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Functional Outcome of Pipkin Type III Fracture Managed by Osteosynthesis through Trochanteric Flip Osteotomy in a Young Patient after 5 Years Follow-Up – A Case Report and Literature Review

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Learning Point of the Article:

Pipkin type III fractures are rare and have a very poor prognosis, however, in younger patients, it may be worth trying to save the femoral head instead of primary arthroplasty.

Abstract

Introduction: Femoral head fractures are uncommon. A femoral head fracture associated with an ipsilateral neck of femur fracture is classified as a Pipkin's Type III fracture and is exceedingly rare. It is a high-energy injury associated with an extremely poor prognosis. This has led some authors to advocate primary arthroplasty for these injuries. The aim of reporting this case is that in young patients even with severely displaced Pipkin's Type III injuries, it is reasonable to opt for internal fixation of these fractures. It is possible to obtain good function for a significant amount of time as evidenced by the 5-year follow-up in this case.

Case Report: A 25-year-old male presented 4 days after a motorbike accident. He was diagnosed as a femoral head fracture with neck fracture of the left side. This fracture is classified as type III Pipkin fracture or OTA type 31C.3. This case was managed with open reduction and internal fixation utilizing the trochanteric flip osteotomy and multiple screws. It is worth to report the first case of Pipkin type three fracture having satisfactory functional outcome after 5 years of follow-up.

Conclusion: It is worth preserving the femoral head in young patients. Good pre-operative planning, meticulous reduction, tissue handling, and fixation could get satisfactory results. The outcome also depends on post-operative rehabilitation and compliance of patient.

Keywords: Femoral head fractures, Pipkin type III, trochanteric flip osteotomy, osteosynthesis, functional outcome, avascular necrosis.

Introduction

Femoral head fractures are known since the pre-radiological era, when Birkitt dissected the affected region of a 35-year-old female after her death due to a fall [1]. Pipkin type III fracture is the least common among all types of femoral head fractures [2, 3, 4]. Like other fractures that are caused by high-energy trauma, it is also more common in a young patient and is often associated with injury of other parts of the body. The management is challenging and difficult. It has the highest risk of avascular necrosis (AVN) of the head of the femur after osteosynthesis among all types of fractures [2, 3, 5]. Few of these fractures are reported in the literature and out of those, most were managed by primary arthroplasty.

The reasons for writing this case report are to explain the importance of preserving the native hip joint in young age which would help in decision-making in such challenging fractures as there is no universally accepted recommendation available due to rarity of these injuries and lack of adequate literature [2, 6, 7, 8, 9].

Case Report

The patient was a 25-year-old married male at the time of the

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Author's Photo Gallery


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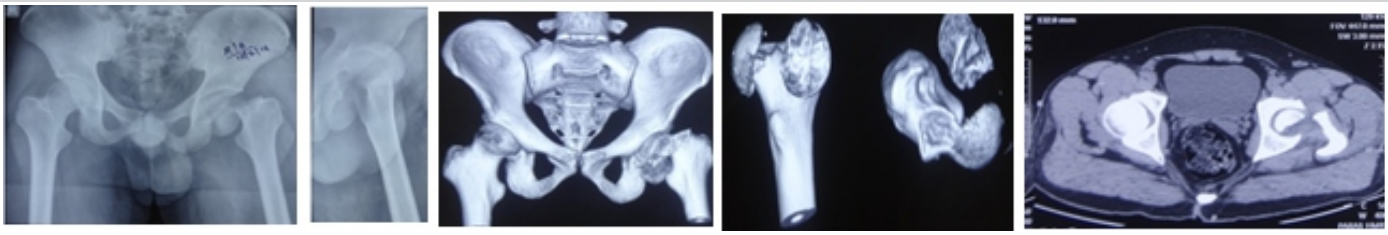

Figure 1: Pre-operative imaging. (a) Anteroposterior radiograph of pelvis with both hip joints showing displaced fracture neck of femur on left side, although fracture head of femur is not obvious here. (b) Lateral radiograph of the left hip showing head split into two parts almost vertically in a sagittal plane one fragment was lying posterior and the other one is in the joint. (c) Computed tomography (CT) scan with 3D reconstruction confirming the diagnosis of X–ray. (d) CT scan with 3D reconstruction with acetabulum and pelvic bone removed showing displaced split fracture of head. (e) 2D CT scan axial view showing one fracture fragment of femoral head inside the acetabulum and anterior displacement of proximal portion of fracture neck on the left side.

accident. He was working in an office (indoor) as an assistant manager in a government firm. He had an unusual mechanism of injury when he slipped from his two-wheeler in rain and hit his left side of the body to a tree. The patient sustained an injury of left hip joint and was admitted in a hospital at his hometown where initial evaluation, and first aid treatment was done. The patient came to our hospital 4 days after injury. A pelvic radiograph showed a Pipkin type III fracture (Fig. 1a). Trauma series radiographs of the patient ruled out fractures of other parts of the body. There was no comorbidity. Computed tomography revealed that the femoral head split into two parts almost vertically in a sagittal plane one fragment was lying posterior and the other one is in the joint. The associated femoral neck fracture was displaced anteriorly, sub-capital, and has irregular fracture line rotated externally. Tosounidis et al. [2] observed that in these injuries, the femoral neck fracture is always of vertical or irregular configuration and always displaced (Fig. 1c, 1d).

After, X-ray (anteroposterior view of pelvis with both hips) and computed tomography (CT) scan with 3D reconstruction, pre-operative assessment and planning, pre-anesthetic checkups, patient was posted for surgery on next day. The patient had been positioned in a floppy lateral position. Kocher-Langenbeck approach was used first to retrieve the posterior head fragment, which was lying free in the posterosuperior part of acetabulum just under the gluteus maximus, having come out through the ruptured short external rotators. Following this, a trochanteric flip osteotomy was done and the anterior part of the neck exposed. The free piece of the head fragment from the hip joint was delivered out (Fig. 2a). Frayed chondral tissue attached to the base of the femoral head fragment was debrided. The two fragments of the head were reduced and fixed using 3.5 mm locking head screws from the small fragment LCP set (Fig. 2b). Following this, the head fragment was reduced to the neck in as anatomical a position as possible. A fairly good match was achieved. We then use three long 5.5 mm titanium locking head screws to fix the reconstructed head to the neck from articular side of the head, through the fractured neck to the shaft (two from one fragment of the femoral head and one from other) (Fig. 2c). The reason for doing this was to avoid the screws fixing the femoral head. The reduction of the well-fixed proximal femur was done into the acetabulum by gentle manipulation. Reduction and provisional fixation of the osteotomized trochanter was done with Kirschner wires followed by definitive fixation using two 3.5 mm cortical screws.

The patient was encouraged to do range of motion exercise after the first post-operative dressing on day 2. This was followed by toe-touch weight-bearing with a walker and he was discharged from the hospital on day 7. Suture removal was done on day 12. Toe-touch weight-bearing was continued up to 6 weeks. Partial weight-bearing was allowed with a walker after 6 weeks. Full weight-bearing with active range of motion exercises against gravity, and cycling started at 12 weeks. The patient was allowed running and normal activity after signs of the radiological union at 6 months.

After 3 months, the patient started using a bicycle for outdoor activity and joined his office. At the 6 months follow-up, he could walk freely and perform activities of daily living, incomplete squatting, difficulty in sitting crossed legged and had a normal sexual function. The patient has no pain but terminal restriction of range of motion (flexion of left hip joint 0-80°) at 2 years

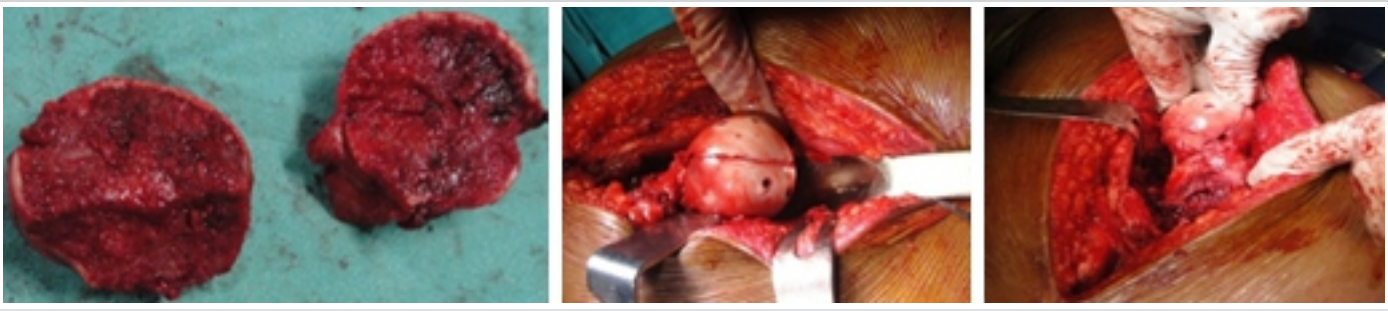

Figure 2: Intraoperative photographs (a) showing two major fracture fragments of head of femur outside the body. (b) Fixed with each other using 3.5 mm locking screws, which was countersunk. (c) Head fragment was reduced to the neck and fixed using 5.5 mm locking screws, which was countersunk.

Figure 3: Post-operative and follow-up imaging – (a) immediate post-operative X-ray anteroposterior (AP) view showing well reduced and fixed fracture using two small screws for the head and two large screws for the neck in retrograde manner, trochanteric osteotomy fixed using two cortical screws, (b and c) X-ray AP and lateral view after 2-year showing well maintained without significant collapse of femoral head. (d) Computed tomography scan: Axial cut after 2 years confirming the X-ray findings.

Figure 4: Post-operative follow-up imaging. (a and b) X-ray AP and lateral view after 4 years follow-up showing although joint space, spherical shape of head is well maintained without significant collapse. (c and d) AP and lateral view after 5 years showing minimal reduction joint space, sclerotic changes on acetabular side too, although spherical shape of head is well maintained with minimum collapse.

follow-up. The patient was able to use an Indian toilet with difficulty. There were signs of AVN on X-rays (Fig. 3b, 3c). Computed tomography was done which showed artifacts due to screws (Fig. 3c), although titanium is bound to produce lesser artifacts on radiological imaging. He was advised to continue physiotherapy and started on alendronate 70 mg weekly for 2 years.

Evaluation of the patient at 5 years showed similar functional status and range of motion of involved hip joint (Fig. 5). He was doing his job normally and managing quite well. The patient was able to walk without any restriction and was also able to go jogging, although he developed mild pain after running about 200–400 m. This mild pain can be correlated with minimal collapse of femoral head with other signs of AVN, although the patient was able to do his day-to-day activity with minimal difficulty. When comparing the imaging at 4th year follow up with the previous one at the 2nd years, femoral head appeared smoother in outline, with no progression of collapse (Fig 4a, 4b). It is noted here that the patient was on alendronate during this period. There is no change in functional status and minimal radiological change on final follow up at 5th year, like little more reduction of joint space, minimal collapse of femoral head and osteophyte lipping on both femoral and acetabular sides (Fig 4c, 4d). There was no heterotopic ossification.

Discussion

Almost all previous studies showed that these fractures are usually due to high-energy trauma, as in this study [6, 8, 9]. Usually, type III Pipkin's fractures occurred when the hip is in <60 degrees of flexion, although the patient was not sure about the position of the limb in our study [7]. In our study, the patient sustained a high-energy injury although the mechanism of injury

Figure 5: Clinical photographs at 5 years. (a) Hip joint extension in standing position. (b) The patient is able to do incomplete squatting with 80° of flexion of hip joint. (c) Restricted internal rotation up to 10° (d and e) able to do normal external rotation and abduction.

is unusual.

Unlike other Pipkin fractures, the intact femur is completely disconnected from the femoral head in type III. Therefore, the attempt of closed reduction will not be successful. We approached the hip joint posteriorly to retrieve the femoral head fragment followed by trochanteric slide osteotomy as described by Ganz et al. [10]. This approach gives an almost 360° view of the head and neck of femur without causing additional damage in vascularity and keeping posterosuperior retinaculum intact. Tannast et al. [11] advised intraoperative decision of osteosynthesis through surgical dislocation approach, in Pipkin type III fractures, if the posterosuperior retinaculum is intact. Although retinaculum was not intact in our case. We felt because the patient was young it was still important to try and salvage the head in the hope of delaying the arthroplasty, Considering that AVN is not always significantly Symptomatic. Nam et al. explained fate of asymptomatic osteonecrosis of femoral head, out of 105 asymptomatic hips with AVN in his study, he found that other 43 remained painless without collapse for 5 years or more. In the remaining 62, the mean interval between the initial diagnosis and the development of pain was 2 years and 1 month [12]. Assessing stage of AVN is sometimes difficult due to metal artifacts. These artifacts are comparatively less in titanium screws [13, 14]. Femoral head appears spherical and there was minimal collapse of the weight-bearing portion of the head after 5 years of osteosynthesis in this case.

The reasons for deciding to do the screw insertion from the articular side while fixing reconstructed head to the neck were, (I) we felt that we had better control during drilling and passing of the screws, (II) we were able to keep all screws perpendicular to the neck fracture, and (III) if we passed it from the trochanteric side, the screw head may be through the flip/osteotomy site and the ideal direction for the screws may be difficult to achieve. Knowing that traumatic AVN will follow a particular pattern, and the weight-bearing superolateral part will sink first, so we would have avoided screws in that part, by keeping in mind that after superolateral collapse, screw head will erode the acetabulum.

Park et al. [15] reviewed 65 femoral head fractures with hip dislocation retrospectively. He identified nine such injuries where the fractured femoral head was perched on the sharp angle of the posterior wall of the acetabulum without femoral neck fracture. He observed conversion to type III fracture from other types of Pipkin fractures in all five out of nine such cases where close reduction had been attempted. Therefore, he suggested not to attempt a close reduction in such injuries. Keong et al. so reported similar case of iatrogenic Pipkin Type III fracture after attempted hip relocation in a 35-year-old female with right posterior hip dislocation with femoral head fracture [2]. Park et al. [15] had managed two of five of iatrogenic type III fractures by osteosynthesis. He reported unsatisfactory outcomes in both. Arthroplasty was done at 7 months in one and 14 months in other, due to AVN of the femoral head. Keong et al. [2] also reported symptomatic osteonecrosis of the femoral head 4 months after osteosynthesis through Ganz approach and subsequently required conversion to arthroplasty. When comparing this case with our case, we felt that there is much more comminution with multiple fracture fragments of femoral head probably had a role. As in our case, it is just two fracture fragments of almost similar size with minimal comminution, because of which fairly good match was achieved, that may be a reason of almost spherical head without much of collapse after 5 years of follow-up. The other reason may be lesser comminution and lesser diameter of screws. Keong et al. used 4.5 mm headless compression screw of femoral head and 6.5 mm cortical screws of femoral neck, while we had used 3.5 mm and 5.5 mm screws in our case and resulted in more preservation of bone of femoral head.

Zhao et al. [6] reported a case of type III Pipkin's fracture with an acetabular fracture in a 34-year male. This patient had a satisfactory outcome after osteosynthesis through anterior and posterior approach after 1 year of follow-up.

Tonetti et al. [16] treated three out of four Pipkin type III fractures by osteosynthesis, all of those were later managed by arthroplasty due to an unsatisfactory outcome. Scolaro et al. [9] treated 13 such fractures by osteosynthesis, all of those were later managed by arthroplasty due to unsatisfactory outcome (he studied 147 femoral head fractures in a prospective study over 13 years). Giannoudis et al. [3] recommended osteosynthesis in these fractures in young patients, knowing the fact from his systemic review, that about half of osteosynthesis of Pipkin type III fracture resulted in unsatisfactory functional outcome.

Yu et al. treated six such fractures by different surgical methods: One case with THR, two with open reduction by cannulated screw fixation, and rest three cases with closed reduction by cannulated screw fixation of neck fracture leaving the femoral head fractures in non-weight-bearing area untreated. The functional outcome was good in three, fair in two, and poor in one. He recommended THA for these fractures as the rate of osteonecrosis will increase enormously for the destruction of blood supply of the femoral head by open reduction [7]. Although Kokubo et al. believed that young patients with Pipkin type III fractures should be managed by open reduction and internal fixation, whereas primary total hip arthroplasty may be a realistic option for elderly patients [4]. Thus, considering his age, (25 years) we decided for osteosynthesis in our case.

Tannast et al. [11] suggested doing osteosynthesis in only those patients with Pipkin type III fractures, who could comply with postoperative non-weight-bearing instructions. In this study, the

patient was enthusiastic and followed the instructions as explained to him.

Agarwala et al. [17] studied 100 hips with osteonecrosis (40 bilateral and 20 unilateral) including five cases of post-traumatic types. All of them were treated with alendronate 10 mg per day or 70 mg once per week, with 500–1000 mg of calcium and 400–800 IU Vitamin D3 and kept non-weight bearing. NSAIDs and analgesics were permitted as needed. They were assessed on the basis of changing requirement of analgesics X-rays (every 3–6 months) and magnetic resonance imaging (at interval of 3–12 months). He concluded that bisphosphonate can be beneficial for patients with early post-traumatic osteonecrosis provided there is no progression of collapse. There was functional improvement and prevention of osteonecrosis progression in their study. In our case, alendronate 70 mg weekly had been started after 2 years for a duration of 2 years, with other medications as explained.

The patient appeared functionally as well as radiologically improved at 5 years, which indicates that the result will last longer before further progression of AVN or complications like secondary arthritis. There is a posterior and inferior retinacular artery that gets restored in many cases if the head is well fixed entirely to each fragment and the neck [9].

Literature is divided into managing these types of fractures between arthroplasty and osteosynthesis. Most of the surgeons tended more toward primary arthroplasty even at a young due to the risk of AVN [15, 18]. Considering the age and occupation, we planned for osteosynthesis after proper counseling of the patient, keeping in mind that he may eventually need arthroplasty after a few years.

In case of collapse, the screw head will become prominent followed by progressive loss of articular cartilage and secondary arthritic changes. The removal of the implant will be difficult. At some stage, the patient will need to undergo THR. Tosounidis et al. [8] suggested difficulty in arthroplasty in those cases where surgical intervention was done previously. Surgical expertise did overcome this problem in many. It's hard to get enough cases of this type to get any type of consensus opinion.

Conclusion

Vascularity of the head of the femur is always compromised in these fractures which results in an almost inevitable complication of AVN. However, it may not always lead to significant collapse of the head and reasonable function may continue for many years as in this case study. Therefore, in young patient, it is justifiable to first try for osteosynthesis and hope for reasonable period of good functional status before proceeding to arthroplasty.

Clinical Message

Type III fractures are challenging and are associated with a poor prognosis. However, in young patients, it may be advisable to delay the need for arthroplasty. Fixation can be challenging and maybe best done using a safe surgical dislocation.

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