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

Xu Y *et al*. Closed reduction technique for hip dislocation

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**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.

**Key Words:** Trauma; Hip dislocation; Close reduction; Open reduction; Fracture; Case report

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**Core Tip:** Hip dislocation associated with ipsilateral lower extremity fractures could be more efficiently managed with the aid of a T-shaped Schanz screw. Furthermore, this is the first review of similar techniques for early closed hip joint reduction for this injury pattern.

**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 × 109 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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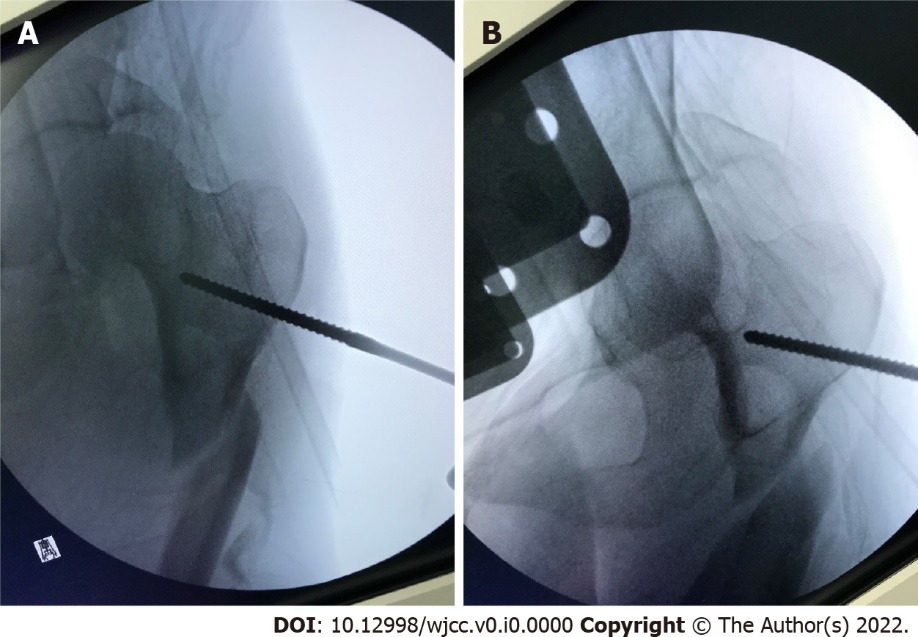
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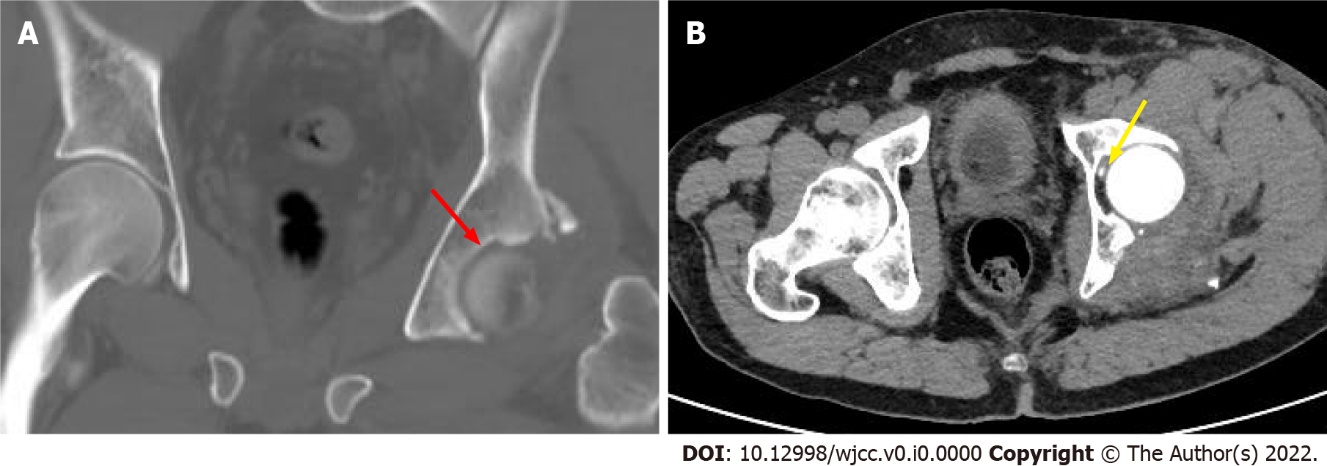
**Figure Legends**



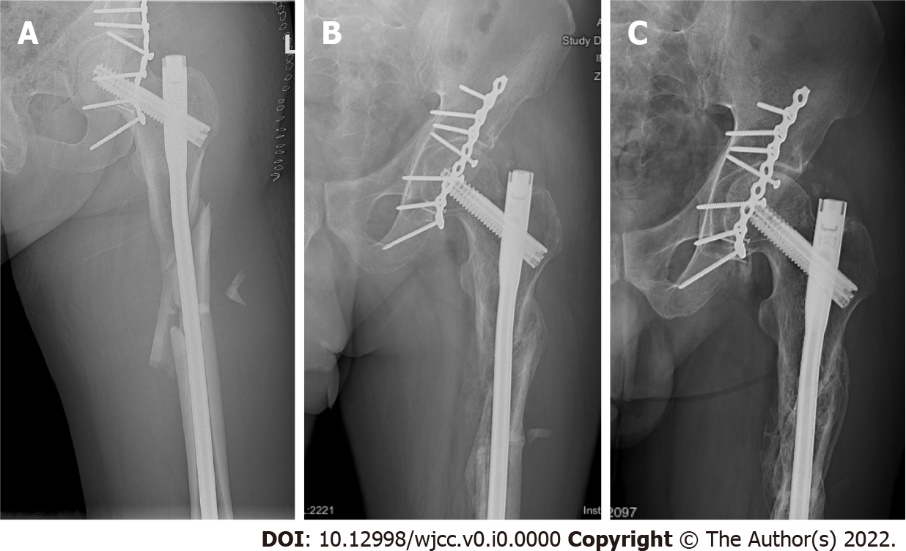
**Figure 1 Three-dimensional computed tomography from a local hospital.** The image shows a left acetabular posterior wall fracture, an ipsilateral comminuted subtrochanteric fracture and dislocation of the hip.



**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], 1983 | 25 | M | Automobile collision | P | Femoral head, trochanter and shaft | Closed1 |
| 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 | Closed1 |
| 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 | Closed1 |
| 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 | Closed1 |
| 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 (2022) | 37 | M | Vehicle accident | P | Posterior wall acetabular fracture, and subtrochanteric fracture | Closed |

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

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