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## Case Report

## Surgical treatment of a traumatic open anterior hip dislocation in a child: A case report and review of 13 cases in the literature

Özgür Mert Bakan<sup>a,\*</sup>, Ali Engin Dastan<sup>b</sup>, Kadir Yagmuroglu<sup>a</sup>, Kemal Aktuglu<sup>a</sup><sup>a</sup> Ege University Faculty of Medicine Department of Orthopaedics and Traumatology, Izmir, Turkey<sup>b</sup> Kusadasi State Hospital Orthopaedics and Traumatology Department, Aydin, Turkey

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## ABSTRACT

Due to the high probability of infection and avascular necrosis, traumatic open anterior hip dislocation poses a serious orthopedic emergency. Despite the emergency of the issue, it appears to be an under-researched topic in the literature. In this study, we present open anterior hip dislocation with both trochanteric fractures in a child and review other pediatric cases from the literature. Because of rareness, there is no standard surgical and postoperative treatment algorithm. We discussed the mechanism of injury, wound size, time of the reduction, associated injury, type of treatment, type of immobilization, clinical and functional results to present a collective perspective on the literature. Once we have compared all of these situations, dealing with infection is key to satisfactory clinical and functional outcomes. The early reduction was the most important point in both coping with infection and preserving avascular necrosis of the femoral head.

## Introduction

The hip joint is fairly stable due to its static and dynamic stabilizers between the femoral head and the acetabulum [1]. Traumatic hip dislocations constitute approximately 5% of all pediatric joint dislocations [1,2]. There are three types of hip dislocations, i.e. posterior, anterior, and central [2]. Posterior dislocations account for 90% of all cases [1,2]. Although pediatric traumatic anterior hip dislocation is observed in 10% of cases, open ones within this 10% constitute an even more extremely rare group of cases [10,14]. While the literature often consists of case reports, this study aims to present a case report with a comprehensive review of the already existing literature [3–15].

In this study, we aim to present a traumatic open anterior hip dislocation which, unlike conventional cases, had both trochanter major and minor fracture; our treatment method and the problems we encountered during the one year of follow-up. Moreover, this article also reviews other pediatric cases with open hip dislocation in the literature.

## Case report

A 9-year-old boy was hospitalized in the Trauma Department of the Emergency Service of the Ege University Hospital with a protruded left femoral head standing on his scrotum from an inguinal wound after a traffic accident. The patient was admitted to the

\* Corresponding author.

E-mail address: [ozgurmertbakan@gmail.com](mailto:ozgurmertbakan@gmail.com) (Ö.M. Bakan).<https://doi.org/10.1016/j.tcr.2021.100492>

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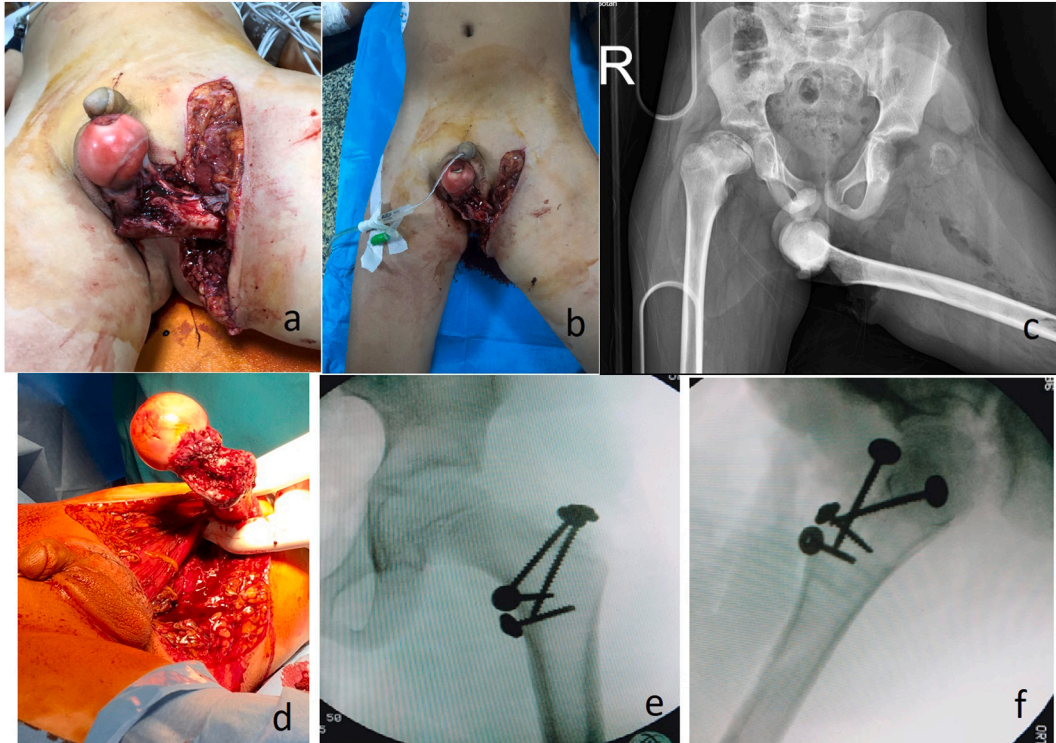
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Emergency Service approximately 3 h after the accident. After stabilization, we took him to the orthopedic operating room the fifth hour of the accident.

The physical examination revealed a protrusion of the left femoral head and neck along with a 15-cm-long inguinal wound through the scrotum (Fig. 1-a). The position of the left lower extremity was abduction, flexion, and external rotation (Fig. 1-b). His arteries pulses were palpated and neurological examination was normal. The radiographic examination and the whole body CT angiography scan revealed anterior dislocation of the left hip with an avulsion fracture of the ipsilateral greater trochanter (Fig. 1-c). Besides, these examinations demonstrated that the arterial structures were intact and there was a fracture at the left clavicle. Since there was no injury other than extremity injury, his Injury Severity Score was 16. We also consulted with a pediatric surgeon with the patient's whole body CT, which did not show any unusual pattern. In his blood tests, while hemoglobin (9.9 g/dl) and hematocrit (31%) levels were low, neutrophil dominant (%83.1) leukocyte count ( $27.73 \times 10^3/\mu\text{L}$ ) was high. In addition, the random glucose (280 mg/dl) and AST (51 U/L) were high, while the total protein (53.8 g/L) and albumin (31.5 g/L) were low. Then, we proceeded with the emergency surgery.

Surgery was started with a pediatric surgical team to protect the testicles and inguinal examination. As a result of our surgical examination and dissection, we found that his left femoral artery, vein and nerve bundle were lateral to the dislocated head and had not suffered any injury. The femoral head, neck, proximal diaphysis, acetabulum, and deep-tissue were washed with a 15-liter saline solution for half an hour (Fig. 1-d). After debridement, the femoral head was placed in the acetabular socket with traction and internal rotation while preserving the femoral artery vein nerve bundle. During the intraoperative examination, apart from a trochanter major, we observed a trochanter minor fracture in the form of an avulsion fracture with a cartilage structure. We fixed the fractures with two pairs of cancellous screws and a washer to increase the stabilization of the hip joint. Furthermore, we did the reduction and screws control with fluoroscopy (Fig. 1-e,f). We closed the wound with a vacuum drain and primary suture. Lastly, we applied a pelvipedal plaster splint. After the surgery, we continued with broad-spectrum antibiotics which had been provided first by the Emergency Service. There were no signs of infection in the examination of the local wound care in the first postoperative days. However, at the end of the first week, we noticed redness in the wound. As soon as we realized that, we performed a second look debridement and VAC (vacuum-assisted closure) therapy. However, we did not see any major infection findings at this debridement. After two weeks, we applied second debridement and VAC therapy to the patient, who started to experience dehiscence and effluence. Per the Pediatric Infection Clinic's recommendation, we prescribed piperacillin-tazobactam and teicoplanin to the patient, who had *Escherichia coli* (ESBL +) growth based on a sample taken during the operation.

Five weeks after the injury, though the patient's wound was healed, there was subluxation in the left femoral head (Fig. 2-a). Due to this, the patient was taken to a fourth operation for debridement. Intraoperatively, we observed that the femoral head was free,



**Fig. 1.** a) First admission to the hospital and protrusion of the left femoral head with a 15-cm-long inguinal wound b) Lower extremity in flexion, abduction and external rotation prior to surgery c) Pelvis AP radiograph d) After debridement and irrigation e) After reduction and fixation intraoperative fluoroscopy (AP) f) Intraoperative fluoroscopy (Lateral).

infected, and chondrolyzed (Fig. 2-b). We removed the infected head, which also was separated from its place. In addition to that, we fixed the femoral neck to the acetabulum with two Steinmann pins (Fig. 2-c). We applied the Steinmann pins while the patient was in the supine position, while the toes and patella were facing the ceiling. We performed it temporarily to control the subluxation caused by severe effusion and to deal with the infection more easily in a stable environment. Thus, we performed it in anatomical position without any force. Two months after the accident, we successfully regressed the infection status. Four months after the injury, we removed the pins and provided a pelvis-supported gait orthosis and physical therapy rehabilitation for him to regain his mobility.

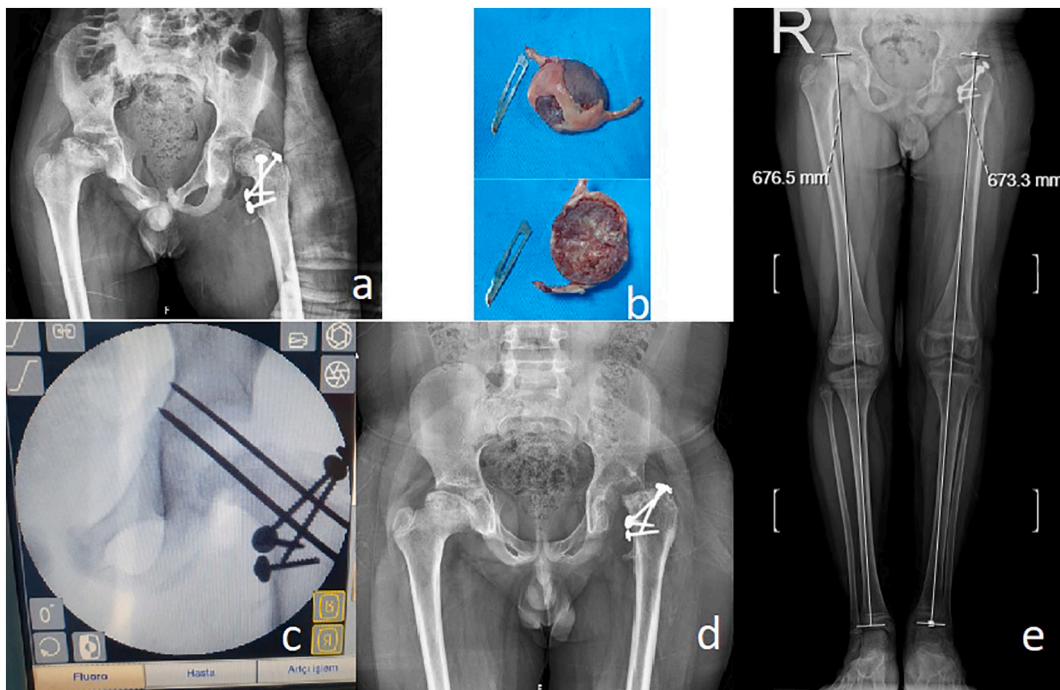
After 12 months of follow-up, he could walk with a limp (Fig. 2-d). The functional outcome was moderate (Harris Hip Score: 69) with a limited range of motion of the hip (flexion 60°, extension 30°, abduction 20°, adduction 10°, internal rotation 5°, external rotation 20°). Moreover, his left thigh had four centimeters atrophy. Sias–medial malleolus measurement and also lower limb length radiography did not illustrate any shortness in the lower extremity (Fig. 2-e). This result may be due to the Legg-Calve-Perthes disease in the patient's right hip.

## Discussion

Traumatic hip dislocations in the pediatric group only constitute 5% of all dislocations [1,2]. Since hip dislocations are mostly posterior, the rate of anterior dislocation in the pediatric group often ranges from 5% to 10% in the literature, however, some studies estimate this range to be from 7.5% to 17.8% [10,14]. When it comes to the small group of open cases, the literature largely relies on case reports. Thus, in this section of the article, we present a review of 13 traumatic open anterior hip dislocation cases from the literature [3–15]. By doing so, this article also embarks on a comprehensive review of the literature which has not been made on such a large-scale before. We have listed the characteristics of all these cases and their follow-up results in Tables 1 and 2.

In 2001, Khan et al. reviewed 5 cases; one of which was an adult [7]. In 2005, Sadhoo et al. published an article on 7 cases, two of which were adults [8]. Esmailiejah et al.'s review of 2015 had 6 cases all of which were children [11]. By reviewing the latest literature, we were able to reach a total of 13 case reports, all of which were children. Even though historically there has been other research on the same topic, unfortunately, we could not have an access to the full text of the two articles, i.e. Grigovich's case report in Russian in 1964, and Rinke and Protze's case reports in German in 1976.

Except for that one case [7], all cases have a history of an off-vehicle traffic accident and a wheel run over. Although some authors did not mention the size of the wound, as the existing pictures in the articles demonstrated, all open wounds were larger than 5 cm. However, the cases from the literature which got infected were not larger than 10 cm. If we include our case as well, 9 of the 14 cases had a distinct ipsilateral trochanter major fracture. Regarding the reduction times, although all of the cases were treated urgently, the timeline of the treatment was not clear in two cases [4,9]. Nonetheless, also these two articles imply the implementation of urgent treatment. In that case, therefore, if we assume that these two cases were also treated under 6 h, there remains only Esmailiejah et al.'s case that was reduced in more than 6 h—within 12 h [11]. A report from Cincinnati mentions that delayed reduction—6 h after the time



**Fig. 2.** a) Subluxation in the left femoral head five weeks later b) Free, infected, and chondrolyzed femoral head c) Fixation of femoral neck and acetabulum d) Final follow-up pelvis AP radiograph e) Final follow-up lower limb length radiograph.

**Table 1**  
Characterization of 13 other cases of open anterior dislocation of the hip in the literature.

Case	Age (years)/sex	Mechanism of injury	Wound	Associated injury	Time of reduction (hours)
Schwartz [3]	5/M	Hit by an automobile	Laceration from ASIS to perineum greater than 10 cm	Femoral artery and vein rupture	1
Renato [4]	6/M	Run over by a bus	Laceration over scrotum	CL tibia fr. / missing of the left testicle	Unclear
Rafai [5]	9/M	Motor vehicle crash	5 cm in the groin region	IL trochanter major fr. / CL femur diaphysis fr.	2
Garcia [6]	10/M	Run over by a car	5 cm over in the groin region	IL T. major fr. / CL femur diaphysis fr.	1
Khan [7]	10/M	Entangled in a water pump	13 cm in the groin region	–	1
Sadhoo [8]	15/F	Run over by a car	5 × 3 cm in the groin region	IL t. major fr. CL pubic ramus and sacral fractures	1
Sabat [9]	11/M	Motor vehicle crash	Laceration in the groin region	IL t. major fr. CL pubic ramus fr.	Unclear
Zekry [10]	14/M	Run over by a car	Laceration in the groin region	IL t. major fr.	2
Esmailiejah [11]	8/M	Traffic accident	8 cm transverse laceration in the groin region	Pelvic ring disruption / IL open distal femur fr.	12
Jalili [12]	17/M	Motor vehicle crash	Laceration in the groin region	IL tibia and fibula fr.	3
Mandavo [13]	7/M	Traffic accident	Laceration in the groin region	IL t. major fr.	2
Khalifa [14]	13/M	Tractor wheel crush in an agricultural region	12-cm-long inguinal wound	IL t. major fr. / CL femur diaphysis fx	4
Momii [15]	11/M	Run over by a car	Laceration in the groin region	–	2

M: Male, F: Female, CL: Contralateral, IL: Ipsilateral, fr.: fracture, t. major: trochanter major.

**Table 2**  
Result of 13 other cases of open anterior dislocation of the hip in the literature.

Cases	Treatment	Immobilization	Follow-up (months)	Result	Functional result
Schwartz [3]	Reduction and repair of vessels	Pelvipedal spica cast	12	Partial AVN No infection	Can walk and run
Renato [4]	Reduction and primary repair	Pelvipedal spica cast	18	AVN superficial infection	Can walk and run
Rafai [5]	Reduction and pinning of associated ipsilateral trochanter fracture	Nothing	15	Partial AVN No infection	Good Can walk and no pain
Garcia Mata [6]	Wound debridement and reduction	Skin traction with 2 kg	36	Deep infection and joint destruction 2.5 months	Can walk and run 6 cm shortening
Khan [7]	Reduction and primary closure	Proximal tibia skeletal traction	25	No AVN No infection	Can walk and run no limb length discrepancy
Sadhoo [8]	Wound debridement and open reduction and primary closure	Bilateral proximal tibia skeletal traction	8	Deep infection and joint destruction	Cannot walk and not run with limb length discrepancy
Sabat [9]	Reduction and pinning of associated ipsilateral trochanter fracture	Proximal tibia skeletal traction	24	No AVN no infection	Good
Zekry [10]	Reduction and primary closure	Skin traction with 5 kg	Unclear	AVN No infection	Unclear
Esmailiejah [11]	Reduction and primary closure	Proximal tibia skeletal traction	72	Partial AVN No infection	Good Can walk and run
Jalili [12]	Reduction and primary closure	Nothing	18	Deep infection and joint destruction	Poor 4 cm shortening
Mandavo [13]	Wound debridement and open reduction and primary closure	Traction	2	Deep infection and joint destruction	Unclear
Khalifa [14]	Wound debridement and open reduction and primary closure	Nothing	96	After AVN THA No infection	After 3 years of follow-up was poor. After 3 years of THA was good.
Momii [15]	Wound debridement and open reduction and primary closure	Non-weight bearing abduction brace	54	No AVN No infection 2 cm shortening of the femoral neck	Harris Hip Score 100

AVN: Avascular Necrosis, THA: Total Hip Arthroplasty.

of injury—increased the risk of AVN (Avascular Necrosis) by a factor of 20 [11]. However, Esmailiejah et al. observed only partial AVN at the end of the 6th year follow-up in their case. In three cases with trochanter major fractures, in addition to these treatments, ipsilateral trochanter major was fixed [5,9,12]. In our case, we fixed trochanter major and trochanter minor fractures with two pairs of cancellous screws with washers. After the extensive review of the literature, we realized that this treatment has not been applied before in the cases of open anterior hip dislocations in children. In 7 out of 13 cases, they applied traction after the surgery. However, in our analysis in Table 1, it is unclear whether or not applying traction has a significant effect on clinical and functional results. Furthermore,



when we examined the results, four cases had deep infection and destruction of the joint, as in our case [6,8,12,13]. In that cases, surgeons needed salvage operations. Garcia et al. removed all sequestered femoral head and neck with radical debridement [6]. Jalili et al. performed debridement for the necrotic tissues and excision of loosed femoral head fragments [12]. We also had to remove the infected femoral head and fix the femoral neck as a salvage procedure to deal with the deep infection. Among the nine patients who did not develop a deep infection, only three patients did not have AVN, while the other six patients had partial or complete AVN. When we examine the functional results, we see that only one of four patients with deep infection and joint destruction were able to walk and run after three 3 years of follow-up [4]. In this review, where the majority of the cases cover short or medium follow-up periods, detecting AVN—let it be complete or partial—does not seem to affect functional results. If we exclude two cases in which functional results are uncertain and the cases where the joint is destroyed by infection, all patients have good functional results where they can walk and run. In our case, which had a deep infection and joint destruction during the treatment, we have moderate functional results at the end of the one-year follow-up period.

## Conclusion

Open anterior hip dislocation, which mostly occurs after a traffic accident, is an extremely rare orthopedic emergency for children. Due to the high-energy trauma, when the general condition is suitable after a general body examination, debridement and reduction should be applied immediately in the operating room. As the cases from the literature suggest, preventing infection is crucial for a satisfactory functional result. Also, to rescue the femoral head, the reduction should take place as soon as possible.

## Declaration of competing interest

The authors declare that there is no conflict of interest.

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