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Closed reduction of hip dislocation associated with ipsilateral lower extremity fractures: A case report and review of the literature

Abstract

BACKGROUND

Traumatic hip dislocation usually occurs following high-velocity trauma. It is imperative that the dislocation be reduced in a timely manner, especially in a closed manner, as an orthopedic emergency. However, closed reduction can hardly be achieved in patients who also have ipsilateral lower extremity fractures. Herein, we focus on hip dislocation associated with ipsilateral lower extremity fractures, excluding intracapsular fractures (femoral head and neck fractures), present an early closed hip joint reduction method for this injury pattern, and review the literature to discuss the appropriate closed reduction technique for this rare injury pattern.

CASE SUMMARY

We report a case of a 37-year-old male who sustained a left acetabular posterior wall fracture, an ipsilateral comminuted subtrochanteric fracture and dislocation of the hip. The hip dislocation was reduced urgently in a closed manner using the joy-stick technique with a T-shaped Schanz screw. The fractures were reduced and fixed as a 2nd-stage surgery procedure. At the 17-month postoperative follow-up, the patient had full range of motion of the affected hip.

CONCLUSION

Closed reduction of a hip dislocation associated with ipsilateral lower extremity fractures is rarely achieved by regular maneuvers. Attempts at closed reduction, by means of indirectly controlling the proximal fracture fragment or reconstructing the femoral leverage rapidly with the aid of various external reduction apparatuses, were shown to be effective in some scenarios. Mandatory open reduction is indicated in cases of failed closed reduction, particularly in irreducible dislocations.

INTRODUCTION

The hip joint is a ball and socket joint, in which its stability is maintained by the combination of bone and strong soft-tissue structures. Generally, traumatic hip dislocation occurs in young patients after high-energy trauma. The incidence of traumatic hip dislocation accounts for approximately 5% of all traumatic joint dislocations[1]. The common mechanisms of hip dislocation are motor vehicle accidents, falls from a height, motorcycle accidents, sports injuries and so on[2-4]. Due to the significant dislocation force, hip dislocation has a high rate of associated hip district fractures[5] or ipsilateral knee injuries[6,7]. Sahin *et al*[4] reported that 71% of patients diagnosed with hip dislocation had concomitant injuries, either systemic or musculoskeletal.

Traumatic hip dislocation is considered an orthopedic emergency. Urgent reduction should be performed to diminish the incidence and severity of major sciatic nerve injury[3], to reduce the duration of ischemia to the femoral head and minimize the incidence of osteonecrosis[2,8]. The longer the duration of hip dislocation, the higher the risk of osteonecrosis of the femoral head[9]. Generally, the priority is closed reduction as the initial treatment choice. In patients who have hip dislocation associated with ipsilateral lower extremity injuries (especially fractures), closed reduction can hardly be achieved because the concomitant injuries may be exacerbated by closed reduction maneuvers[8]. The early recognition and assessment of concomitant injuries is imperative to optimize the treatment procedures. The paucity of literature on closed

reduction of this hip dislocation type poses a challenge for orthopedic surgeons for the reduction of this type of hip dislocation in a timely manner.

CASE PRESENTATION

Chief complaints

A 37-year-old male with hypotension was transferred to our trauma center from a local hospital after a vehicle crashed into the left side of his motorcycle on April 12, 2021. The patient complained of severe pain in the left hip and chest.

History of present illness

The patient had no present illness.

History of past illness

The patient had no past illness.

Personal and family history

The patient had no personal or family history.

Physical examination

The patient's blood pressure was 96/62 mmHg, and his heart rate was 85-110 beats/min with a normal sinus rhythm. Physical examination revealed minor pallor of the conjunctiva and shortening, external rotation and abduction deformities of the left leg. The femoral head was palpable in the gluteal region. Upon neurological examination, he was unable to dorsiflex his left foot and toes, and his sensory touch was impaired in the calf and foot regions. There was no distal vascular deficit noted.

Laboratory examinations

The laboratory examinations appeared unremarkable, except for leukocytosis (white blood cell count, 15.98×10^9 cells/L) before resuscitation.

Imaging examinations

The computed tomography (CT) scan from a local hospital revealed hydropneumothorax, pulmonary contusions, multiple rib fractures, a left acetabular posterior wall fracture, an ipsilateral comminuted subtrochanteric fracture and dislocation of the hip (Figure 1).

FINAL DIAGNOSIS

The patient was diagnosed with a left hip dislocation fracture associated with an ipsilateral comminuted subtrochanteric fracture and a closed chest injury.

TREATMENT

After advanced trauma life support, the patient was urgently taken to the operating room and positioned in the right lateral decubitus position under deep conscious sedation through propofol. We inserted a T-shaped Schanz screw into the subtrochanteric cortex percutaneously under fluoroscopic guidance and manipulated the femoral head into the acetabulum using the joy-stick technique. The reduction was intraoperatively confirmed by fluoroscopy (Figure 2). Proximal tibial skeletal traction was performed to prevent femoral head redislocation, fracture immobilization and limb length restoration. Then, the patient was transferred to the intensive care unit, and fluid resuscitation and the optimization of physiological status continued. In the interim, to illustrate the acetabular fractures in detail for the development of the definitive surgical strategy, we performed post-reduction CT scans (Figure 3) which showed an acetabular posterior wall fracture, a marginal impaction fracture and an intra-articular loose body.

The 2nd-stage definitive fracture fixation was performed as soon as the patient's physiological status was stable enough. The patient was positioned in the right lateral decubitus position under general anesthesia. First, we explored the sciatic nerve and addressed the acetabular fractures through a Kocher-Langenbeck approach. After removal of the loose body, the impaction fracture was elevated and filled with an

autograft. The acetabular posterior wall fracture was reduced and stabilized using 2 Lag screws and a buttress plate. Then, the femoral subtrochanteric fracture was reduced with a closed procedure and fixed with an antegrade intramedullary nail (Figure 4A). Intraoperative fluoroscopy was performed to confirm a concentric reduction, and hip stability was assessed by gently moving and applying force in the direction of the dislocation. Postoperatively, skin traction was applied to the affected leg for 2 wk until the stitches were removed. Then, non-weight-bearing activity with axillary crutches ambulating was allowed for another 4 wk.

OUTCOME AND FOLLOW-UP

Full weight-bearing activity was allowed when the radiographs demonstrated a solid union of the subtrochanteric fracture at 6 mo after surgery (Figure 4B). At the 17-mo postoperative follow-up, the patient had full range motion of the affected hip with residual foot droop. Radiographs revealed no evidence of avascular necrosis of the femoral head (Figure 4C).

DISCUSSION

Early closed reduction is the priority for traumatic hip dislocation since it can often be conveniently manipulated in the emergency room, it can shorten the duration of femoral head ischemia, and it can be carried out in conditions that are not suitable for the definitive management of associated fractures. Moreover, early closed reduction could also promptly relieve any distortion of the nerve from a dislocated femoral head or a displaced acetabular fracture in cases of nerve injury[10]. In contrast to open reduction, closed reduction tends to have better clinical outcomes, possibly because of less disruption of the remaining blood supply to the femoral head[11]. All kinds of closed reduction maneuvers, whether for anterior or posterior dislocation, rely on an intact ipsilateral lower extremity to transmit inline traction force and allow the femur to act as a lever to manipulate the femoral head into the acetabulum. Regardless of the closed reduction maneuver and hip dislocation type, the surgeon needs to place his or her

hand (or knee/arm/shoulder/forearm) underneath the ipsilateral knee of the affected hip and needs to apply a longitudinal traction force with internal and external rotation until the hip is reduced[8]. When a hip dislocation is associated with ipsilateral lower extremity fractures, closed reduction can hardly be achieved due to the ineffective traction fulcrum resulting from fractures around the knee or the absence of an intact femur necessary to transmit the traction force. We reviewed similar cases (Table 1) to discuss the appropriate closed reduction technique for this rare trauma pattern to improve the clinical outcomes.

The first reported method of closed reduction for posterior hip dislocation associated with an ipsilateral femoral shaft fracture seems to have been published by Wiltberger in 1948[13]. The attempt at early closed reduction with the aid of two threaded pins (reduction apparatus) placed approximately four inches apart into the lateral aspect of the left femoral trochanter had failed. After 3 d of tibial tubercle traction, the author threaded a two-foot length gas pipe over the crossbar of the reduction apparatus and successfully reduced the dislocation eventually. Although the dislocation was managed in a closed manner, delayed reduction increased the risk of femoral head necrosis. In clinical practice, early open reduction should be performed as an alternative once the attempt at closed reduction fails.

Ingram *et al*[14] introduced another closed reduction method in 1954. This seems to be the first description of an early closed reduction for hip dislocation with an ipsilateral femoral shaft fracture. He inserted a large Steinmann pin through the greater trochanter in an anteroposterior direction and clamped the Steinmann pin with large vice-grip pliers anteriorly and posteriorly at the skin edge. Then, closed reduction was accomplished by strong manual traction. In 1958, Murray DS[15] also successfully reduced hip dislocation by this method. This technique is effective, however, there is a high risk of puncturing the sciatic nerve behind the greater trochanter while the pin transfixes the greater trochanter percutaneously because of the nonanatomic position of the greater trochanter. In 1982, Harper *et al*[19] inserted the Steinmann pin in a posterior-

anterior direction, taking care to stay lateral to the sciatic nerve, and successfully treated two patients with dislocations.

Some surgeons advocate closed reduction by manipulating the proximal fracture fragment with the aid of various apparatuses, such as Scuderi traction screw[11], Smith traction screw[16], large bone clamp[18], Lardennois hoop[21], tourniquet[23], Hoffmann half pin[24], and temporary external fixator[43]. However, Schoenecker *et al*[18] achieved 2 dislocations by gentle manual traction in a regular manner, ignoring the ipsilateral femoral fracture, which may involve distraction and angulation of the soft tissues at the fracture site and could inevitably jeopardize the neurovascular bundle.

Among all the reduction apparatuses, the Schanz screw has been the most preferred[25,29,30,35,51]. It is inserted percutaneously under fluoroscopic guidance and is connected with a universal AO chuck or T handle universal chuck to manipulate the proximal fracture fragment to facilitate reduction. In our present case, we also performed closed reduction with the aid of a Schanz screw, although we were unaware of these previous reports at that time. The Schanz screw we used was T-shaped and was whole without any connector, which is often applied to pull the femoral head laterally in our reduction of acetabular fractures. Due to eliminating the potential loosening between the screw and the connector, the T-shaped Schanz screw played a role of pulling and levering the dislocated femoral head more easily as a whole and facilitated the joystick maneuver more efficiently to reduce the dislocation.

In 2019, Rana *et al*[49] recommended a novel approach to perform closed manipulation of a hip dislocation with a femoral shaft fracture. He restored the leverage of the fractured femur by temporarily fixing the femur with an external fixator instead of controlling the proximal fracture fragment with an external fixator. In 2020, Iftekhar *et al*[52] also addressed hip dislocation with the same protocol. A temporary external fixator was applied to reduce and fix the femoral shaft fracture. The femoral lever arm was obtained, and hip reduction was achieved with a closed procedure. This practical technique reconstructs the continuity and leverage of the femur by means of external fixator osteosynthesis to transmit the traction force and manipulate the affected leg.

Although many closed reduction methods have been reported and do truly work, they are not always successful[54]. Open reduction could never be abandoned as an alternative, and its importance cannot be overemphasized. Many factors, such as the buttonholed femoral head through the capsule or abductors, a large interposed intra-articular fragment from the femoral head or acetabular wall, and soft tissue impingement, always contribute to irreducible dislocations[55-57]. Forced closed reduction may exacerbate these concomitant fractures or cause iatrogenic bone and peripheral neurovascular injuries[8,58]. Multiple attempts at closed reduction may result in further traumatic injury to the chondral surface of the femoral head[3] and increase the risk for iatrogenic femoral neck fracture[59]. In this situation, mandatory open reduction should eventually be performed as an alternative after a failed closed reduction attempt for the hemodynamically stable patients. Another situation is the presence of nonconcentric joint after reduction, which also needs surgery to eliminate intra-articular osteochondral fragments or suture the labral tear to obtain the reduction adequacy and excellent long-term clinical outcome[60].

Analyzing the reported similar cases (Table 1), the success rate of initial closed reduction has been reduced, although various closed reduction techniques have been reported. This is because surgeons have had to tackle more complex associated fractures rather than simple femoral shaft fractures in recent years. This may result from the increasing incidence and severity of such complex injury patterns due to increased high-velocity trauma, especially road traffic accidents. On the other hand, experienced trauma teams and modern resuscitation equipment have allowed an increasing number of patients with associated serious complex fractures to survive[61]. Another tendency was the increased prevalence of associated acetabular and per-trochanteric fractures. In such situations, immediate closed reduction has also been favored over open reduction, especially if the patient's general condition is too unstable for open procedures or if the patient's acetabular fractures need no surgical intervention. For patients who require a prolonged transfer to receive definitive surgery, management should also include immediate closed reduction as the primary procedure of the staged treatment strategy

at the local hospital. Although hip dislocation associated with an ipsilateral femoral fracture or knee injury was considered a contraindication for closed reduction in some literature[3,8,59], attempts at closed reduction could also be performed with the aid of various external reduction apparatuses. The rational mechanism of effective indirect reduction techniques is controlling the proximal fracture fragment more easily or reconstructing the femoral leverage rapidly.

CONCLUSION

Closed reduction of a hip dislocation associated with ipsilateral lower extremity fractures is rarely achieved by regular maneuvers. Attempts at closed reduction, by means of indirectly controlling the proximal fracture fragment or reconstructing the femoral leverage rapidly with the aid of various external reduction apparatuses, were shown to be effective in some scenarios. Although closed reduction tends to have better clinical outcomes, mandatory open reduction is indicated in cases of failed closed reduction and particularly irreducible dislocations.

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Figure Legends

Figure 1 Three-dimensional computed tomography from a local hospital. The image shows a left acetabular posterior wall fracture, an ipsilateral comminuted subtrochanteric fracture and dislocation of the hip.

Figure 2 Intraoperative fluoroscopy showing reduction of a dislocation. A: Prereduction and T-shaped Schanz screw; B: Postreduction.

Figure 3 Computed tomography scans. A, B: The images show an acetabular posterior wall fracture associated with a marginal impaction fracture (red arrow) and an intra-articular loose body (yellow arrow).

Figure 4 Left hip radiographs. A: Postoperative; B: 6 mo later; C: 17 mo later.

Table 1 Review of reported cases of hip dislocation associated with ipsilateral lower extremity fractures

No.	Ref.	Age (yr)	Gender	Cause of injury	Dislocation type	Associated fractures of ipsilateral lower extremity	Method
1	Henry *et al*[12], 1934	64	F	-	P	Femoral shaft	Open
2	Wiltberger *et al*[13], 1948	35	M	Industrial accident	P	Femoral shaft	Closed
3	Ingram *et al*[14], 1954	17	M	Automobile vehicle accident	P	Femoral shaft	Closed
4	Murray *et al*[15], 1958	25/18	M/-	Motorcycle accident/-	P	Supracondylar of femur/tibia and supracondylar of femur	Open/closed
5	Helal *et al*[16], 1967	-	-	-	P	Femoral shaft	Closed
6	Lyddon *et al*[11], 1971	47	M	Automobile accident	Obturator	Femoral shaft	Closed
7	Ehtisham *et al*[17], 1976	19/19/; 19/17	-	Road traffic accident/ motorcycle accident (3)	A/P/P/A	Femoral shaft/femoral shaft/femoral shaft and roof of the acetabulum/femur, tibia and medial malleolus	Open
8	Schoenecker *et al*[18], 1978	18	M	Motor vehicle accident	A	Femoral shaft	Closed
9	Harper *et al*[19], 1982	17/19	M/F	Automobile accident	P	Femoral shaft	Closed
10	Barquet *et al*[20],	25	M	Automobile	P	Femoral head,	Closed[1]

	1983			collision		trochanter and shaft	
11	Verdonk *et al*[21], 1984	17/21	M	Motor cycle accident/-	P	Femoral shaft	Closed
12	Shannak[22], 1987	29	M	Automobile accident	Bi (A/P)	Femoral shaft/acetabulum, tibia and fibula	Closed
13	Carlsen *et al*[23], 1991	42	-	Motorcycle-car accident	P	Femoral shaft	Closed
14	Wu *et al*[24], 1993	16 cases	-	-	P (11) C (5)	Femoral shaft	Closed
15	Maqsood *et al*[25], 1996	21	M	Run over by a jeep	P	Femoral shaft	Closed
16	Maini *et al*[26], 2004	25	M	Railway accident	P	Femoral neck and greater trochanter	Open
17	Duygulu *et al*[27], 2006	52	M	Motor vehicle collision	P	Transverse and posterior wall acetabular fracture, femoral neck and shaft	Open
18	Sié EJB *et al*[28], 2006	24	M	Fall from a moving truck	P	Shaft, supra and intercondylar of femur, patella, tibial and medial malleolus	Closed[1]
19	Singh *et al*[29], 2006	35	M	Roadside accident	Inferior	IT fracture	Closed
20	Singh *et al*[30], 2008	55	M	Fall from a moving bus	Inferior	Open femoral subtrochanteric fracture	Closed
21	Alexa *et al*[31], 2009	41	M	Traffic accident	P	IT fracture	Open
22	Almosalamy *et al*[32], 2010	28	M	Car accident	P	Posterior wall acetabular and IT fracture	Open

23	Rodriguez-Martin *et al*[33], 2010	27	M	Car accident	P	Femoral head and intertrochanteric fracture	Open
24	Sen *et al*[34], 2011	32	M	Car accident	P	Femoral head, acetabular wall, knee dislocation and tibial plateau fracture	Open
25	Kuhn *et al*[35], 2013	44	M	Motor vehicle collision	P	Posterior wall acetabular and femoral per-trochanteric fracture	Closed
26	Radulescu *et al*[36], 2013	44	M	Precipitation	A	IT fracture	Open
27	Sinha *et al*[37], 2013	45	M	Fall from moving train	P	Transverse and posterior wall acetabular fracture, IT fracture	Open
28	Yousefi *et al*[38], 2013	43	M	Motor vehicle accident	P	Posterior wall acetabular and IT fracture	Open
29	Zhen[39], 2013	59	M	Car crash	Inferior	Posterior wall acetabular fracture and IT fracture	Total hip arthroplasty
30	Jamshidi *et al*[40], 2014	26	M	Motor vehicle accident	P	Posterior wall acetabular and IT fracture, tibia, fibula	Closed[1]
31	Chotai *et al*[41], 2015	25	M	Motor vehicle accident	P	IT fracture and proximal tibial	Open
32	Panigrahi *et al*[42], 2015	20	M	Road traffic accident	P	Femoral head, shaft and medial condylar fracture	Open
33	Alhammoud *et al*[43], 2016	30	M	Motor vehicle collision	P	Femoral head and shaft	Closed

34	Qi *et al*[44], 2016	43	M	Car accident	P	Transverse and posterior wall acetabular fracture, femoral shaft	Open
35	Ul Haq *et al*[45], 2016	26/36	M/F	Road traffic accident	P	IT fracture/femoral head and intertrochanteric fracture	Open
36	Uzun *et al*[46], 2017	20	M	Traffic accident	P	Transverse and posterior wall acetabular fracture, IT and lateral condyle	Open
37	Fageir *et al*[47], 2018	31	M	Fire truck accident	P	IT fracture	Open
38	Desai *et al*[48], 2019	19	M	Road traffic accident	P	IT fracture	Open
39	Rana *et al*[49], 2019	18	M	Road traffic accident	P	Femoral shaft	Closed
40	Benabbouha *et al*[50], 2020	56	F	Hit by a car	P	Posterior wall acetabular fracture, femoral shaft, tibia and fibula	Closed*
41	Gokulprasath *et al*[51], 2020	26	M	Road traffic accident	A	Subtrochanteric fracture	Closed
42	Iftekhar *et al*[52], 2020	24	M	Motor vehicle accident	P	Femoral shaft	Closed
43	Su *et al*[53], 2020	38/29	F/M	Train crash/traffic accident	P	Acetabulum, IT and neck fracture/IT and neck fracture	Open
44	Anand *et al*[54], 2021	50	M	Road traffic accident	P	Transverse-posterior acetabular fracture, IT and shaft, tibia, fibula	Open
45	Present case	37	M	Vehicle	P	Posterior wall	Closed

(2022)		accident	acetabular fracture, and subtrochanteric fracture

[1]The closed reduction maneuver was not mentioned in the literature.

IT: Intertrochanteric; A: Anterior; P: Posterior; C: Central; -: Not mentioned.

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