Hip Arthroscopy: Prevalence of Intra-articular Pathologic Findings After Traumatic Injury of the Hip

Vickas Khanna, M.D., F.R.C.S.C., Adam Harris, M.D., Forough Farrokhyar, B.Sc., M.Phil., Hema N. Choudur, M.D., F.R.C.S.C., and Ivan H. Wong, M.D., F.R.C.S.C.

Purpose: The purpose of this study was to document and compare the incidence of intra-articular hip pathologic findings identified using arthroscopy versus conventional imaging in patients with acute trauma to the hip. Methods: This was a blinded prospective case series study designed to review the incidence of intra-articular pathologic disorders in patients with post-traumatic injury between the ages of 18 and 65 years who were referred to a single surgeon. Injuries included hip dislocation, proximal femur fracture, pelvic ring fracture, acetabular fracture, penetrating injury (gunshot wound), and soft tissue injury. Preoperative radiographs, computed tomographic (CT) scans, or magnetic resonance imaging/magnetic resonance angiography (MRI/MRA) scans (or a combination of these) were obtained. Findings were documented and compared with intraoperative findings. Results: A total of 29 post-traumatic hips were enrolled in this study. Hip arthroscopy identified 17 of 29 hips (59%) as having loose bodies, 11 of 29 (38%) hips as having an intra-articular step deformity, 14 of 29 (49%) hips as having an osteochondral lesion, and 27 of 29 (93%) hips as having a labral tear. Plain radiographs and CT scans yielded low sensitivity when compared with arthroscopy for the identification of loose bodies and step deformities. MRI/MRA comparison with arthroscopic findings suggest that MRI/MRA is an accurate tool for identification of labral tears, because 91% of tears seen on arthroscopy were also identified by MRI/MRA. In 4 hips, however, MRI/MRA failed to identify osteochondral lesions that were subsequently identified by arthroscopy. Conclusions: Traumatic injuries of the hip result in substantial intra-articular pathologic findings, including loose bodies, labral tears, step deformities, and osteochondral lesions. The arthroscope is a powerful tool in identifying these injuries. Plain radiographs and CT scans appear to underestimate the true incidence of loose bodies and step deformities within the joint when compared with hip arthroscopy after a traumatic injury of the hip. Level of Evidence: Level IV, diagnostic case series.

H

ip arthroscopy is an increasingly popular minimally invasive procedure for intra-articular conditions. The application of hip arthroscopy for the diagnosis and treatment of hip trauma has been studied previously and reported in the literature.1–6 However, we believe that this procedure requires further study to clarify its indications, focusing on all forms of hip trauma and not only dislocations. In particular, the indication for the use of an arthroscopic intervention after a traumatic hip injury has not been clearly defined.

Traumatic injuries to the hip range from simple dislocation without a fracture to complex injuries involving gross displacement and fracture of the acetabulum, pelvic ring, or femoral head/neck. Often, the latter injuries with increased severity require open reduction and internal fixation (ORIF). However, despite fractures or dislocations, or both, being treated with anatomical reduction, many patients still fail to return to their preinjury functional level.7 Loss of function is particularly significant with traumatic hip injuries because these patients tend to be young and are part of the working class.7–9 Our study aims to show that a potential cause for failure in these patients consists of underappreciated intra-articular pathologic disorders.

Recent literature suggests that even simple traumatic injuries of the hip are associated with intra-articular conditions that may not be evident on radiographs, computed tomographic (CT) scans, or magnetic resonance imaging/arthrography (MRI/MRA), yet are identifiable with hip arthroscopy.1–6 These injuries
include, but are not limited to, labral tears, intra-articular step deformities, and osteochondral or chondral lesions resulting in loose bodies within the joint.

The incidence of intra-articular pathologic findings may have significant clinical consequences. More than 60 years ago, Thompson and Epstein\(^3\) discussed the importance of removing “loose fragments” to restore articular congruity and to prevent the development of traumatic arthritis in the hip. Other studies have shown an incidence of loose bodies after traumatic hip injuries, and some surgeons believe that the presence of intra-articular cartilage or bone fragments is an indication for surgery to restore congruency of the joint.\(^{1,12}\)

Although even less data are available regarding labral injuries after trauma and their significance, it is believed that tears may at the very least be a cause of ongoing pain.\(^3\) Additionally, patients who have suffered a traumatic hip injury are at high risk of the development of post-traumatic arthritis.\(^{14-17}\) It has been shown that hip dislocations associated with an acetabular fracture lead to an even greater chance of the development of post-traumatic arthritis.\(^18\)

The use of hip arthroscopy in the United States increased by more than 600% from 2006 to 2010, with relatively low complication rates of approximately 5%.\(^19\) The use of hip arthroscopy leads to less morbidity than is associated with open arthrotomy.\(^2\) However, its utilization rates and indications in trauma remain largely unknown. Arthroscopically assisted fracture reduction and osteosynthesis in the hip is a new and emerging field in orthopaedics that may further change the way surgeons approach hip trauma.\(^20-22\)

The purpose of this study was to document and compare the incidence of intra-articular hip pathologic findings identified using arthroscopy versus conventional imaging in patients with acute trauma to the hip. We hypothesized that hip arthroscopy is a superior means of detecting intra-articular pathologic conditions in patients after acute hip trauma compared with routine imaging techniques (plain radiographs, CT scans, and MRI/MRA).

**Methods**

**Study Design**

This was a prospective cohort study involving English-speaking patients referred to a single surgeon (I.W.) for post-traumatic hip arthroscopy. The criteria for inclusion included a traumatic injury to the hip and a patient aged between 18 and 65 years at the time of injury. For the purposes of this study, we defined traumatic injury to the hip as any high-energy injury to the hip region resulting in hip dislocation, proximal femur fracture, pelvic ring fracture, acetabular fracture, penetrating injury (eg, gunshot wound), and soft tissue injury. Patients were considered to have a soft tissue injury if they were involved in a high-speed trauma (i.e., a motor vehicle collision) and had no radiographic evidence of bony injury but, on history taking and physical examination, continued to have ongoing pain specific to the hip that was not present before the trauma. Patients enrolled in the study were referred to the senior author from another orthopaedic surgeon after the identification and management of an acute traumatic injury to the hip or when the sequelae of a traumatic hip injury, in the case of a soft tissue injury, was recognized in clinical follow-up. The criteria for exclusion were previous hip arthroscopy and refusal to consent to hip arthroscopy.

**Radiographic Measurements**

All 29 enrolled hips underwent a prearthroscopic anteroposterior pelvis and frog leg lateral radiograph; 19 hips underwent CT scanning, and 11 hips had an MRI or MRA (Table 1). The findings from imaging were documented based on review of the images by a musculoskeletal radiologist who was blinded to the findings of the hip arthroscopy. CT scan and radiographic findings were recorded and quantified by the blinded radiologist using a simple binary “yes/no” system for loose bodies and joint incongruity/step deformity. MRI/MRA findings were recorded and quantified by the blinded radiologist using the same binary “yes/no” system for loose bodies, joint incongruity/step deformity, osteochondral lesions, and labral tears.

Intraoperative arthroscopic findings were independently recorded as either positive or negative through review of the operative video by the study investigator (V.K.) for the same lesions as with MRI. The study investigator was blinded regarding the initial hip injury and to any preoperative imaging. Results of intraoperative findings were compared with the prearthroscopic findings from the imaging.

**Surgical Technique**

Hip arthroscopy was performed with the patient in a supine position with traction applied through a perineal post. Traction was considered adequate when between 7 and 10 mm of space between the acetabulum and the femoral head was seen with fluoroscopy. Standard

![Table 1. Patient Demographics](image)

<table>
<thead>
<tr>
<th>Number of hips (N)</th>
<th>29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right hip</td>
<td>14</td>
</tr>
<tr>
<td>Left hip</td>
<td>15</td>
</tr>
<tr>
<td>Mean age (yr)</td>
<td>38.5 (19-65)</td>
</tr>
<tr>
<td>Median time from trauma to arthroscopy (d)</td>
<td>65 (1-1201)</td>
</tr>
<tr>
<td>Radiographs</td>
<td>29</td>
</tr>
<tr>
<td>CT scans</td>
<td>19</td>
</tr>
<tr>
<td>MRI/MRA</td>
<td>11</td>
</tr>
</tbody>
</table>

CT, computed tomographic; MRI/MRA, magnetic resonance imaging/magnetic resonance angiography.
Statistics

Descriptive statistics were used to summarize patients’ demographic and baseline characteristics. Categorical variables were reported as counts and percentages, and continuous variables as mean and standard deviation or median and range if not normally distributed.

The primary objective of the study was to estimate the sensitivity and specificity of arthroscopic surgery versus conventional imaging in identifying hip pathologic conditions. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV), and their corresponding 95% confidence intervals (CIs) were calculated for all patients.

Results

A total of 29 hips were enrolled from 28 patients (one patient had bilateral hips enrolled). All patients who were approached for enrollment in the study ultimately underwent hip arthroscopy. Sex distribution consisted of 10 women and 18 men. Fourteen of the cases consisted of right hips, and 15 of the cases consisted of left hips. The average age of the patient was 38.5 years, and 75% (22/29) were approached for enrollment in the study ultimately complied. The median time from trauma to hip arthroscopy was 17.5 days (range, 1 to 210 days). The median age was 37 years (range, 19 to 65 years). The median time from trauma to hip arthroscopy was 2 days (range, 1 to 1,201 days). The main traumatic injury of the hip was recorded. Pelvic ring fractures were the main injury in 5 hips, 6 hips had acetabular fractures, 7 hips had fractures of the proximal femur (head/neck), and 2 hips were simple dislocations with no associated fracture. Eight hips were involved in high-energy motor vehicle collisions with no obvious fracture, but there was continued ongoing hip pain. One enrolled patient had a gunshot wound to the hip.

Of the 29 post-traumatic hips that underwent hip arthroscopy, 17 hips (59%) were identified by arthroscopy as having intra-articular loose bodies, 11 hips (38%) were identified as having intra-articular step deformities, 14 hips (48%) were identified as having osteochondral lesions that included cartilage delamination, and 27 of the 29 hips (93%) had labral tears seen through the arthroscope. The intra-articular hip pathologic findings identified using arthroscopy are organized by category of traumatic hip injury in Table 2.

Of the 17 hips identified as having loose bodies by arthroscopy, one was identified preoperatively by radiography and 2 by computed tomography. This yielded a sensitivity of 6% (95% CI, 1% to 27%) for radiography and a sensitivity of 14% (95% CI, 4% to 40%) for computed tomography. Specificity was 100% for both (95% CI, 75% to 100% for radiography and 56% to 100% for computed tomography). The NPV of radiography and computed tomography for the presence of loose bodies was 43% (95% CI, 26.5% to 61%) and 29% (95% CI, 13% to 53%), respectively. PPV was 100% for both (Table 3).

Of the 11 hips identified as having intra-articular step deformities by arthroscopy, 5 were identified preoperatively by radiography and 6 were identified by computed tomography, yielding a sensitivity of 45% (95% CI, 21% to 72%) for radiographic identification of step deformity and a sensitivity of 67% (95% CI, 35% to 88%) for computed tomography. The specificity was 100% (95% CI, 82% to 100%) for radiography and 90% (95% CI, 60 to 98%) for computed tomography. The NPV of radiography and computed tomography for the presence of an intra-articular step deformity was 75% for both (95% CI, 55% to 88% for radiography and 95% CI, 65% to 95%) and 90% (95% CI, 60 to 98%) for computed tomography. The NPV of radiography and computed tomography for the presence of an intra-articular step deformity was 75% for both (95% CI, 55% to 88% for radiography and 95% CI, 65% to 95%).

Table 2. Intra-articular Pathologic Findings Identified by Arthroscopy in Each Category of Traumatic Hip Injury (Total N = 29)

<table>
<thead>
<tr>
<th>Pelvic Ring Fracture</th>
<th>Acetabular Fracture</th>
<th>Proximal Femur Fracture</th>
<th>Posterior Hip Dislocation</th>
<th>Soft Tissue Injury</th>
<th>Gunshot Wound</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 5</td>
<td>n = 6</td>
<td>n = 7</td>
<td>n = 2</td>
<td>n = 8</td>
</tr>
<tr>
<td>Loose body</td>
<td>3 of 5</td>
<td>6 of 6</td>
<td>4 of 7</td>
<td>0 of 2</td>
<td>3 of 8</td>
</tr>
<tr>
<td>Step deformity</td>
<td>2 of 5</td>
<td>5 of 6</td>
<td>2 of 7</td>
<td>0 of 2</td>
<td>1 of 8</td>
</tr>
<tr>
<td>Osteochondral lesion</td>
<td>2 of 5</td>
<td>5 of 6</td>
<td>4 of 7</td>
<td>1 of 2</td>
<td>1 of 8</td>
</tr>
<tr>
<td>Labral tear</td>
<td>5 of 5</td>
<td>5 of 6</td>
<td>7 of 7</td>
<td>2 of 2</td>
<td>8 of 8</td>
</tr>
</tbody>
</table>

Table 3. Radiographic and Computed CT Loose Body Identification (95% CI)

<table>
<thead>
<tr>
<th></th>
<th>Radiograph</th>
<th>CT Scan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>6% (1%-27%)</td>
<td>14% (4%-40%)</td>
</tr>
<tr>
<td>Specificity</td>
<td>100% (75%-100%)</td>
<td>100% (56%-100%)</td>
</tr>
<tr>
<td>PPV</td>
<td>100% (21%-100%)</td>
<td>100% (34%-100%)</td>
</tr>
<tr>
<td>NPV</td>
<td>43% (26%-65%)</td>
<td>29% (13%-53%)</td>
</tr>
</tbody>
</table>

CI, confidence interval; CT, computed tomographic; NPV, negative predictive value; PPV, positive predictive value.
radiography and 47% to 91% for computed tomography). The PPV was 100% for radiography and 85.7% for computed tomography (Table 4). Radiographs and CT scans were not used to assess for soft tissue injuries such as labral tears, nor were they used to assess for chondral injuries.

Because only 11 patients had MRI/MRA followed by hip arthroscopy, the incidence of imaging-identified versus arthroscopically identified intra-articular pathologic conditions was limited. As a result, the numbers were too low to permit appropriate 2 × 2 table statistical analysis, and thus only observations are reported here.

In the assessment of the presence of loose bodies, 1 of 11 (9%) hips was identified as positive through MRI/MRA and 2 of 11 (18%) hips were identified by arthroscopy as having loose bodies. When assessing intra-articular step deformities, 0 of 11 hips (0%) were found to have pathologic conditions by MRI/MRA, and one of 11 hips (9%) was found to have a step deformity by arthroscopy (Table 5).

The incidence of osteochondral lesions identified by MRI/MRA was 0 of 11 hips (0%), but 4 of these 11 hips (36%) were found to have osteochondral lesions intraoperatively during arthroscopy (Fig 1). MRI/MRA identified 10 of 11 hips (91%) as having labral tears versus 11 of 11 (100%) hips identified as having labral tears by arthroscopy (Table 5).

### Table 4. Radiograph and CT Joint Incongruity/Step Deformity Identification (95% CI)

<table>
<thead>
<tr>
<th></th>
<th>Radiograph</th>
<th>CT Scan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>45% (21%-72%)</td>
<td>67% (35%-88%)</td>
</tr>
<tr>
<td>Specificity</td>
<td>100% (82%-100%)</td>
<td>90% (60%-98%)</td>
</tr>
<tr>
<td>PPV</td>
<td>100% (56%-100%)</td>
<td>86% (49%-97%)</td>
</tr>
<tr>
<td>NPV</td>
<td>75% (55%-88%)</td>
<td>75% (47%-91%)</td>
</tr>
</tbody>
</table>

CI, confidence interval; CT, computed tomographic; NPV, negative predictive value; PPV, positive predictive value.

### Table 5. Intra-articular Pathologic Findings Identified by MRI/MRA Versus Arthroscopy

<table>
<thead>
<tr>
<th></th>
<th>MRI/MRA</th>
<th>Arthroscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose bodies</td>
<td>1 of 11 (9%)</td>
<td>2 of 11 (18%)</td>
</tr>
<tr>
<td>Step deformity</td>
<td>0 of 11 (0%)</td>
<td>1 of 11 (9%)</td>
</tr>
<tr>
<td>Osteochondral lesion</td>
<td>0 of 11 (0%)</td>
<td>4 of 11 (36%)</td>
</tr>
<tr>
<td>Labral tears</td>
<td>10 of 11 (91%)</td>
<td>11 of 11 (100%)</td>
</tr>
</tbody>
</table>

MRI/MRA, magnetic resonance imaging/magnetic resonance angiography.

### Discussion

Currently, the role for hip arthroscopy in the post-traumatic patient remains undefined. Although several studies have retrospectively reviewed the findings of hip arthroscopy in the traumatic hip, few to no prospective data exist. In this prospective study, we set out to investigate the utility of hip arthroscopy as a diagnostic tool compared with traditional imaging modalities in patients who have undergone trauma.

A recent study of hip arthroscopy after hip dislocations by Philippon et al. in 2009 observed chondral injuries and labral tears in all 14 of their enrolled patients, and 11 of 14 patients had loose bodies within the joint. Similarly, in a study by Ilizaliturri et al. in 2011, of 17 patients with posterior hip dislocations who subsequently underwent arthroscopy, 14 were found to have intra-articular loose bodies, and all were found to have chondral injuries and labral tears. These findings are in keeping with our results identifying considerable intra-articular pathologic conditions. In particular, labral tears and loose bodies were common findings when the arthroscope was introduced into a post-traumatic hip. Although most other studies focused on intra-articular pathologic findings solely after hip dislocations, our data suggest that intra-articular injuries are not limited to hip dislocations only but can be associated with proximal femur fractures, pelvic ring fractures, acetabular fractures, and even soft tissue injuries not associated with a fracture. Early identification and treatment of these pathologic disorders may prevent subsequent development of early post-traumatic osteoarthritis. In one study, a traumatic arthritis prevalence rate of 24% was reported in patients 5 years after injury. This rate was seen in patients who experienced a simple hip dislocation without an associated fracture. The prevalence rate rose as high as 54% when more complex injuries, such as fracture-dislocations, were included.

A recent retrospective study by Mullis et al. reported that loose bodies were found by arthroscopy in 7 of 9 cases in which standard radiographs and CT scans found no evidence of loose bodies preoperatively.
Similarly, in a case series by Yamamoto et al. in 2003, in a series of 11 hips that had undergone trauma, 7 hips had findings of loose chondral or osteochondral fragments by arthroscopy that were not seen on preoperative imaging. Similarly, our study suggests that with respect to loose bodies and joint incongruencies, plain radiographs and CT scans appear to underestimate the true incidence of these pathologic findings, with resultant low sensitivity and NPV. Possible reasons for CT and radiographic underestimation of these pathologic conditions may include the small size of the step deformity or loose body. In fact, reports suggest that plain radiographs are limited to visualization of fragments greater than 4 mm, whereas the detection limits for a CT scan in the hip are fragments greater than 2 mm. Yet, it is unknown what size fragment can lead to clinical symptoms. Other possible reasons we propose for lack of detection by CT scans and radiographs include the chondral nature of the loose bodies or overlying hardware placed during fixation of the fracture subsequently obstructing an adequate view on imaging.

Our study was one of the first to compare MRI and MRA with arthroscopic findings. Although small numbers prevented a robust statistical analysis of the results, some interesting trends were observed and warrant further discussion. Chiefly, MRI and MRA identified labral tears in all but one hip that subsequently had a tear identified by arthroscopy. This suggests MRI/MRA is a useful tool if a labral tear is suspected after a traumatic hip injury. However, MRI/MRA failed to identify osteochondral lesions in 4 hips that were subsequently found to have osteochondral lesions by arthroscopy. Again, small numbers prohibited assessment of this finding for statistical significance but raised an interesting discussion point that perhaps MRI/MRA underestimates the incidence of osteochondral lesions. Possible explanations for this finding may again be related to the small size of the osteochondral fragment so that it is identifiable by the eye with the assistance of arthroscopic magnification but may be smaller than the resolution needed for detection on MRI/MRA.

The musculoskeletal radiologist reviewing the imaging reported no difficulty in assessing intra-articular pathologic disorders in the setting of MRI for patients who experienced hip trauma and had undergone previous ORIF. Eight of the patients with traumatic hip injury required ORIF, 3 of whom later required MRI after ORIF. All 3 of these patients had proximal femur fractures and their constructs consisted of either a dynamic hip screw or cephalomedullary nail. Some metal artifact was of course present on MRI; however, the hardware did not cross the joint line, and thus the assessment of the intra-articular aspect of the hip by MRI was relatively unaffected.

Limitations

Limitations of this study include single-surgeon data and lack of homogeneity with respect to the preoperative imaging modalities. However, we believe the strength of this study lies in the fact that it was a prospective study. Furthermore, the study is enhanced by the use of a blinded musculoskeletal radiologist to quantify pathologic findings from the imaging and the use of a blinded reviewer to quantify intraoperative pathologic findings. Finally, the study is one of only a few to assess MRI/MRA findings compared with arthroscopic findings in the hip after traumatic injury.

Conclusions

Traumatic injuries of the hip result in substantial intra-articular pathologic findings, including loose bodies, labral tears, step deformities, and osteochondral lesions. The arthroscope is a powerful tool in identifying these injuries. Plain radiographs and CT scans appear to underestimate the true incidence of loose bodies and step deformities within the joint when compared with hip arthroscopy after a traumatic injury of the hip.

References


**ARTHROSCOPY TECHNIQUES**

Have you submitted your new Tech Note and Video? What’s holding you back? Share your interesting new discovery with your colleagues!

Submit at [http://ees.elsevier.com/arth/](http://ees.elsevier.com/arth/)