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Review Article

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REVIEW ARTICLE

Hip arthroscopy for the management of trauma: a literature review

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ABSTRACT

The first descriptions of the use of hip arthroscopy for traumatic injuries were presented in 1980. One paper described arthroscopy for the removal of a bullet fragment while others reported using hip arthroscopy to remove fragments following total hip arthroplasty. With the application of traction and modification of arthroscopic instruments, hip arthroscopy has become a useful tool in treating trauma to the hip. Most of the literature describes traumatic hip dislocation. Several studies have documented the successful use of arthroscopy for removal of loose bodies, but it has also been used to treat labral tears, chondral defects and acetabular rim fractures. Complications reported include fluid extravasation, the lowering of the patient's body temperature using cool saline irrigation and further injury due to unrecognized concomitant pathology.

HISTORY

Hip arthroscopy indications and techniques are expanding. As the experience of the hip arthroscopy surgeon increases and as technology improves, the use of hip arthroscopy to aide in the diagnosis and treatment of traumatic pathology about the hip is expanding. The application of hip arthroscopy to post-trauma of the hip is described but remains very limited. The incidence of femoral, acetabular and peri-articular injuries around the hip injuries that are amenable to arthroscopic treatment is low. The numbers of patients treated by this method are also limited by the diverse skill set or access to surgeons who are well versed in these techniques. Patients who undergo an acute injury are often under the care of a traumatologist or an orthopaedist who is either providing event coverage or emergency department coverage. As hip arthroscopy is a relatively nascent procedure, the exposure to hip arthroscopy in training is limited [1]. Contrary to arthroscopic procedures in the knee and shoulder, relatively few surgeons are comfortable and capable of using this technique [2]. In addition, the expeditious care of the traumatically injured patient and positioning requirements for hip arthroscopy limit the use of this technique in many situations. The paucity of these cases that present to an individual institution presents an obstacle to the quality of the literature and investigations that can be carried out in this arena.

The first descriptions of the use of hip arthroscopy for traumatic injuries were presented in 1980. Goldman *et al.* [3] described the extraction of a bullet that was lodged in the postero-superomedial femoral articular surface with the assistance of an arthroscope. The same year there were two reports of arthroscopy used to remove an obstructing cement fragment from a total hip arthroplasty prosthesis. Traction was not used in one of these cases of frank dislocation, while a fracture table facilitated entrance into the acetabular cup in the other, but the equipment available did not provide visualization of the entrapped fragments which were able to be dispelled by forceps and irrigation [4, 5].

Distraction of the hip for inspection of the joint with successful removal of intra-articular loose bodies after closed reduction of a hip dislocation was reported in two patients in 1994 by Keene and Villar [6]. Subsequently, Byrd [7] described 30 successful hip arthroscopy cases in

1996, of which three were performed for post-traumatic loose fragments in young athletic males [7]. This was followed by several studies where hip arthroscopy was used to treat intra-articular damage associated with hip trauma in cases without complex injuries [8–10]. These studies highlighted the evolution of hip arthroscopy with the application of judicious traction and the modification of arthroscopic instruments to allow for the decreased morbidity that is afforded without the need for an open approach.

INDICATIONS

Hip dislocations

The rate of post-traumatic arthritis following a traumatic posterior hip dislocation has been shown to be as high as 88% for complex dislocations, those that involve acetabular fractures, and up to 24% for simple dislocations, that occur without an associated fracture [11]. It has been reported that despite expeditious reduction in <3 h, that medium- to long-term results after simple dislocations show satisfactory results in only approximately one-half of patients [12]. This is an area where hip arthroscopy can make an impact on outcomes.

Relative indications for hip arthroscopy after a hip dislocation were reported by Foulk and Mullis to be: (1) as an alternative to an open arthrotomy for a non-concentric reduction; (2) similarly to address a dislocation associated with a stable acetabular fracture not requiring open reduction and internal fixation; (3) to evaluate for residual loose bodies or a labral tear when suspicion for these lesion exists [13]. In addition to the described role of dynamic stress views to evaluate for hip instability when associated posterior wall fractures exist [14], the need for post-reduction radiographic evaluation and a thin cut CT scan to assess for concentricity and the presence of loose bodies is common practice. Despite imaging failing to demonstrate abnormalities, there remains a high prevalence of intra-articular loose bodies that have been diagnosed with arthroscopy [15, 16].

In the event of a traumatic simple hip dislocation or subluxation event, the senior author's preferred technique includes prompt reduction, if indicated, under adequate relaxation to preclude any further intra-articular damage. At this initial setting, an intra-capsular aspiration can be performed to decrease the intra-articular pressure and to decrease the likelihood of avascular necrosis. Emergent reduction and aspiration are important, as osteonecrosis is reported in 6–40% of cases, with the severity of injury having a large effect on outcomes [11, 17–19]. Intra-operative fluoroscopy assists in confirmation of reduction and needle localization. Subsequent immediate imaging to confirm a

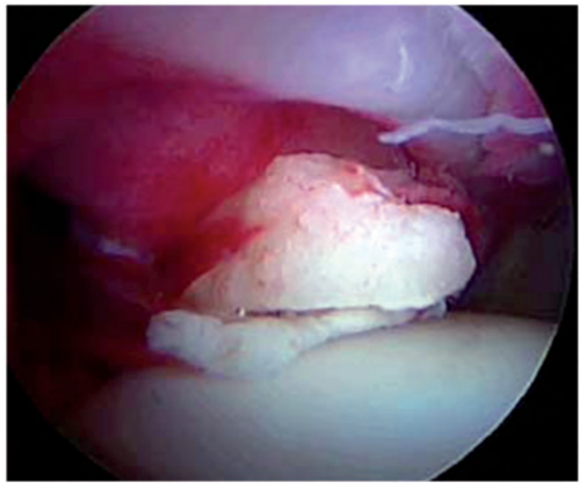

Fig. 1. Loose bodies seen at hip arthroscopy following hip dislocation.

simple dislocation, concentric reduction and to rule out concomitant fractures is essential and includes a low AP pelvis and a fine-cut CT with image reconstruction including axial, sagittal and coronal views of the pelvis that extends distal to the bilateral lesser trochanters. A single limb CT is not sufficient, as concomitant pelvic pathology may be missed and comparison to the contralateral hip may be essential to evaluate for concentricity. In the absence of intra-articular pathology that requires urgent surgical intervention, protected weight bearing and motion is vital. As expeditiously as is feasible, an MRI is obtained in a facility that is accustomed to and experienced with imaging to evaluate for intra-articular pathology. If indicated, hip arthroscopy is generally planned for ~3 weeks after the initial event, to allow for the capsule to stabilize to avoid fluid extravasation, excessive swelling and optimize visualization from optimal fluid containment. The plan at arthroscopy is to address the anticipated residual loose bodies and associated pathology to include FAI, labral tears and chondral defects, if present.

Arthroscopic examination after a hip dislocation demonstrates an alarmingly high rate of intra-articular lesions. This is in stark juxtaposition to prior imaging-based studies that advocated that CT scans were not necessary after simple dislocations due to the lack of their influence on the treatment plan, as they did not identify loose bodies that were not associated with non-concentric reductions [20]. Arthroscopically diagnosed loose bodies (Fig. 1) were reported in 92% of 39 dislocated hips, including seven of nine patients in whom the reduction was concentric and loose bodies were not identified on CT [15], and another reported that eight of 11 cases had loose bodies that had not been diagnosed on pre-operative imaging [16]. Owens and Busconi [21] also described a consecutive cohort of patients undergoing hip arthroscopy for loose bodies after dislocations and fracture dislocations that did not require an open procedure, and successful outcome was reported in all patients. This study also highlighted the ability to treat concomitant labral tears [21].

Loose bodies are one component of a constellation of hip pathology that can accompany a hip dislocation. Philippon *et al*. [10] reported on 14 professional athletes who sustained simple dislocations during competition. Reduction was prompt, and patients presented to hip arthroscopy for continued hip pain at a mean of 125 days. While the majority of these patients had FAI, which is discussed later in the article, and the status of the hip pathology prior to the dislocation is unknown and may contribute to the pathology discovered at time of arthroscopy, there was a large incidence of concomitant injuries discovered. All of these patients had labral tears and chondral defects (Fig. 2), with six of the 14 having chondral defects to both the acetabulum and femoral head. Two had capsulolabral adhesions and two had capsular tears. Eleven of these patients had loose osteochondral fragments and 11 had ligamentum teres tearing (Fig. 3) [10].

Labral tears following high-energy trauma are often complex tears. In cases where adequate tissue is available, labral tears are repaired. Debridement is generally used for degenerative tears or very small tears. If the tear is complex and disrupts the longitudinal fibers, a labral reconstruction is recommended. The decision to reconstruct the labrum is often made at arthroscopy, following a dynamic exam. If the labrum does not provide a suction seal with the femoral head, then treatment is necessary.

Cartilage injuries are commonly seen post-trauma. Treatment options include debridement, chondroplasty, microfracture, mosaicplasty, chondrocyte implantation and partial resurfacing. If cartilage damage is acute due to trauma, factors such as size, patient compliance, and quality of underlying bone, can decide the optimal treatment choice. Microfracture is the treatment of choice for focal and contained cartilage lesions. Adequate cartilage surrounding the lesion, helps contain the clot that is formed following microfracture. Microfracture is contraindicated if the patient is unable or unwilling to comply with post-operative guidelines. Cartilage damage can also be a result of impingement. In order for microfracture to be successful, any bony impingement must be addressed.

The role of the ligamentum teres to hip stability continues to be defined. The anatomy of this ligament predisposes it to

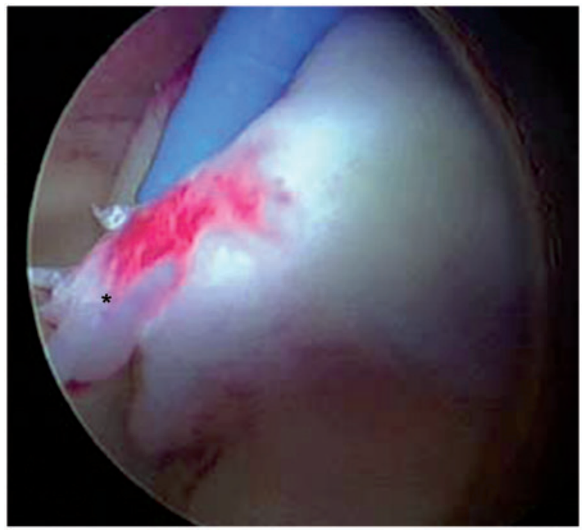

Fig. 3. The ligamentum teres completely torn (asterisk) following traumatic hip dislocation as seen at time of hip arthroscopy.

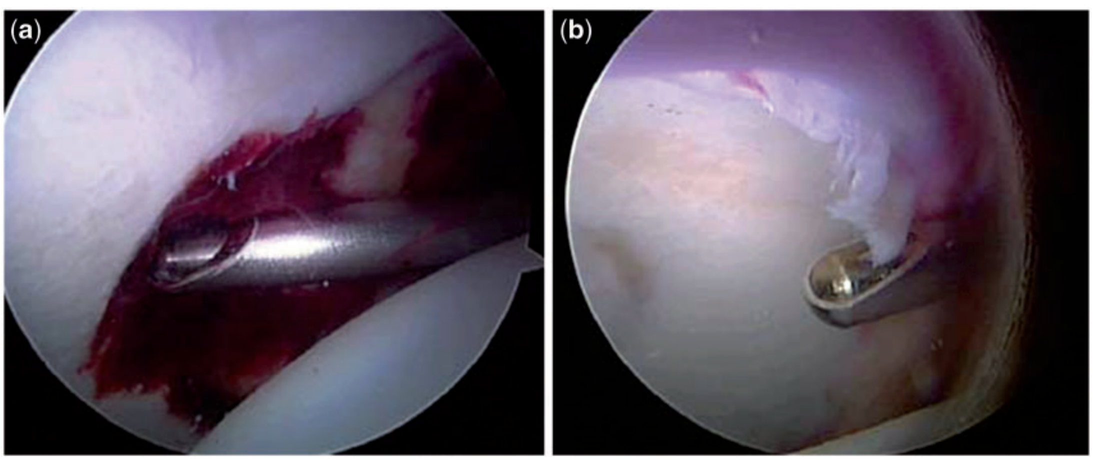

Fig. 2. Intra-articular damage following hip dislocation can include (a) labral tears and (b) cartilage lesions.

injury with a hip dislocation [22, 23]. Debridement of the ligament after repeated hyper-abduction injuries was reported to successfully relieve pain in an 18-year-old patient [24]. A similar report demonstrated the efficacy of arthroscopy to remove an offending torn ligamentum teres in a 10-year-old female [25]. It has also been suggested that there is potential for the ruptured ligamentum teres to heal after traumatic dislocation of the hip [26]. Byrd and Jones [27] reported on 23 traumatic ligamentum teres tears that presented with pain that was localized to the hip that underwent arthroscopic debridement, and reported significant improvement post-operatively. Of interest, in this study only two patients had a pre-operative diagnosis of a ligamentum teres lesion [27].

HIP ARTHROSCOPY FOR FRACTURE MANAGEMENT

Femoral head fractures

Hip arthroscopy for traumatic injuries has also been used as an adjunct to and improvement upon traditional methods of fracture fixation. A logical progression of hip arthroscopy techniques to trauma is found in the reduction and fixation of femoral head fractures. By avoiding the morbidity of a traditional hip dislocation to reduce and fixate a certain subset of femoral head fractures, and to provide visualization of the fracture and its subsequent reduction that is seen with the several fold magnification of arthroscopic monitors, the benefit of arthroscopically assisted reduction and fixation is clear.

Yamamoto *et al.* [16] in 2003 reported on five femoral head fractures associated with dislocation that were managed arthroscopically. These fractures consisted of three Pipkin type 1, one type 2 and one type 3. At an average of 3.2 days, the fractures were reduced and fixated with absorbable pins. The type 3 fracture went on to osteonecrosis, but the other two achieved satisfactory results [16]. Matsuda [28] in 2009 described in a case report the arthroscopic reduction and assisted fixation with a Herbert screw of a suprafoveal osteochondral femoral head fracture that was isolated and not associated with a dislocation event. Two additional reports and the description of the technique for arthroscopically managed reduction and fixation of Pipkin type I fractures were presented by Lansford and Munns [29] and Park *et al.* [30]. The literature and outcomes in this arena are very limited, but there is potential for this method of treatment to become more mainstream as the exposure to and experience with hip arthroscopy improves.

Acetabular fractures

The other aspect of associated intra-articular pathology that lends its self to arthroscopically assisted fixation is

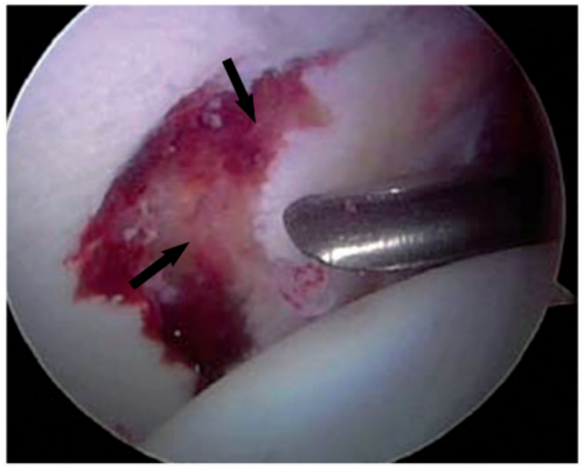

Fig. 4. Posterior wall acetabular fracture (at arrows) as seen prior to arthroscopic fixation.

found in acetabular fractures (Fig. 4). When indirect reduction techniques are utilized, or to assess the incongruity that may persist after these techniques, arthroscopic visualization can play a role. The visualization afforded by this technique is similar to that employed in the reduction of tibial plateau fractures. The reports of arthroscopy for this indication are limited. The acetabular fracture must be amenable to and not be further displaced by the necessary traction. The visualization in the presence of hemoarthrosis may be difficult and the insufficiency of the bony architecture to contain the arthroscopic solution must be recognized. In addition, the energy and mechanism that often accompanies these types of fractures may result in a polytraumatized patient, and the associated injuries may preclude the additional surgical time and positioning required for hip arthroscopy.

One successful case of arthroscopically assisted percutaneous fixation of a fracture of the weight bearing region of the acetabulum was reported by Yamamoto *et al.* [16] in 2003. Yang *et al.* [31] subsequently reported on two cases of anterior column acetabular fractures that were treated with arthroscopically assisted indirect reduction and percutaneous fixation. The reported benefits of this technique included fracture and cartilage debridement, decreased fluoroscopy use required to ensure no joint penetration of acetabular column screws, and to directly assess joint congruity after reduction [31] (Fig. 5).

COMPLICATIONS

With respect to the paucity of reported cases of hip arthroscopy in the trauma setting, the list of reported complications is small. Bartlett *et al.* [32] in 1998 reported on a devastating complication of hip arthroscopy employed to

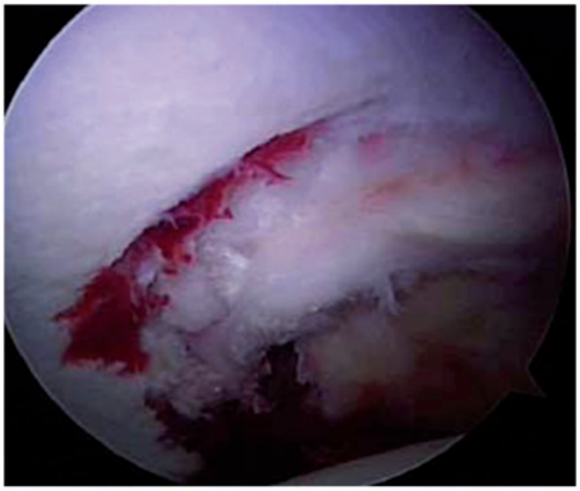

Fig. 5. Arthroscopically fixed acetabular fracture.

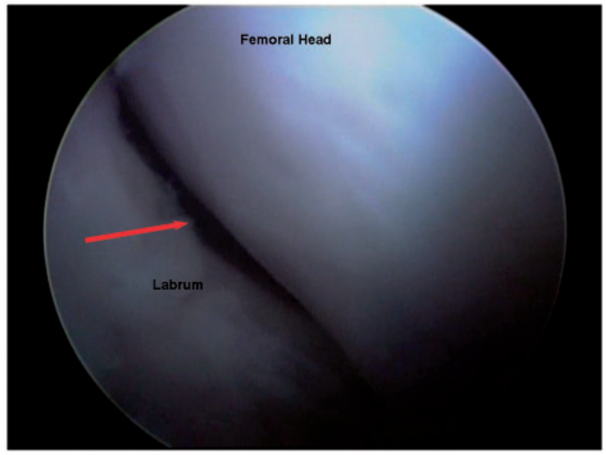

Fig. 6. Arthroscopic dynamic exam showing bony abnormality of cam impingement engaging the acetabulum. The labral seal is disrupted (arrow showing gap) and the femoral head may be at increased risk of dislocation.

remove loose bodies after prior ilioinguinal approach and internal fixation of a both-column acetabular fracture. Fluid extravasation through the fracture site resulted in intra-abdominal compartment syndrome that presented as cardiopulmonary arrest. The patient recovered after an emergent laparotomy [32].

Many other complications are possible with the application of hip arthroscopy to trauma-related indications. The surgeon must be cognizant of the traditional complications of hip arthroscopy, in addition to the added risks associated with a trauma patient. This list includes a reduction in core temperature associated with the irrigation for arthroscopy. Our institution has implemented a protocol of using only warmed saline to help prevent cooling in all hip arthroscopy cases. The amount of fluid that passes through the patient and system may be in excess of 30 l, which has great potential to inadvertently cool the patient. The presence of concomitant pathology must also be ruled out. For example, an unrecognized non-displaced femoral neck, femoral, tibial or other lower extremity fracture may declare itself with the use of traction. The perineal edema that often accompanies abdominal or acetabular fractures may place an unnecessary risk associated with traction. In addition, the extravasation of fluid into the surrounding musculature and abdomen as is seen in hip arthroscopy patients with an insufficient capsule may be exacerbated with a traumatic capsular disruption. Not uncommonly, the swelling and edema associated with this swelling in a routine hip arthroscopy case will require hydrochlorothiazide or similar anti-diuretic at our institution to expeditiously improve symptoms. This condition could be more pronounced in a trauma patient, and associated systemic conditions or third-spacing could exacerbate the complication.

Predisposition to dislocation—the role of femoroacetabular impingement

The contribution of pre-existing FAI to hip dislocation has also been reported. One retrospective review of traumatic hip dislocations without associated fractures in 14 professional athletes demonstrated evidence of FAI in nine of these patients. Four patients had isolated cam lesions, one had an isolated pincer lesion on the acetabular rim, and four had evidence of mixed type pathology [10]. In another series of patients with posterior acetabular rim fractures in athletes as a sequela of a posterior hip instability episode, an association with FAI was made [33]. Of the 22 patients presented, 18 had FAI of which 16 sustained an injury mechanism that was twisting or non-contact in nature. The most common accompanying injuries included a rim fracture associated with anterior and posterior labral tears, capsular tear, ligamentum teres avulsion and chondral injury of the femoral head with loose bodies [33]. Another series of three athletes with traumatic posterior hip instability showed that all had acetabular retroversion, a cam lesion and an elevated alpha angle, which the authors proposed predisposed the patients to instability [34] (Fig. 6). At the time of hip arthroscoy following dislocation, hip impingement is addressed as well as any intra-articular injuries caused by FAI.

CONCLUSIONS

Acute, traumatic injuries to the hip are traditionally managed with an open approach. While these techniques have been shown to be effective, there is associated morbidity of the approach, difficulties with visualization despite an open approach and concerns of the amount of radiation exposure encountered with percutaneous procedures. With the selective use of hip arthroscopy to assist in the treatment of these patients, these factors can be improved. Decreased blood loss is also a potential benefit of arthroscopy. Soft tissue violation is also a concern that is mitigated with the minimally invasive approach that hip arthroscopy affords. Scarring, adhesions, capsular integrity and post-operative restrictions to motion and activity can all be positively influenced by the use of arthroscopic techniques.

Attention to known and occult concomitant injuries in the polytraumatized patient is of vital importance to limit complications. The use of arthroscopic procedures in the trauma situation should also be performed after sufficient experience has been gained by the surgeon in more routine cases. The ruptured capsule, presence of hemoarthrosis and distorted anatomy that is often encountered in this scenario can increase the difficulty of the procedure. In addition, the work-up of these patients will often require imaging and planning beyond a typical hip trauma patient. The presence of previously existing anatomical variants, such as femoroacetabular impingement or mild dysplasia that may have predisposed to or contributed to the presenting injury should be recognized in order that they can be discussed with the patient and treated concomitantly, if appropriate.

The literature on this subject is limited and further descriptions of techniques and analysis of outcomes are needed. There is promise for improved outcomes with these techniques, but further research is warranted.

CONFLICT OF INTEREST STATEMENT

None declared.

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