

CT Findings of Traumatic Posterior Hip Dislocation after Reduction¹

Sung Kyoung Moon, M.D., Ji Seon Park, M.D., Wook Jin, M.D.², Kyung Nam Ryu, M.D.

Purpose: To evaluate the CT images of reduced hips after posterior hip dislocation and to propose specific diagnostic criteria based on the CT results.

Materials and Methods: We retrospectively reviewed the CT findings on 18 reduced hips from 17 patients with radiographs and clinical histories of traumatic posterior hip dislocations by evaluating 18 corresponding CT scans for joint space asymmetry, intra-articular abnormalities (intra-articular fat obliteration, loose bodies, and joint effusion), changes in posterior soft tissue (capsule, muscles, and adjacent fat), the presence, and location of fractures (acetabulum and femoral head).

Results: All 18 hips (100%) showed posterior soft tissue changes. In total, 17 hips (94.4%) had intra-articular abnormalities and 15 hips (83.3%) had joint space asymmetries. In addition, 17 hips (94.4%) had fractures involving the acetabula (15 cases, 88.2%), the femoral head (13 cases, 76.5%), or on both sides (11 cases, 64.7%). The most frequent fracture location was in the posterior wall (13/15, 86.7%) of the acetabulum and in the anterior aspect (10/13, 76.9%) of the femoral head.

Conclusion: Patients with a prior history of posterior hip dislocation showed specific CT findings after reduction, suggesting the possibility of previous posterior hip dislocations in patients.

Index words : Hip, dislocation
Computed tomography (CT)
Soft tissue injury

Posterior hip dislocations commonly result from traumatic events such as traffic accidents and sports injuries (1). An immediate diagnosis of this injury can be made before reduction through both physical examination and

a plain radiography. The radiological diagnosis of a posterior hip dislocation after reduction can be difficult, particularly if there is no clinical information. Further, long intervals between dislocation and the imaging study can make diagnosis even more difficult. A closed reduction for the treatment of a posterior hip dislocation sometimes has no remarkable findings under a plain radiography, even though the reduction was inappropriate. This misdiagnosis may result in improper treatment and significant clinical sequelae.

The computed tomography (CT) is regarded as the best imaging modality for detecting fractures associated

¹Department of Diagnostic Radiology, KyungHee University Medical Center

²Department of Diagnostic Radiology, KyungHee East-West Neomedical Center

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Address reprint requests to : Ji Seon Park, M.D., Department of Diagnostic Radiology, Kyung Hee University Hospital, 1, Heokidong Dongdaemun-gu, Seoul 130-702, Korea

Tel. 82-2-958-8623 Fax. 82-2-968-0787 E-mail: gdluck@hitel.net

with posterior hip dislocation and has advantages over the plain radiography because of its ability to precisely evaluate any accompanying soft tissue changes. Many previous studies have described results from the imaging of posterior hip dislocations after reduction and associated complications such as fractures, muscle injuries, joint effusions, and hemarthrosis (2 - 11). These findings highlight the possibility of a prior posterior hip dislocation. Few of these previous studies have documented the diagnostic criteria for a posterior hip dislocation after reduction based on the CT findings and their prevalence. Such diagnostic criteria may be possible for posterior hip dislocations, which are analogous to the Bankart and Hill-Sachs lesions of anterior shoulder dislocations.

Thus, our study evaluated the CT findings of patients with posterior hip dislocations after reduction and determined which findings could be indicators for a posterior hip dislocation diagnosis after reduction.

Materials and Methods

CT scans were performed from May 2002 to April 2006 on 18 hips belonging to 17 patients with radiological evidence and a clinical history of a posterior hip dislocation. Of the 17 patients studied (12 men, 5 women, 15 - 69 years old, mean age: 41.3 years), 16 had unilateral posterior hip dislocations, whereas one had a bilateral hip dislocation. All patients were treated with closed reductions (13 hips) or surgical correction (5 hips) after posterior hip dislocation. The time intervals between trauma and CT examination ranged from within 24 hours to 720 days, with a mean time interval of 108.3 days. The CT scans of 16 hips were performed within 52 days of the trauma (time interval range: 0 - 52 days, mean time interval: 9.3 days), whereas two others were performed on days 207 and 720 after trauma, respectively. Informed consent was not required because of the retrospective study design.

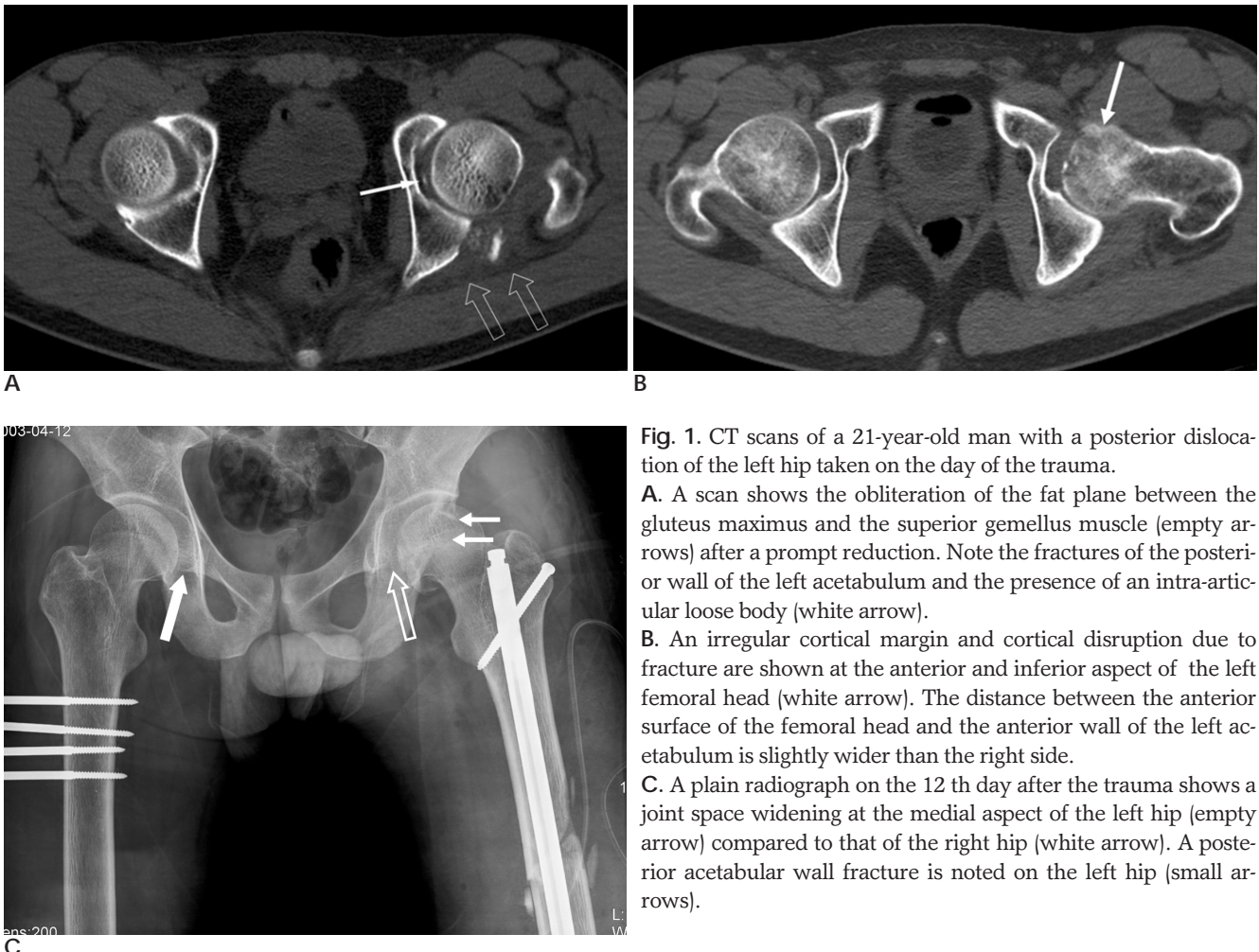


Fig. 1. CT scans of a 21-year-old man with a posterior dislocation of the left hip taken on the day of the trauma.

A. A scan shows the obliteration of the fat plane between the gluteus maximus and the superior gemellus muscle (empty arrows) after a prompt reduction. Note the fractures of the posterior wall of the left acetabulum and the presence of an intra-articular loose body (white arrow).

B. An irregular cortical margin and cortical disruption due to fracture are shown at the anterior and inferior aspect of the left femoral head (white arrow). The distance between the anterior surface of the femoral head and the anterior wall of the left acetabulum is slightly wider than the right side.

C. A plain radiograph on the 12 th day after the trauma shows a joint space widening at the medial aspect of the left hip (empty arrow) compared to that of the right hip (white arrow). A posterior acetabular wall fracture is noted on the left hip (small arrows).

Twelve hip CT scans (Siemens Somatom Plus 4 and GE Light Speed Ultra 16) were performed at the KyungHee University Medical Center in Seoul, Korea. The section thicknesses ranged between 2 - 5 mm and were taken at 5 mm intervals using a bone algorithm. Six CT scans were performed at outside institutes by means of various CT protocols. The coronal and sagittal reformatted images were produced from nine CT scans.

Next, two experienced musculoskeletal radiologists retrospectively reviewed the CT images and formed a consensus on which patients had posterior soft tissue changes, intra-articular abnormalities, joint space asymmetry, and fractures. Posterior soft tissue changes were identified by the sagging or tearing of the joint capsule, obliteration of posterior fat from the deep fascial plane, or swelling of the posterior muscles. Intra-articular abnormalities were identified with the presence of loose bodies, intra-articular fat obliteration, joint effusions, hemarthrosis (high attenuation fluid within the joint space) or lipohemarthrosis (fat-fluid level of joint fluid within the joint space). Further, joint space asymmetry was defined as an asymmetric width between the cortical surface of the femoral head and the acetabular margin of the axial, coronal, or sagittal images. We also evaluated the presence and location of the fractures.

Results

All 18 hips (18/18, 100%) showed posterior soft tissue changes (Fig. 1A and 2A). Of these, 16 had initial CT examinations within 52 days after trauma and showed

muscle swelling as well as fat plane obliteration of the deep fascia. The two other hips with relatively delayed CT examinations (on days 207 and 720 after trauma) showed similar findings, except that the patients exhibited muscle atrophy instead of muscle swelling (Fig. 3). Capsular tears were not definitely identified on CT scans, but capsular sagging was observed (Fig. 2B).

Seventeen hips (17/18, 94.4%) had intra-articular abnormalities (Fig. 1A and 3B), whereas loose bodies or bone fragments were found in 6 of the hip joints. Three hip joints were expanded by joint effusion, whereas one hip joint was expanded by hemarthrosis. Of these, no signs of observed lipohemarthrosis were identified. Seventeen hips showed evidence of intra-articular fat obliteration.

Fifteen hips (15/18, 83.3%) had joint space asymmetries (Fig. 1C and 3). The asymmetry width was usually widened between the anterior margin of the acetabulum and the femoral head, or between the acetabular roof and the superior margin of the femoral head. The femoral heads had a tendency to be slightly subluxated toward the posterior and lateral directions. To detect joint asymmetries, coronal and sagittal images were more feasible than axial images (Fig. 3C).

Of the seventeen hips with fractures (17/18, 94.4%), 15 involved the acetabula (15/17, 88.2%), 13 involved the femoral heads (13/17, 76.5%), and 11 had fractures on both sides (11/17, 64.7%, Fig. 1 and 2A). The acetabular fractures were most frequently located in the posterior wall (12/15, 80.0%, Fig. 1A) and included 11 posterior wall as well as three posterior wall with a superior and

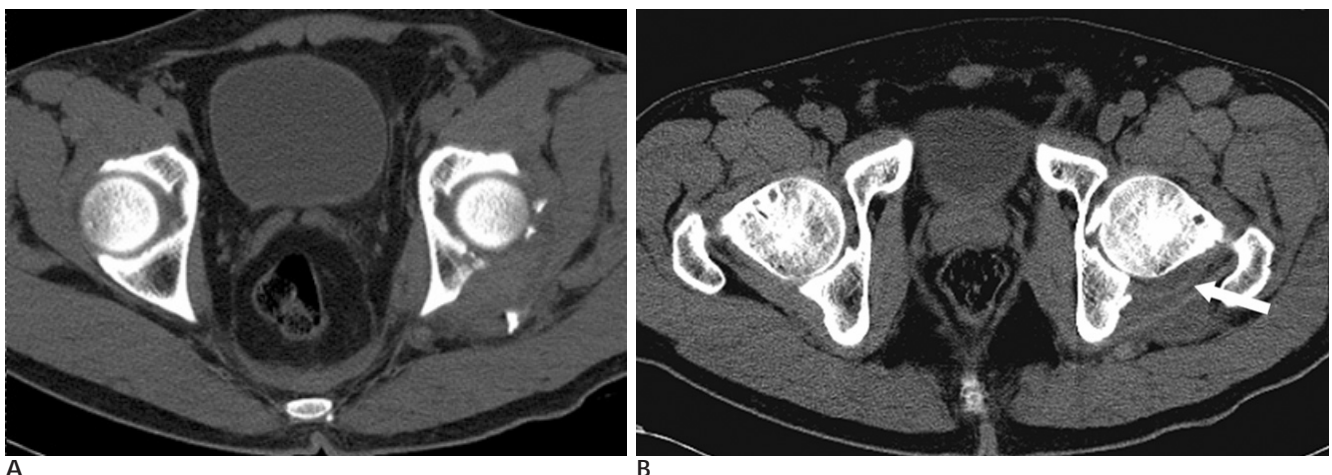


Fig. 2. CT scan of a 52-year-old man with a left hip dislocation .

A. A CT scan at the upper level of the hip joint shows the posterior soft tissue swelling and a fracture of the posterior wall of the left acetabulum. Note the bone fragments around the hip joints and within the joint space (B).

B. A CT scan at a much lower level of the left hip joint shows joint effusion with joint capsular distension and posterior sagging (white arrow) on the 4th day after trauma.



Fig. 3. Hip images of a 15-year-old male with a posterior dislocation of the right hip (207 days ago).

A. A plane radiography shows the complications of avascular necrosis and secondary osteoarthritis of the affected hip. The medial aspect of the right hip is wider than that of the right side (empty arrow). When compared to the left side, the soft tissue of the right thigh is more atrophied along with bone density is more decreased.

B. An axial CT scan shows a bone fragment in the joint space as well as the obliteration of the intra-articular fat. The presence of joint space in the right medial aspect is widened compared with the left hip. Avascular necrosis of the right femoral head is also shown (empty arrow). The ipsilateral obturator internus tendon (small arrows) and muscle (white arrow) are also slightly atrophied.

C. The coronal reformatted image shows joint space widening (empty and white arrows), bone fragments in the joint space of the right hip (empty arrow), and avascular necrosis (small empty arrow) of the affected hip and corresponding femoral head.

medial portion of the acetabula. Other locations included the anterior wall (1 case, 6.7%), central aspect of acetabulum (1 case, 6.7%), and both the anterior and posterior wall (1 case, 6.7%). Femoral head fractures were most frequently located at the anterior aspect (10/13 hips, 76.9%, Fig. 1B). Among them, six femoral head fractures were accompanied with the medial aspect of the femoral head. Other locations (3/13 hips, 23.1%) included the medial (2 cases, 15.4%) and superior aspects (1 case, 7.7%). No observations were made about the fracture at the posterior aspect of the femoral head. A total of 11 hips (11/17, 64.7%) had fractures of both the acetabula and the femoral heads. The most frequent combination of fracture locations in both areas was the posterior columns of the acetabula and the anterior aspect of the femoral heads (7 hips, 7/11, 63.6%, Fig. 1). Among the 11 hips with fractures in both sides, posterior wall

fractures of the acetabulum were identified in nine hips (9/11 hips, 81.8%). Eight hips (8/11, 72.7%) had anterior femoral head fractures.

Discussion

A posterior hip dislocation is the most common type of the hip dislocation and most often results from different kinds of traumatic injuries (1). These injuries are often orthopedic emergencies requiring an urgent reduction. Sometimes, the posterior hip dislocations are accompanied by fractures of the femoral head, femoral shaft, pelvic bone, as well as various soft tissue abnormalities (2 - 10). A few possible delayed complications are posttraumatic osteoarthritis, avascular necrosis, myositis ossificans, and sciatic neuropathy (2 - 13). Radiological assessment, using a plain radiograph, CT,

or MR of the reduced hip, followed by posterior dislocation is necessary to detect both of the associated injuries at an early stage and the complications correlated with the patient's symptoms at the delayed stage.

Previous reports have described some radiological findings associated with posterior hip dislocations. The anterior cortical fractures and osteochondral impaction of the femoral heads (1, 3, 4), acetabular fractures (5), iliofemoral ligament injuries, muscle injuries involving the gluteal region (2, 6), joint effusions, or hemarthrosis can be demonstrated in posterior hip dislocations (2).

Our study revealed a very high frequency in four CT findings. These four specific findings were posterior soft tissue changes, intra-articular abnormalities, joint space asymmetries, and fractures specific to the femoral heads and acetabulae. Posterior soft tissue abnormalities were shown in all of the hips, even three years later. In addition, CT scans showed posterior muscle swelling followed by atrophy and fat obliteration of the deep fascial plane.

A previous study by Laorr on the early findings of traumatic hip dislocation showed that posterior hip dislocations are more frequently accompanied by the posterior muscle injuries than anterior hip dislocations (2). Half of the patients in the study by Laorr (1995) had a moderate degree of injury in the posterior muscles group. In our study, all of the hips also showed posterior soft tissue changes in the muscle injury including the piriformis, obturator internus, gluteal muscles, as well as the obliteration of the adjacent fat plane around the hip joint. Sixteen hips experienced muscle swelling during the early stages following trauma, as opposed to two hips that had long time intervals between trauma and imaging showed posterior muscle atrophy instead of muscle swelling. Muscular atrophy in the delayed stage develops at the surrounding muscles of the affected hip, including the posterior muscles, and most likely results from a limited range of motion.

The detection of capsular tears and sciatic nerve injuries are limited to the CT scan. The MRI is more sensitive at detecting capsular and sciatic nerve injuries (2, 5, 7).

The obliteration of intra-articular fat results from joint effusion, hemorrhaging, or soft tissue interpositions such as in the acetabular labrum, capsule, or ligaments. Our study indicates that CT scans are more useful than the plain radiography for detecting the intra-articular abnormalities.

We found that the joint space asymmetries are related

to intra-articular abnormalities, hip joint capsule laxity resulting from the surrounding soft tissue injury, and bony deficiency in the femoral head resulting from fractures (Fig. 1 and 3). The results of the initial CT scan taken 11 days after the trauma indicated that one hip in our study did not have joint asymmetry, but revealed joint space widening in a follow-up CT scan that was taken 288 days after the trauma. We also found that coronal reformatted images were more useful in assessing joint asymmetry than axial images (Fig. 3C).

The fracture-dislocation of hip joints is a common CT finding in patients with posterior hip dislocations. CT scans are the most accurate diagnostic method for demonstrating the location of fractures and small bony fragments in the joint space (especially in the medial aspect) (3). In previous studies, the most frequent location of fractures was in the anterior aspect of the femoral heads and in the posterior walls of the acetabula (3, 4). Our study results are consistent with these previous studies. The coronal and sagittal reformatted CT images were superior to the CT scans with only axial images having the ability to demonstrate the accurate location of fractures or precise joint space asymmetries.

Our study had several limitations. First, the sample size was small. However, the four CT findings that were discussed above were seen in most of our cases. Therefore, we think that these findings could be representative CT features for posterior hip dislocations after reduction. Second, the CT protocol varied due to the retrospective nature of this study where the films were obtained from other institutes. Some of the CT scans with the coronal and sagittal reformatted images were more useful in their corresponding image analyses. For example, an MDCT can show the accurate location of the fractures and joint space asymmetries (8).

In conclusion, the previous posterior hip dislocation has four characteristic footprints in CT examinations, even after reduction. The four specific findings are posterior soft tissue changes, intra-articular abnormalities, joint space asymmetries, and specific fracture sites of femoral heads and acetabula. These findings can remain on CT scans taken during long-term follow-up. An observation of the four CT findings described above may strongly suggest the possibility of a previous posterior hip dislocation.

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15	(83.3%)	17 (94.4%)
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	(13/15, 86.7%)	(10/13, 76.9%)
CT	가	가