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Case Report

Avascular Necrosis of the Femoral Head After Recurrent Traumatic Posterior Hip Dislocation in a 10-Year-Old Girl: A Case Report and Review of Literature

Raymond Massaad, MD[1], Said El Orra, MD[2], Dounia Massaad, MD[3], Antonella Massaad, MD[3], Monah Orra, MD[4]

[1] Department of Orthopedic Surgery, West Bekaa General Hospital, Sohmor, Lebanon
[2] Department of Orthopedic Surgery, Beirut Arab University, Beirut, Lebanon
[3] Department of Orthopedic Surgery, Carol Davila University, Bucharest, Romania
[4] Department of Pediatrics, Makassed General Hospital, Beirut, Lebanon

Corresponding Author: Said El Orra, Beirut, Lebanon, saidelorra@gmail.com

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Abstract

Background: Traumatic hip dislocation (THD) is a rare pathology in the pediatric population. The severity of the trauma, mismanagement, or late treatment of such pathology can lead to complications, including avascular necrosis (AVN) of the femoral head. We hereby report a case of recurrent traumatic posterior hip dislocation that eventually lead to AVN of the femoral head in a 10-year-old girl.

Case presentation: A 10-year-old girl presented to the Emergency Department complaining of left hip pain one day following a fall from a standing position. On physical examination, the left hip was held in the position of flexion, adduction, and internal rotation, with complete loss of range of motion of the left hip joint. Radiographic imaging was done and showed: a posterior dislocation of the left hip, enlargement of the growth cartilage of the left femoral epiphysis, hypertransparency of the anterosuperior corner of the left femoral neck, and increased bone density of the upper left femoral epiphysis, suggesting previous hip dislocations. Open reduction with arthrotomy and posterior capsulorrhaphy was performed 36 hours post-injury, followed by hip immobilization by a spica cast. Two months after surgery, the cast was removed. On examination, the left hip was stable with good mobility, and weight-bearing was authorized. Follow-up was done three months post-injury. The patient had no complaints, but radiographic images showed signs of avascular necrosis (AVN) on the left femoral head.

Conclusion:. Our case emphasizes the importance of early diagnosis and management of a THD in pediatrics, to prevent serious complications such as AVN.

Keywords: Hip dislocation, Traumatic, Pediatric, Avascular Necrosis, Recurrent, Case Report

Introduction

Traumatic Hip Dislocation (THD) in children is rare, accounting for less than 6% of all traumatic injuries in the pediatric population, with the predominance of the posterior-type dislocation (87% of all hip dislocations) [1, 2]. According to studies, THD is more common in males, probably because males are more prone to trauma than females [3].

THD should be immediately managed by a closed reduction. However, a closed reduction is not always possible, usually when associated with a soft tissue interposition or femoral fracture. In such cases, an open reduction is indicated [3]. One of the important long-term complications following THD is avascular necrosis AVN of the femoral head [1]. Several factors are thought to be involved in the development of such complications, such as the severity of the injury, delayed reduction, the association of fractures around the hip joint, and open reduction procedure [4].

We hereby report a case of recurrent traumatic posterior hip dislocation complicated into AVN of the femoral head in a 10-year-old girl.

Case Presentation

A 10-year-old girl, not known for any past medical or surgical history, presented to the Emergency Department complaining of left hip pain one day following a fall from a standing position. Patient reports tripping while running resulting in a fall that landed on both knees. As per the patient's parents, the girl had a similar fall multiple times (unspecified number of falls) over a two-months duration that resulted in transient pain and functional impairment of the left hip joint. However, the patient didn't seek medical attention at the time due to financial reasons but recovered eventually. The pain was progressive, deep, of moderate intensity, located in the left hip region, and non-radiating. On physical examination, the patient was stable and afebrile. She was unable to ambulate, and her left hip was fixed in the position of flexion, adduction, and internal rotation (Figure 1), with a complete loss of range of motion. Femoral pulses were palpable. The rest of the examination was unremarkable.

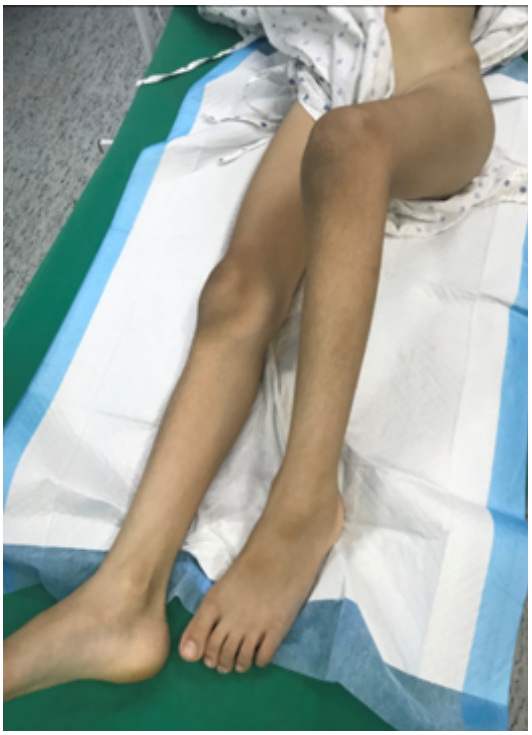

Figure 1: Picture showing patient's position at presentation. Note the left hip fixed in the position of flexion, adduction, and internal rotation.

Radiographic imaging was done and showed: a pure posterior dislocation of the left hip, with no signs of dysplasia of the acetabulum (Figure 2), enlargement of the growth cartilage of the left femoral epiphysis (Figure 3), hypertransparency of the anterosuperior corner of the left femoral neck, and increased bone density of the upper left femoral epiphysis (Figure 4), suggesting previous hip dislocation. No loose bodies were noted.

Figure 2: Anteroposterior pelvis radiograph, showing a posterior dislocation of the left hip.

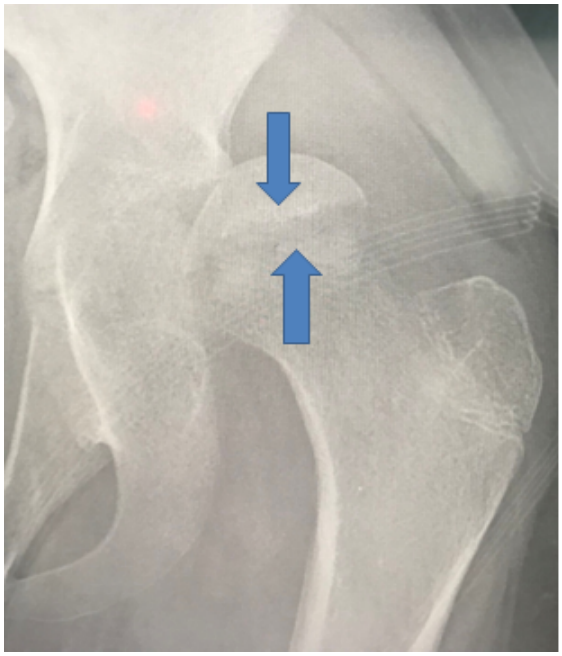

Figure 3: Anteroposterior radiograph of the left hip, showing the enlargement of growth cartilage of the left upper femoral epiphysis (arrow).

Figure 4: Anteroposterior radiograph of the left hip, showing Hypertransparency of the antero-superior corner of the neck femoral, and increased bone density of the upper femoral epiphysis (arrow).

36 hours post-injury, and after failing to perform a closed reduction of the hip by Allis maneuver, we opted for an open reduction with arthrotomy and posterior capsulorrhaphy. Lesion assessment showed the anterosuperior and external part of the femoral epiphysis completely stripped of its cartilage (Figure 5), as well as an erosion with the detachment of the cartilage from the superior external part of the femoral metaphysis (Figure 6).

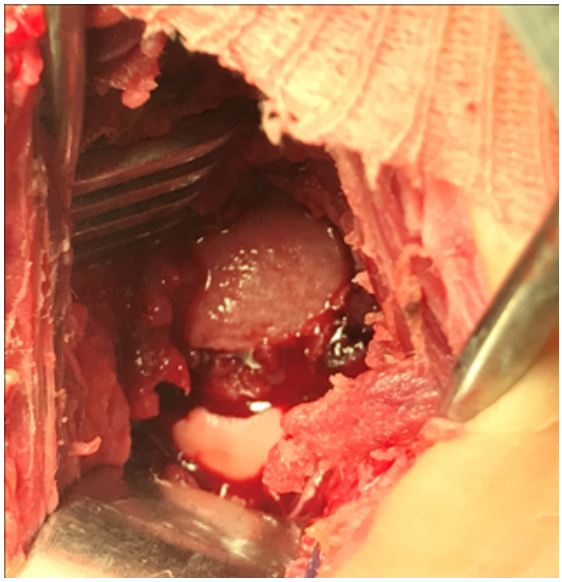

Figure 5: Gross picture taken intraoperatively, showing the antero-superior and external part of the femoral epiphysis is completely stripped of its cartilage.

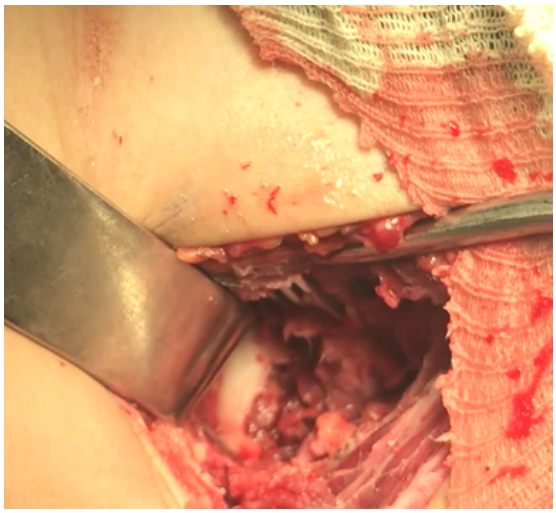

Figure 6: Gross picture taken intraoperatively, showing an erosion with detachment of the cartilage from the superior external part of the femoral metaphysis.

The acetabular cavity was filled with hard consistency fibrocartilaginous tissue suggesting the oldness of the lesion (Figure 7). After clearing the joint from the fibrocartilagenous tissue and reducing the hip, we noticed an instability of the hip in the neutral position. After a successful surgery, the hip was immobilized in the position of flexion, abduction, and slight internal rotation by a hip spica cast (Figure 8).

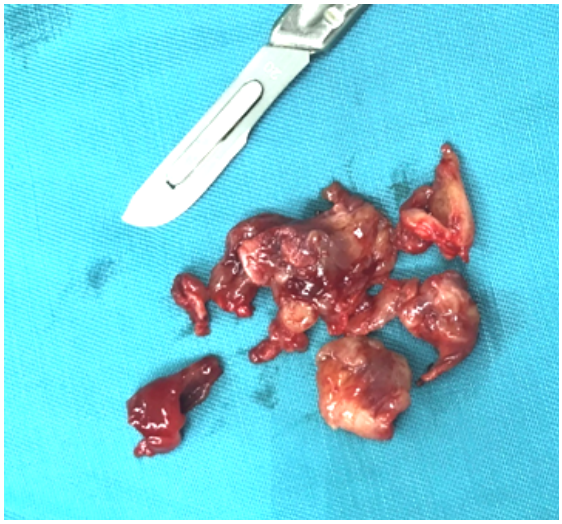

Figure 7: Gross picture taken after evacuating the acetabular cavity, showing the hard consistency fibrocartilaginous tissues.

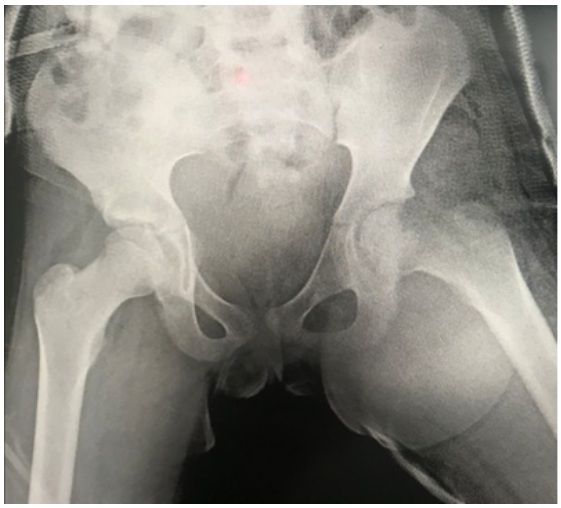

Figure 8: Anteroposterior radiograph of the pelvis post-operative, showing a good reduction of the left hip.

Two months after surgery, the cast was removed. On examination, the left hip was stable and showed good mobility. Weight-bearing was authorized. Follow-up was done three months post-injury, and the patient was clinically good and had no complaints, but radiographic imaging showed signs of AVN of the left femoral head (Figure 9 and 10). A follow-up was scheduled after three months for observation.

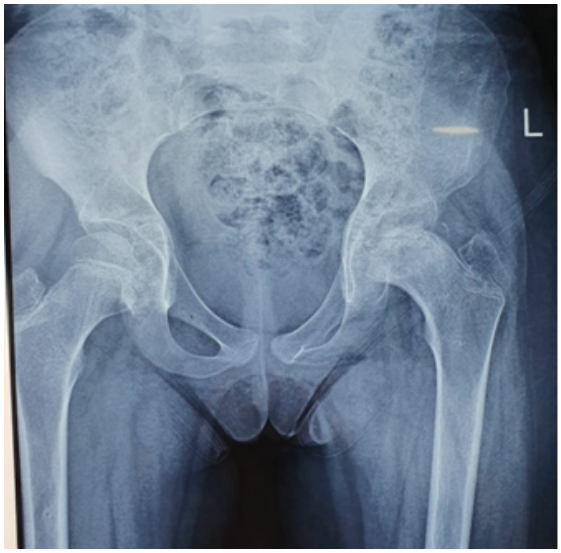

Figure 9: Anteroposterior radiograph of the pelvis three months after surgery, showing signs avascular necrosis of the left femoral head.

Figure 10: Close-up of figure 9, showing signs avascular necrosis of the left femoral head.

Discussion

THD in the pediatric population is 25 times less common than in adults, occurring in 3 of 1824 hip dislocations, with the predominance of the posterior-type dislocation [2,5]. Hip dislocations can be classified according to the Thompson-Epstein classification (Table 1) [6].

Table 1: Thompson-Epstein Classification of Hip Dislocations

Type I	Dislocation with or without a minor fracture
Type II	Dislocation with a single large fracture of the posterior acetabular rim
Type III	Dislocation with a comminuted fracture of the acetabular rim with or without a major fracture
Type IV	Dislocation with a fracture of the acetabular floor
Type V	Dislocation with a femoral head fracture

In terms of mechanism, most dislocations are caused by low-energy trauma. The reason behind that is that younger children have a generalized joint laxity, flexible cartilage, and soft acetabulum [5]. In children less than six years old, dislocations are usually due to a low-energy trauma, such as slipping on a wet floor. In those between 6-10 years old, it is mostly due to a fall from great heights and athletic injuries. In older children (more than ten years), the cause is related to motor vehicle accidents [7]. Our case was due to a low-energy trauma on a ten-year-old resulting from a simple fall while running. In posterior dislocations, the patient presents with a shortened leg held in the position of flexion, adduction, and internal rotation. A protrusion of the greater trochanter may be visible as well. Whereas in anterior dislocations, the patient presents with the affected leg held in the position of extension, abduction, and external rotation [8]. After a careful neurovascular examination, radiographic imaging should be carried out before proceeding with the reduction procedure [9]. However, a computerized tomography (CT) scan is performed in some cases. It is mainly indicated in cases of hip instability on physical examination after an initial closed reduction attempt, joint asymmetry of 3 mm or more, and presence of ipsilateral periarticular fracture on radiographic imaging [10]. Every case of THD should be managed immediately by closed reduction, ideally by the Allis method, with monitoring of the maneuver by radiographic imaging [3].

Multiple reduction attempts are not recommended, and when delayed by more than four weeks post-injury, it is less likely to be successful [6,11]. When closed reduction is not possible or when associated with a femoral fracture or soft tissue interposition, open reduction should be attempted instead [3]. Irreducibility usually occurs due to interposing tissue in the hip joint. In a retrospective study on children that underwent arthroscopy post-THD, most pathologies identified were the avulsion of a bony fragment attached to the posterior capsular labral soft-tissue complex, osteochondral fragments, and an avulsed ligamentum teres. These tissues became enfolded and blocked reduction [12]. Although a CT scan is indicated in such cases, tissue interposition may be evident on plain films by a hip asymmetry of 3 mm [9]. Post-reduction radiographic imaging is essential to ensure the proper reduction of the hip. A CT scan may still be needed in case the reduction is still doubtful [13]. After a successful reduction, skin traction, cast immobilization, or bed rest is recommended [3]. The duration of non-weight-bearing is still not clear. Glass et *al.* recommend a non-weight-bearing period of 4-6 weeks, while Funk recommends a period of at least one month in children less than six years, and 3-4 months in children more than six [14,15]. According to Brav, follow-up must be done every three months for two years, and then yearly for three more years [16]. Complications post-THD include osteoarthritis, coxa magna, periarticular ossification, sciatic nerve injury, and AVN.

Redislocation is also an important complication, occurring at a rate of about 6% [1]. Some authors previously mentioned possible causes of redislocation. Aufranc reported capsular defect as a common finding during his surgeries, while Liebenberg and Dommisse suggested that inadequate immobilization and early ambulation could be a predisposing factors [17,18]. In general, causes of recurrent dislocation include a capsular tear resembling a relaxed or herniated capsule, a relaxed capsule without a tear, or a relaxed capsule that represented a previously healed tear [19]. In such cases, arthrography is recommended within 24 hours post-injury [8]. Simmons et *al.* even highlighted that arthrography after an initial dislocation may be useful in predicting which hip is liable to redislocation [19]. Surgical repair for capsular defects is recommended for recurrent dislocations, with post-operative spica immobilization in the position of extension, abduction, and external rotation for 4-6 weeks [19]. Surgical options include bone block type surgeries and capsular plication [20]. Wilchinsky revealed that non-surgical treatment of redislocation by closed reduction and immobilization can lead to good outcomes as well [21]. In our case, the pre-reduction radiological lesions described, the severity of the osteocartilaginous lesions of the femoral head noticed during surgery, the filling of the articular cavity with hard tissue of fibrocartilaginous nature, the instability of the hip after reduction in a neutral position, in addition to the history of similar multiple falls over two months without seeking medical treatment, all these elements together confirm for us the recurrent nature of the dislocation.

Another important long-term complication mentioned is AVN. The incidence of post-THD AVN in children is around 3-15%, and if associated with epiphysiolysis this incidence may increase to almost 100% [9]. The presence of physis in children prevents the blood flow between the epiphysis and metaphysis, and the cervical arteries become the only blood supply to the capital femoral epiphysis. Thus, it is expected to have a higher incidence of AVN in children as compared to adults [5].
Shim explained the vascular implication following a THD through an experiment conducted on dog and rabbit models; the extraosseous vessels affected were the extraosseous branches of the femoral circumflex arteries and their extraosseous branches of the epiphyseal and metaphyseal arteries, and the retinacular artery of the circulus vasculosus articularis. The extraosseous vessel injury of the hip eventually leads to intraosseous circulation insufficiency [22]. The interval by which AVN may become evident on plain films is 2 to 12 months and even reaching two years post-injury. MRI has the ability to detect marrow changes at around six weeks post-injury [5]. Meyers et *al.* stated that conducting a bone scan after a dislocation can detect ischemia in the initial stages and thus has diagnostic and prognostic importance [23]. Changes in the femoral head caused by AVN post-THD in children <12 years old are the same as those seen with Legg-Calvé-Perthes disease [9].

Several factors were thought to influence the development of AVN: severity of the injury, delayed reduction, an association of fractures around the hip joint, and open reduction [4]. According to Mehlman et *al.*, patients who had their reduction delayed by less than six hours had 20 times higher risk of developing AVN, compared with patients who had their reduction performed under six hours [10]. The vascular injury includes an irreversible type by which there is a tear of a small number of vessels along with the ruptured capsule and teres ligament, as well as a reversible type by which there is a compression and spasm of the majority of undamaged vessels, all of which can be reversed with early reduction. In cases of prolonged dislocation, circulatory insufficiency is aggravated by additional pathological changes such as inflammation, fibrosis, thrombosis, and fixed deformity. All contribute to eventual ischemic necrosis of the femoral head. Hence, an early reduction is important for restoring the normal circulation of the femoral head [22]. In our

case, we believe that many factors contributed to the development of AVN: the previous dislocations that were left without any medical treatment, the delay in reduction more than 36 hours post-injury, and the open reduction approach.

The management of AVN in children varies according to age. In children less than 12 years, the treatment of AVN is the same as in Legg-Calvé-Perthes (activity restriction, physiotherapy, others), and those usually have a better prognosis than older children. In older children, management is more difficult. Some of the treatment methods before femoral head collapse include containment, vascular fibula graft, core decompression, and distraction arthroplasty. New treatment methods are emerging for the management of AVN associated with femoral head collapse, including arthrodesis of the hip and resurfacing arthroplasty [9]. A period of non-weight-bearing showed to influence the prognosis of AVN. Kim et *al.* examined piglet models of the femoral head after inducing AVN. They concluded that the set of femoral heads in the non-weight-bearing group had a lesser degree of deformity as compared to the weight-bearing group. In addition, the revascularization process was more rapid in the non-weight-bearing group as compared to the weight-bearing group, indicating the benefits of the non-weight-bearing regimen in patients suffering from AVN [24]. Allowing weight-bearing within 6 weeks leads to mechanical stress on the femoral head during its revascularization process that may eventually cause its premature breakdown and collapse [25]. It is known that the prognosis of AVN post-THD is generally poor [9]. However, the prognosis of AVN in children may be better than that in adults; the damage to the femoral head caused by an AVN can be restored with the help of the growth plate cartilage present in the immature skeleton. However, this is not the case in mature patients with thin growth cartilage [26].

Conclusion

THD is rare in the pediatric population. A prompt diagnosis and management is the key to dealing with such patients, as well as a periodic follow-up to look out for serious long-term complications, such as AVN.

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