed before surgery. Magnetic resonance imaging may also be indicated if no osseous block to reduction is found, as this imaging modality is more sensitive to labral and other soft-tissue injuries. During the time that it takes to obtain the appropriate studies, the leg should be placed in traction to avoid injury to the articular cartilage by intra-articular fragments of bone (third-body wear).

Small fragments that are seen in the fovea and do not impinge on the head need not be removed.[35] This is a common finding and usually represents a small piece of bone avulsed from the femoral head by the ligamentum teres. The fragments that require removal are interposed between the articular surface of the head and the acetabulum (Fig. 3, A).

The standard method for removal of incarcerated fragments has been through a formal open arthrotomy. However, many of these fragments are located on the side opposite to the direction of dislocation, which makes extraction difficult. Bucholz and Wheeless[20] described fragments from the posterosuperior acetabular rim as being the cause of nonconcentric reduction in six posterior dislocations. These fragments remained attached to the iliofemoral ligament and the head of the rectus femoris and were interposed inferiorly and anteriorly after closed reduction of the hip. The authors recommended open reduction and fixation of the fragments if they are large enough. Complete dislocation of the hip to remove these fragments may be necessary.

For smaller intra-articular fragments that will not require fixation, arthroscopic removal has been recommended.[36] This technique is relatively new, and most orthopaedic surgeons may not be familiar with it. It does offer some distinct advantages, however. Most important, redislocation of the hip is not needed to clean the joint, and additional vascular insult to the head is avoided. It may also be used to diagnose labral tears.[37] Regardless of the type of surgery performed, a concentric reduction of the hip should be confirmed on plain radiographs before wound closure (Fig. 3, B).

The final indication for surgery is an unstable fracture-dislocation (Stewart-Milford type III). Unstable posterior fracture-dislocations are not the topic of this review and should be treated as acetabular fractures. However, assessing stability may be difficult on the basis of static radiographic studies alone. Posterior-wall fragments of the same size may be found in both stable and unstable hips and may therefore represent a Stewart-Milford type II or type III injury. This problem has been studied by several authors who used CT grading of the size of the posterior-wall fragment. In two cadaveric studies, hips with 20% to 25% of the posterior wall displaced were all stable, and those with more than 40% to 50% of the wall displaced were unstable.[38,39] In a study correlating CT and clinical examination findings, Calkins et al[33] found that hips with less than 34% of the posterior wall displaced (using radians of arc as the basis for measurement) were unstable, and those with more than 55% of the wall remaining were stable. In these studies, stability in hips in which the size of the fragment was between the values in stable and unstable hips was dependent on the status of the capsule and labrum.[38]

The definitive test for stability is a stress test. Since clinical instability leads to repeated subluxation and arthritis, the most conservative estimate must be used in determining stability. If more than 20% of the posterior wall is fractured, stress testing should be performed. Regardless of the method of reduction, the hip should be tested in the operating room with the patient paralyzed. If an open reduction is being performed, direct examination of the hip should be done at the same time. If the hip is being reduced in a closed manner, the use of fluoroscopy will be helpful in assessing stability. The patient is positioned supine. The hip is flexed to at least 90 degrees and internally rotated slightly, and a posterior force is applied. The hip is visualized with the image intensifier in both the obturator oblique and near-lateral projections. If there is any subluxation of the head, indicating instability, the injury is considered to be a fracture-dislocation. Fixation of the posterior wall is then carried out with the use of standard techniques.[40] If the hip is stable, it is a Stewart-Milford type II dislocation, and routine fixation is not needed or desirable.

Fixation of small fragments can be extremely difficult; the fragments may comminute, and lag screws may enter the joint. The extra dissection for the placement of reconstruction or spring plates may also increase the risk of formation of heterotopic bone.

Treatment After Reduction

Many recommendations exist for the postreduction treatment of simple hip dislocations.[1-4,13,41-44] Strict immobilization leads to intraarticular adhesions and arthritis and should be avoided. Most surgeons recommend a temporary period of traction or balanced suspension until the patient's initial pain has subsided. This rarely takes longer than several days. After this, controlled passive range-of-motion exercises with a continuous-passive-motion machine and early mobilization are thought to benefit the patient's overall condition. Extremes of motion should be avoided for 4 to 6 weeks to allow capsular and soft-tissue healing.

The most controversial point regarding aftercare is the length of time that weight bearing should be prohibited. Time frames from several days to 1 year have been proposed. The theoretical advantages of a prolonged non-weight-bearing period apply to patients who have had an ischemic insult severe enough to lead to late collapse. Although early weight bearing has not been shown to add to the initial ischemic insult, it is believed that the amount of collapse in patients who develop AVN may be diminished if weight bearing is delayed.[45] This hypothesis has not been tested prospectively, but does have merit on historical grounds.[13] Until it has been proved or disproved, a delay in full weight bearing for 8 to 12 weeks for patients who are at high risk of collapse may be reasonable. This applies when reduction of the hip was delayed for more than 6 hours. Patients who show radiologic signs (on plain radiography or MR imaging) of AVN early in their follow-up course may also be treated with protected weight bearing and passive range-of-motion exercises. For other patients, partial weight bearing can begin when comfortable and be advanced as tolerated, with full weight bearing usually becoming possible after 2 to 4 weeks. The ability of the patient to control the leg in space is a good indicator that he is ready to progress to full weight bearing.

Three radiologic modalities have been shown to be useful in evaluating the postreduction status. Bone scanning and MR imaging have revealed vascular changes in the head before they were apparent on plain films. Single-photon-emission CT, or SPECT, has recently been used to distinguish AVN from segmental impaction of the head.[46]

The use of MR imaging to determine the risk of AVN after simple hip dislocation has not been evaluated prospectively. For nontraumatic AVN, MR imaging is the most sensitive noninvasive method of assessing the vascularity of the femoral head, and MR findings have been shown to correlate with histologic findings. Few studies have looked at the usefulness of this modality for identifying posttraumatic AVN. Laorr et al[19] examined 18 patients an average of 13 days after hip dislocation with MR imaging of both hips. Trabecular injury was identified in 8 patients (44%). However, as follow-up of these patients was not reported, no conclusions can be drawn regarding the natural history of these MR findings. Dreinhofer et al[4] examined 33 patients after pure hip dislocation and found only four abnormal hips. All four of these hips also showed plain-film abnormalities. Thus, MR imaging may have a role to play in the future, but further study is required to determine whether it can actually be used to detect posttraumatic AVN. It may be possible to decide when weight bearing should begin on the basis of MR findings if they are shown to be useful in detecting AVN or predicting collapse.

Rehabilitation should include specific strengthening exercises for the musculature about the hip. Proprioceptive training, such as that with use of a tilt board, can be helpful. Return to high-demand activities and sports should be delayed until the strength of the hip is near normal.

Outcome

The long-term prognosis of simple hip dislocations has been reported to be excellent or good in 48%[4] to 95%[6] of patients. This disparity cannot be fully explained, but several factors may have influenced the reported results. In general, anterior dislocations without femoral head injury have a better long-term prognosis than posterior dislocations.[4,21,47] The duration of follow-up, age of the patients, time to reduction, method of reduction, postreduction management, and associated injuries varied among studies. In most series, a patient with a good or excellent result had no limp or a limp only after a long work day, no more than 25% restriction of motion, no interference with activities of daily living, and no radiographic evidence of joint-space narrowing or AVN. A sample of the results reported in the larger series is shown in Table 2.

Table 2
Results in Stewart-Milford Type I and Type II Dislocations*

Study	Year	Good or Excellent Results	Avascular Necrosis	Osteoarthritis
Armstrong[48]	1948	76	2	13
Thompson and Epstein[2]	1951	67	10	7
Paus[3]	1951	71	2	20
Stewart and Milford[1]	1954	57	19	48
Morton[24]	1959	76	NA	NA
Brav[13]	1962	77	22	26
Hunter[6]	1969	95	4	NA
Reigstad[26]	1980	83	3	3
Upadhyay et al[25]	1983	75	NA	24
Hougaard and Thomsen[27]	1987	87	5	31
Yang et al[5]	1991			
Anterior dislocations		83	NA	NA
Posterior dislocations		87	NA	19
Schlickewei et al[44]	1993	94	0	10
Dreinhofer et al[4]	1994			
Anterior dislocations		75	0	11
Posterior dislocations		48	19	26

* Data extrapolated from original text and tables. Values are percentages of study populations. NA indicates specific data not available.

Clinical grading has been found to correlate with radiographic grading in approximately 80% of patients.[2] The outcome for individual patients depends mostly on the development of arthritis or AVN. In the absence of these complications, the prognosis is generally good.

Other variables have also been associated with poorer outcomes, although these may have their effect by inducing AVN or arthritis. Associated injuries have a negative prognostic effect on the clinical result. Dreinhofer et al[4] and Yang et al[5] both reported poorer results in patients with multiple severe injuries. In other studies, Upadhyay et al[25] and Hougaard and Thomsen[27] found increased rates of arthritis with increasing length of follow-up. Patients who continued to do heavy work after their injury were also found to be at increased risk for a poor outcome.[25]

The most important prognostic factor is probably the time to reduction.[1,3,13,24,27,41] The longer the interval between injury and reduction, the worse the result. Stewart and Milford[1] reported 88% good results if the reduction was performed within 12 hours. Likewise, Brav[13] found that reduction after 12 hours increased the percentage of unsatisfactory results from 22% to 52%. Morton[24] found excellent results only in patients whose hips were reduced within 12 hours. Reigstad[26] found no instances of AVN or arthritis when simple dislocations were reduced within 6 hours. Furthermore, higher rates of AVN and arthritis were found by Hougaard and Thomsen[27] if the time to relocation was over 6 hours.

Complications

Avascular Necrosis

Avascular necrosis occurs in 1.7% to 40% of hip dislocations, and the rate increases with delay in reduction. If the dislocation is reduced within 6 hours, the incidence rate of AVN is approximately 2% to 10%. A summary of the rates of AVN reported in various studies is found in Table 2.

The cause of AVN is thought to be an ischemic insult to the femoral head. Although the ligamentum teres is ruptured after hip dislocation, the artery of the ligamentum provides only a small contribution to the head. Two well-done studies of posterior dislocation in rabbits yielded similar results.[34,49] Femoral head ischemia was found to be caused by hip dislocation in adult rabbits. The authors of these studies further demonstrated that revascularization commences at the time of reduction, and that a delay of more than 12 hours does not ameliorate the rate and extent of vascular recovery of the rabbit's femoral head. Avascular changes were found on histologic examination in 51% of the rabbits. Microangiographic findings, however, revealed substantial vascular disturbances in only 4%. Extrapolated to humans, these findings imply that an ischemic episode, rather than a permanent vascular disruption, is the cause of AVN in patients with hip dislocation.

The results of AVN from dislocation can be localized. This differs from AVN of systemic origin. The natural history of AVN varies as well. It usually appears within 2 years, but has been seen as long as 5 years after injury. The localized nature of the disease makes it more amenable to treatment by osteotomy if necessary. Most authors agree that a non-weight-bearing period is beneficial in preventing collapse once AVN has been diagnosed.

Arthritis

Arthritis is the most common problem seen after hip dislocation and has been reported to occur in approximately 20% of cases (Table 2). However, rates as high as 70% have been observed after open reduction.[1] The cause is likely multifactorial. The most widely held belief is that arthritis is a consequence of cellular injury to the cartilage from the impact causing the dislocation.[10] Repo and Finlay[50] produced chondrocyte death after 20% to 30% strain on cartilage. Borelli et al[51] demonstrated radiographic fractures in the subchondral bone and decreased metabolic activity in cartilage exposed to a compression injury.

Although it is clear that radiographically discernible AVN leads to coxarthrosis, subtle avascular changes may also be contributory. However, the damage to the chondrocytes at the time of the injury is probably responsible for the incidence of late arthritis seen after dislocation. At the present time there is no effective treatment for the cartilage injury at the cellular level.

Sciatic Palsy

Sciatic nerve injury is more common after fracture-dislocation than after pure dislocation. If it occurs, it is usually partial and most often affects the peroneal division. Resolution after reduction of the dislocation is the rule, and exploration is not required unless nerve function was intact before the reduction and then lost afterward.

Redislocation

Redislocation is uncommon, having been reported in only 1% of dislocations.[9] Poor healing of the posterior soft tissues or large labral tears accounts for most cases. These can be diagnosed with MR imaging and treated with soft-tissue repair.

Myositis

Calcification of the soft tissues is uncommon after dislocation. If it occurs, it is seen as a late complication and usually does not restrict motion.[42,48]

Summary

Simple hip dislocations include those that are stable after reduction and have no fractures requiring repair. Despite early reports of an excellent prognosis after pure dislocation, multiple series with long-term follow-up have yielded a much bleaker outlook. Car seat-belt use would decrease the incidence of this problem.

Of the factors that affect outcome, the only ones in the control of the surgeon are the recognition of the primary and associated injuries and the timing of reduction. Future research may allow early identification of those patients at risk for AVN so that earlier treatment can be initiated. It currently appears that most complications associated with hip dislocation are instigated at the time of injury in the form of cartilage and soft-tissue damage. The orthopaedic surgeon should be aware of the potential of a poor long-term prognosis after this injury and should advise patients accordingly.

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