Treatment of Type IV Pipkin Fracture in Patients via Hip Arthroscopy-Assisted Surgery: Two Cases Report and Review of Literatures

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Abstract

Pipkin type IV Femoral Head (FH) fracture-dislocations are usually treated via open surgery. There are many surgical approaches for the treatment of this difficult fracture depending on the fracture pattern. We discuss herein Pipkin type IV FH fractures who underwent Open Reduction Internal Fixation (ORIF) of an acetabular fracture with reconstruction plates and hip arthroscopy-assisted surgery and review the previous literatures. The intra-articular osteochondral loose bodies were excised by hip arthroscopy simultaneously. The joint congruency and screw positions were checked during surgery by arthroscopy. After 6 months, clinical and radiology showed excellent results. The patients had a satisfactory short-term outcome after ORIF and hip arthroscopy-assisted surgery. We concluded that hip arthroscopy-assisted surgery is a viable option for the treatment of Pipkin type IV FH fracture-dislocations in the future.

Keywords: Pipkin type IV fracture; Hip arthroscopy; HO

Introduction

Femoral and acetabular surgery has been evolving over the years as a distinct subspecialty in the field of trauma and orthopedic surgery. Several articles have been published addressing important issues in the surgical management of FH fracture with acetabular fracture, Pipkin type IV. Being a high energy and intra-articular injuries, Pipkin IV FH fracture always presented innate difficulties for every surgeon in terms of management. Treatment of these fractures may range from a single closed reduction to a prosthetic replacement. Regardless of the type of treatment, a serious of consequences, as post-traumatic arthritis, avascular necrosis and Heterotopic Ossification (HO), may complicate the natural course and lead to unsatisfactory clinical outcomes and a variable degree of disability. Hip arthroscopy surgery has been noticed in hip trauma over the last few years due to technique advances. With the development of hip arthroscopy, it has since been used for hip fracture-dislocations beyond the roles of diagnosis and foreign body removal. Combining arthroscopic surgery offers the advantages of the less invasive approach, results in lower morbidity rates. Herein, we reported our experience of arthroscopy-assisted internal fixation or excision in Pipkin type IV FH fracture-dislocations.

Case Series

Case 1

A 21-year-old man reported to our Emergency Department (ED) after a road motorcycle traffic accident with severe right hip pain. The patient had a deformity of the right hip area. On clinical examination, he was noted to have abduction, and a shortened and internally-rotated right lower limb. Active and passive movements of the right hip joint were not possible due to pain, with no neurovascular deficits detected. The initial plains radiographs showed right FH posterior fracture-dislocation and was reduced by closed manipulation promptly. The 3D Computed Tomography (CT) scans of the pelvis revealed a FH fracture with posterior acetabular wall fracture and fracture fragments within the hip joint originating from the infra-fovea of the femoral head. The patient was admitted to the orthopedic service with a working diagnosis of right FH fracture-dislocation, Pipkin type IV. Initially, the patient was planed to the operating theater for hip arthroscopy-assisted surgery with excision and irrigation of fracture fragments within the hip joint under fracture table
A 36-year-old man (BMI: 44, body weight: 135 kg, body length: 175 cm) was transferred to our ED after a motorcycle accident. He sustained a right hip fracture-dislocation according to initial plain radiographs, which was reduced by closed manipulation promptly. There was no neurovascular damage of the lower extremity. Follow-up plain radiographs confirmed the reduced hip joint with a displaced posterior acetabular fracture and intra-articular osteochondral loose bodies. A 3D-CT scan showed that the FH fracture was associated with a posterior acetabular fracture, Pipkin type IV. After in-depth discussion with the patient, it was agreed that the ORIF procedure combined with hip arthroscopy-assisted surgery via the posterior approach would be performed. The patient underwent ORIF with reconstruction plates for the posterior acetabular wall fracture and combined hip arthroscopy-assisted surgery using two Herbert screws for internal fixation of the FH fracture, with removal of intra-articular osteochondral loose bodies through a single incision wound. Postoperative plain radiographs showed anatomic reduction of the FH and posterior wall fractures. The patient was able to walk under non-weight-bearing conditions for 2 months after surgery using crutches. Three-month postoperative CT scans with 3-D reconstruction verified healing of the fracture sites and FH congruency with no screw migration (Figure 2). The patient was free of pain and able to walk without any support.

**Case 2**

A 36-year-old man with a Pipkin type IV femoral head fracture dislocation after motorcycle accident. (a) Preoperative radiography of 3-D computed tomography image showing the left femoral head fracture dislocation, Pipkin IV after closed reduction. (b) The hip arthroscopy surgical removal of bony fragments was performed first under fracture table. (c) Followed by open reduction internal fixation with hip dislocation through posterior approach. (d) The posterior capsule and short external rotators were repaired layer by layer. (e) Postoperative plain radiography. (f) Postoperative one posterior incision wound condition.

**Surgical Technique**

**Case 1**

Under general anesthesia, the patient was treated in the supine position on the fracture table. We used three standard portals to visualize the hip joint with a 70° arthroscope. A surgical grasper and probe were used to remove the fracture fragments, and then irrigation of the hip joint was done. The wound was closed without suction drains in the hip joint. During the arthroscopy surgery, we found the hip joint was easy to be posterior subluxation in the fracture table from intraoperative fluoroscopy. After well-discussion with patient about the necessity of posterior fixation and repair of ruptured capsule, we performed second-stage surgery through posterior approach 3 days later. The patient was treated in the lateral decubitus position with the injured hip facing upwards under general anesthesia. The skin incision field was through a curved wound one-inch posterior to the posterior edge of the greater trochanter and down to the femur shaft using the posterior approach. The injured leg was prepared in an aseptic field for manual traction and manipulation during the surgery. The subcutaneous tissue and fat were divided sharply, and the fascia and tensor fascia lata along the fascia of the gluteus maximus were incised proximally to dissect the deep short external rotators. The short external rotators were detached after tapping and the posterior acetabular fracture was approached. The injured leg was kept under hip extension and knee flexion to protect the sciatic nerve during the procedure. The capsule attachments to the posterior wall fragments were maintained as far as possible to prevent devascularization. After anatomic reduction of the fracture site with manual traction,
Kirchner wires were used for temporary fixation. Two reconstruction plates were applied to restore the congruency and stability of the hip. The position of plate and screws were confirmed by intraoperative fluoroscopy. The posterior capsule and external rotators were sutured layer by layer. Put a drain after the wound was closed and remove it next day.

Case 2

Under general anesthesia, the patient was treated in the lateral decubitus position with the injured hip facing upwards. The skin incision field was through a 20-cm curved wound one-inch posterior to the posterior edge of the greater trochanter and down to the femur shaft using the posterior approach. The injured leg was prepared in an aseptic field for manual traction and manipulation during the surgery. It was noted that the anterior approach may also be prepared in an aseptic field if needed during the surgery. The posterior approach procedure was the same as the case 1. We did not open the joint capsule, and the capsule attachments to the posterior wall fragments were maintained as far as possible to prevent devascularization. After anatomic reduction of the fracture site with manual traction, Kirchner wires were used for temporary fixation. Two reconstruction plates were applied to restore the congruency and stability of the hip. A mini-incision was then made over the superior capsule to allow hip scope portals into the hip joint. A monolateral external distractor with Schanz screws fixed at the superior acetabulum and proximal femur was applied to distract and maintain the distention of hip joint with the lower leg in the external rotation position. We used two standard portals to visualize the hip joint with a 70° arthrooscope, which allowed for visualization of the infrafoveal FH fracture site under hip external rotation. Joint irrigation was maintained, in which a sufficient positive intra-articular pressure and a sufficient flow was provided using an automated control pump. After thorough reduction of the fracture site, percutaneous guidewires were inserted into the femoral head under fluoroscopic guidance. The fracture fragments were fixed with two 2-mm Herbert screws under arthroscopic guidance, and the screws were engaged into the subchondral bone below the articular surface under video guidance. Dynamic fluoroscopic examination confirmed the successful and secure fixation of the FH and acetabular fractures without protrusion of any screws. Some small osteochondral fragments in the hip joint were excised during the surgery. The posterior capsule and external rotators were sutured layer by layer after completing the surgery. The wound was closed, and suction drain was placed in the joint. First-generation cephalosporin was administered as antibiotic prophylaxis prior to anesthesia and for 24 h after surgery. The patients were able to walk under non-weight-bearing conditions using crutches and were discharged when their wound condition was stable.

Discussion

Choice of surgical approach to treat these injuries is difficult to decide based on published results. Opting for a posterior approach for internal fixation of posterior acetabular wall fracture is logical. Since the dislocation is often posterior resulting in a variable degree of posterior capsule rupture, which can give procedure to the fracture without further capsular disruption. The fracture location of FH however is often antero-inferior area which makes it difficult to access through the posterior approach and often requires extension of the posterior capsular tear to dislocate the hip posteriorly. The concerns about interfering with the predominantly posterior based blood supply to the femoral head have influenced surgeons to use anterior approach or trochanter flip osteotomy. Although these methods avoid further damage to the posterior joint capsule, it still has to open the anterior capsule and cause another problem. The entire process can possibly jeopardize the femoral head capsular blood supply further. No matter which kind of approach, the blood supply of the FH will be affected by the extensive destruction of the soft tissue, which will lead to the occurrence of the ONFH or HO. As we know, hip scope-assisted surgery may lower the incidence of complications by avoiding soft tissue dissection and minimizing compromise to blood supply of FH. In our cases, the bony fracture fixation or excision of FH Pipkin type IV could be combined with hip arthroscopy-assisted surgery by only one posterior incision wound. There is no need for anterior incision wound or hip joint further dislocation, which significantly reduces soft tissue damage. Although there were only two short-term follow-up patients, we still believed that hip arthroscopy assisted surgery can be used in such patients and reported early. As for whether it is a one-time or staged operation, there is no presupposition. We performed staged surgery for case one because instability of hip joint was found during the arthroscopy surgery. If needed, we could do one-time surgery, and we had to change body position during the surgery. In case 2 with high BMI, we had some new approaches. The first is to design an external extractor to replace the role of fracture table to distract the patient’s hip joint. Second is that obese patients are usually contraindicated in using arthroscopy. We overcame this difficulty and used some incision wound for arthroscopic surgery. Therefore, ORIF of the posterior acetabular wall can be simultaneously performed with arthroscopic surgery. The rare publications of Pipkin type IV FH fractures make comparative studies difficult. Yi-Hsun [1] in 2017 reported 9 patients with Pipkin type IV fractures via a modified Gibson approach with one incision wound. They made modified Hardinge approach with T-shaped capsulotomy in anterior capsule to dislocate the hip joint for FH surgery. One patient with early post-traumatic osteonecrosis 3 months after index surgery underwent total hip arthroplasty. Our results maybe similar or better than Shan-Xi [2] in 2018 reported 21 patients using the Kocher-Langenbeck approach to treat Pipkin type IV fracture. The major difference in our posterior approach is that we did not dislocate the hip joint to treat femoral head fractures and further decreased the rate of morbidity by avoiding soft tissue injuries. There were many limitations for this technique. It is difficult to drive the screws to most ideal position and achieve complete anatomic reduction of FH within limited space of the hip joint, especially in the rotational orientation. In addition, the time required to learn this procedure is considerable, and more patients need to enroll in studies and compare with the open surgery. It has not was any report in the application of hip arthroscopy surgery to FH, Pipkin type IV patients. Only M-S park in 2013 reported one case that used arthroscopy to remove residual osteochondral fragments 2 months later after open reduction and internal fixation surgery. We used ORIF and combined hip arthroscopy surgery can simultaneously remove foreign bodies in the joint cavity. This was the first cases report of arthroscopy-assisted surgery in the FH Pipkin IV fracture and it has been successful. It is believed that such patients can be provided with options for treatment selection in the future.

References