Irreducible Pipkin II femoral head fractures: Is transgluteal approach the best strategy?

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Accepted: 13 April 2010

Summary
Femoral head fracture-dislocations (FHFD) are rare, while irreducible cases are even less frequent. Truly irreducible fractures such as the two cases in this report must be differentiated from incomplete reduction due to incarcerated bone or soft tissue interposition. Opinions vary on the surgical approach to be used once the hip is reduced and the fragment of the femoral head yet remains to be stabilized. Reports in the literature do not usually take into account the specificity of irreducible lesions, which in our opinion should be treated by the transgluteal approach (TGA) while reducible forms can be treated by the Hueter approach. The transgluteal approach with the patient in the lateral decubitus position provides a direct anterior view of the antero-infero-medial fracture site as well as dorsal access via the injuries occasioned to dorsal soft tissues by the posterolateral dislocation. A lag screw can be used with this approach, which is the only way to stabilize the ligament teres femoris attachment.

Level of evidence: Level IV retrospective historical study.

Introduction
The incidence of femoral head fracture-dislocations (FHFD) is between 8 and 26% [1]. This entity is rare, and dislocations that cannot be reduced are even less frequent, with possible serious effects to future hip function in these cases. The main aetiology is a road accident [1—6]. The Pipkin [7] classification is most frequently used in these cases, but other classifications are sometimes mentioned [8—10]. Initial X-
rays are often of poor quality. Judet oblique views make it possible to complete the evaluation. CT-scan is sometimes difficult to obtain in emergencies, but should be systematic. Truly irreducible dislocations, where the femoral head cannot be reinserted into the acetabulum, as in our two cases, must be differentiated from incomplete reduction caused by a femoral head fragment or soft tissue interposition. [7]. Treatment of FHFD is difficult, and the surgical approach remains controversial. The aim of our study was to provide technical and anatomical support for the transgluteal approach (TGA) for the reduction and fixation of irreducible Pipkin II fractures.

**Observations**

In 1996 and 1999 two patients with irreducible Pipkin fractures were treated by the TGA by only incising the anterior part of the gluteus medius muscle, which is digastric with the lateralis vastus muscle. The first case involved a 24-year-old woman who presented with posterolateral dislocation (Fig. 1) and the second case a 37-year-old man who presented with posterolateral subluxation, with the head indented on the posterior rim of the acetabulum (Fig. 2). Both traumas occurred during road accidents. Close reduction was attempted with the patient under general anesthesia, curare induced muscle relaxation and a C-arm, using a maneuvre associating flexion, adduction and lateral disengagement of the hip with the patient in the decubitus dorsal position with counter-traction of the pelvis by an assistant. This was unsuccessful. With the transgluteal approach partial tearing of the pelvitrochanteric muscles was identified and the femoral head was found to be indented on the posterior rim of the acetabulum in case 2. Moreover a suprafoveal fragment of the femoral head, still attached to the ligament teres femoris was found in both cases. The cartilage on the intact part of the femoral head was explored, and in both cases abrasions were identified on the femoral head adjacent to the fracture line. Reintegration of the femoral head was extremely difficult due to a buttonhole effect from the capsulolabral incarceration. In both cases a femoral head extractor was introduced into the femoral neck by the greater trochanter to disengage the femoral head under curare muscle relaxation then manually and instrumentally free the interposed soft tissues. The hip was positioned in slight abduction with external rotation by an assistant to align the femoral head with the intraarticular fragment, which was left attached to the ligament teres femoris. Reduction was stabilized with two pins, whose direction was confirmed by frontal and profile slices with the C-arm (hip at 90° flexion and maximal abduction) making drilling and osteosynthesis possible. In case 1, the lag screw system was placed in trochanteric region with one canu- lated screw 7 mm in diameter (in this case, one of the two pins broke and was left in place). In case 2, the lag screw fixation was inserted into the femoral head with two canu- lated screws 3.5 mm in diameter whose heads were buried under the cartilage.

The posterior capsular fissure was repaired with absorbable suture. The posterior 1/3 of the detached labrum was repositioned and sutured to the capsule through the opening provided by the partial tearing of the pelvitrochanteric muscles from the dislocation. We did not use suture anchors on these soft tissues because peripheral elements were still intact.

The rehabilitation protocol in both cases included longitudinal traction for 3 weeks so that healing of the soft tissues could begin, as well as isometric muscle contractions. Walking rehabilitation without applying weight for a total of three months was then begun. Post-operative follow-up at 4 months showed no limping in either case.
Follow-up

Case 1: fracture union occurred in 3 months. At 13 years of follow-up the Merle d'Aubigné and Postel Classification (PMA) scores were 5/6/6 [11]. On X-ray, density was found to be restored in the medial half of the femoral head with bone cysts suggesting avascular necrosis of the medial head (which was slightly more extensive than the initial fracture fragment), but the femoral head remained circumferential. Superior-pole osteoarthritis was also noted with narrowing of the joint space of more than 50% (Fig. 3).

Case 2: at 4 months of follow-up the PMA score [11] was 6/6/6 and the patient had gone back to working as a plumber. X-ray revealed the presence of Brooker stage II ossifications [12]. The follow-up consultation at the 33rd month showed necrosis of the femoral head with osteoarthritis of the hip with a score of 4/6/4. Total hip arthroplasty was performed in June 2004 at 4½ years of follow-up (Fig. 4).

Discussion

Irreducibility

True irreducible dislocations as in our two cases must be distinguished from incomplete reduction, which may have many causes: rotation of the fracture fragment around the ligament teres femoris, impaction of the soft tissues or an osteochondral fragment [7]. In both our cases a button-hole effect associated with capsulolabral incarceration in the acetabulum was the cause of complete irreducibility. Moreover, in case 2 the femoral head was indented on the posterior acetabular rim.

Management of capsulolabral tears

Management of these tears is an important prognostic factor because the labrum plays a role in hip stability and lubrication, as well as in the distribution of mechanical stress, and resection results in an increase of mechanical loading on the cartilage of more than 90% [13]. Thus, theoretically at least, failure to stabilize the labrum is a negative prognostic factor. In non-traumatic cases, Sadri [14] did not find better results when the labrum was stabilized with anchor sutures than after resection of the damaged area. However, if the tear is more than 1/3 of the circumference of the acetabular rim, fixation with at least three suture-anchors seems to be preferable to resection. In a study on femoro-acetabular impingement, Espinosa et al. [15] obtained better results in the group, which underwent labral re-fixation.

Dangers of irreducibility

With a high-energy impact and a large femoral head fragment, irreducibility can weaken the femoral neck, thus the radiological evaluation must confirm that the femoral head and neck are intact before attempting reduction. Type III femoral neck fractures are often a result of accidents during orthopedic reduction [2,3,7,16–18]. The review of the literature of iatrogenic type III fractures by Sy et al. [18] noted that 13/14 cases occurred during attempts to reduce type II fractures. This type of lesion is therefore at high risk of complications, which should be prevented by a precise initial diagnosis, gentle manoeuvres during reduction, and complete muscle relaxation under anesthesia.

Surgical approach

Although the treatment of irreducible FHFD fractures can only be surgical, opinions vary on the type of surgical
<table>
<thead>
<tr>
<th>Authors</th>
<th>Approach</th>
<th>Advantage 1</th>
<th>Advantage 2</th>
<th>Disadvantage 1</th>
<th>Disadvantage 2</th>
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<tbody>
<tr>
<td>Butler [4]</td>
<td>Lateral approach with trochanterotomy</td>
<td>Good access to the anterior and posterior part of the joint</td>
<td>Nil</td>
<td>Necrosis due to possible injury to the circumflex artery during trochanterotomy</td>
<td>Pseudarthrosis of the trochanteric region</td>
</tr>
<tr>
<td>Roeder et Delee [3] and Epstein [17]</td>
<td>Posterior approach</td>
<td>Good access to the posterior dislocation and the posterior wall of the acetabulum</td>
<td>Good for the treatment of Pipkin IV fractures</td>
<td>Difficult to control reduction</td>
<td>No direct fixation of the femoral head</td>
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<td>Duquennoy et al. [2]</td>
<td>Watson-Jones approach</td>
<td>No MCA injury</td>
<td>Visual control of reduction of dislocation and direct fixation of the fragment after dislocation of the hip</td>
<td>Possible superior gluteal nerve injury</td>
<td>No dorsal access in the presence of an irreducible dislocation, to reduce the hip and free any incarceration</td>
</tr>
<tr>
<td>Stannard et al. [6]</td>
<td>Smith Petersen approach</td>
<td>No MCA injury</td>
<td>Visual control of reduction of the dislocation and direct fixation of the fragment after dislocation of the hip</td>
<td>Can only be performed in the decubitus dorsal position</td>
<td>No dorsal access in irreducible dislocations to reduce the hip and free and incarceration</td>
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<tr>
<td>Vielpeau et al. [1]</td>
<td>Hardinge or Thomine type transgluteal approach</td>
<td>No MCA injury</td>
<td>Visual control of reduction of the dislocation and direct fixation of the fragment after dislocation of the hip</td>
<td>Performed in decubitus lateral position</td>
<td>Dorsal access possible through soft tissue damage caused by the dislocation</td>
</tr>
<tr>
<td>Ganz et al. [24]</td>
<td>Digastric Trochanterotomy</td>
<td>360° access to the acetabulum and the femoral head</td>
<td>Good for the treatment of Pipkin type IV fractures Direct screw fixation possible if the ligament teres femorus is incised</td>
<td>Trochanteric osteosynthesis may fail</td>
<td>Trochanteric pseudarthrosis (but less than in with a classic trochanterotomy because the gluteal medius and the vastus lateralis remain intact)</td>
</tr>
<tr>
<td>Nazarian and Muller [23]</td>
<td>Ludloff approach</td>
<td>Anatomical approach with no incision of muscles</td>
<td>Direct screw fixation, the ligament teres femoris is preserved</td>
<td>Control limited to the coxofemoral joint</td>
<td>Rarely used, near to the genital region</td>
</tr>
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MCA: Medial circumflex artery.
approach to be used to repair and stabilise this entity. To our knowledge none of the authors except Vielpeau et al. [1], takes into account the specificity of the irreducible lesion, which, for us, must be treated through the TGA, while reducible cases can be treated by the Hueter approach. The advantages and disadvantages of these different approaches are reported in Table 1. Knowledge of the anatomy of the medial circumflex femoral artery (MCA) is essential during the trochanterotomy because the deep branch of this artery can be damaged if a retractor placed in the medially-posterior zone above the trochanter slips [19]. The modified trochanterotomy described by Siebenrock et al. [20] has been proposed for acatabular fractures, and provides access to the posterior and posterosuperior acetabulum, and to a small zone of the anterior column above the anterior inferior iliac spine. In order to protect the MCA, these authors [20] do not incise the obturator externus or the quadratus femoris muscles. When a posterior approach is used there is a risk of damage to the deep branch of the MCA, the main source of vascularization of the femoral head [19]. During hip dislocation treated by simple closed reduction, the incidence of necrosis is 11%. This increases to 31% after surgical management of dislocation-fractures [19], in particular due to iatrogenic damage to the vascularization of the femoral head, especially the MCA [19]. For Epstein [17] there is damage to femoral head vascularization during posterior dislocation, and he does not advise using anterior approaches which would impede the contribution of the lateral circumflex femoral artery LCA which is still patent, although its vascular contribution is limited [19]. Khan et al. [21] compared blood flow in the femoral head during hip resurfacing by the anterolateral and posterior approach after injection of cefoxime. The concentration of the antibiotic was significantly higher during the anterolateral approach, with a significant reduction in vascularization of the femoral head during the posterior approach [21]. The modified Watson-Jones approach [22], which is performed with the patient in the lateral decubitus position, preserves the blood supply to the femoral head and provides good anterior access, but in cases of irreducible posterior dislocation, it would be difficult to implement. With the Ludloff approach [23] which is more frequently used by pediatric orthopedic surgeons, in particular for realignment of congenital dislocations of the hip, direct fixation of the femoral head fragment with a screw is possible but only if the posterior dislocation has been reduced. The approach described by Ganz et al. [24] includes a trochanteric flip osteotomy of 15 mm of the trochanter and preserves continuity with the gluteus medius muscle and the vastus lateralis muscle. This approach makes it possible to surgically dislocate the hip in the decubitus lateral position and obtain 360° exposure of the acetabulum and the femoral head to clearly identify all osteochondral lesions.

We used a TGA with the patient in the lateral decubitus position. This approach provided direct access to the antero-infero-medial femoral bone fragment because the incision exposes the anterior hip joint. Dorsal access is possible without touching the posterior joint and especially without making existing injuries worse. Indeed our experience has shown that posterolateral dislocation causes damage to the pelvitrochanteric muscles, and with this approach any posterior incarceration of the capsule or the labrum can be freed manually or with an instrument, which we did in both our cases. The hip was then disengaged by introducing a femoral head extractor through the greater trochanter into the femoral neck. Visualisation is also better than with a posterior approach because of the anatomy of the acetabulum: the anterior acetabular wall is not as wide, and the acetabulum and femoral neck are anteverted.

Several variations of the TGA, which can be performed with the patient in the lateral or dorsal decubitus have been described including the Hardinge approach [25]. These variations mainly concern the incision line of the gluteus medius, which can be more or less anterior in greater trochancter region and in the muscle. With the Hardinge approach [25] the incision line is in the middle of the gluteus medius. With our approach only the anterior part of the gluteus medius was incised with the periostum to maintain a maximum amount of material for reinsertion. In this way it is similar to the approach by Thomine et al. [26] who limit the incision line to the anterior part of the gluteus medius where it converges with its tendon without touching the vastus lateralis muscle.

**Screw fixation technique**

Direct screw fixation to preserve the attachment of the ligament teres femoris is only possible with the Ludloff [23] approach. With other approaches, only lag screw fixation, which begins in the trochanteric region or the femoral head makes it possible to preserve the attachment of the ligament teres femoris to the femoral head fragment. Direct mediolateral screw fixation is impossible because the sagittal direction of the fracture line and the medial soft tissues make it impossible to obtain proper inclination of the screw even with the hip in maximum lateral rotation. With the Ganz approach [24] surgical hip dislocation is possible and the fracture can be screwed directly but only after incising the ligamentum teres femoris. In type II fractures, reduction of the fragment is easier when it is still attached to the ligamentum teres femoris [27]. From an anatomical point of view, the vessels of the ligament teres femoris are always present but vary in size [28–31]. For Sevitt and Thompson [31] the arteries of the ligament teres femoris are absent or minimal in the femoral head and any vascularization is limited to a part of the subfoveal zone. It should be noted that if this artery is cut during total hip replacement, coagulation is often necessary, and there is a non-negligible amount of blood flow. We used non-absorbable cannulated screws whose heads were buried in case 2, but bioabsorbable polylactide pins have also been used with success [32].

**Role of hip arthroscopy**

Whatever the approach used, arthroscopy of the hip during surgery makes it possible to evaluate chondral lesions and to remove any existing foreign bodies. Its prognostic value is essential, because the presence of impactions and/or abrasions to the cartilage can compromise the outcome of the hip. It is essential in reducible dislocations requiring screw fixation by an anterior approach and where overall access to the hip is limited, while in our cases, the TGA and
the access provided by the pelvitrochanteric muscle lesions made direct evaluation possible.

**Complications**

Avascular necrosis of the femoral head is the most serious complication after surgically treated dislocation, and this developed fairly rapidly in both our cases. Although 13 years and 9 months after surgery the clinical results are satisfactory in our first case, the medial part of the femoral head appears necrotic with osteoarthritic lesions. Nevertheless, the fragment was realigned and union was obtained. We do not believe that the surgical approach played a role in the outcome of these two hips because at worst this approach would result in injury to the LCA, which does not play a major role in vascularization of the femoral head [19]. Posterior dislocation seems to be the cause. Indeed, in case 1, the femoral head is healthy except for the medial fragment. However, we cannot compare our results to other series in the literature because there are only two cases. Stannard et al. [6] combined their series with that of Swiontkowski et al. [33] and Marchetti et al. [34]. Their results showed that avascular necrosis developed in eight out of 40 cases treated by the posterior approach while only two cases of necrosis occurred in 32 cases treated by the anterior approach. These authors concluded that there was a greater chance of developing necrosis with the posterior approach; with results that were nearly significant ($p = 0.09$). The study by Vielpeau et al. [1] found an unfavorable outcome in 19 cases out of 26, all types of FHFD combined, with 16 cases of osteoarthritis and three cases of severe avascular necrosis. An analysis of this series after at least 5 years of follow-up reported osteoarthritis in approximately 20% of cases. [1].

**Conclusion**

Surgical treatment of femoral head fracture-dislocations must not worsen existing injuries. There is a high risk of femoral head fractures in Pipkin II irreducible type dislocations during reduction. The transgluteal approach with the patient in the lateral decubitus position provides direct antero-infero-medial and dorsal access to the fracture site because of musculocapsular lesions caused by the dislocation. The only way to preserve the ligament teres femoris is by using a lag screw through the greater trochanter or the femoral head itself.

**Conflict of interest statement**

No conflicts of interest.

**References**


