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ORTHOPAEDIC SURGERY

Posterior wall acetabular fracture in a 13-year-old boy treated by open reduction and mini-plate internal fixation: long-term follow-up of 17 years

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Abstract

Background Acetabular fractures are uncommon in children and adolescents, mainly because of predominant cartilaginous component and strong surrounding ligaments. Although acetabular fractures at this age can lead to significant disability, there is no consensus regarding management, which continues to be controversial. Particularly, long-term outcome after operative management has not been evaluated.

Case presentation We report a case of a 13-year-old boy skeletally immature who presented with an isolated acetabular fracture involving the posterior wall secondary to a traumatic hip dislocation. A Kocher-Langenbeck approach with a surgical luxation of the hip was used for reduction and mini-plate internal fixation of the fracture. Long-term (17-year) follow-up showed a good clinical outcome and a good congruence of the. The patient has bilateral beginning osteoarthritis due to a cam configuration of both hips

Conclusion We describe a case of successful operative management of an acetabulum fracture in a skelettaly immature child with a long-term follow-up. Aggressive management of this rare type of fractures may lead to durable positive outcome.

Keywords Acetabular fracture · Pediatric orthopaedic surgery · Posterior wall fracture · Mini-plate internal fixation

Introduction

Pelvic fractures are rare in children and adolescents, comprising between 1% and 4.6% of all pediatric fractures [1]. Acetabular fractures are even rarer, counting for only 0.8 to 15% of pelvic fractures [1]. The lack of maturity of the acetabulum, with a high volume of thick cartilage, provides an increased elasticity, which could explain the rarity of this fracture at this age. In addition, radiographic workup is difficult in the immature skeleton. Although Buchholz proposed a classification according to the Salter-Harris classification [3], there is no specific classification of acetabular fractures in childhood [2]. Posterior acetabular wall fractures are the most common acetabular injuries [1, 11]. Treatment of these fractures among adolescents remains primarily conservative [1] and there is no consensus on surgical management [6]. We present a case of a 13-year-old boy who benefited from the surgical management of an acetabular fracture using open reduction and mini-plate fixation.

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Case report

History and evaluation

A 13-year-old boy without previous medical history presented after a trauma while playing floor hockey. Witnesses reported his right hip was flexed and internally rotated, leading to a fall on the right side. There was no closed reduction performed after the trauma. A first radiological examination revealed a congruent joint, but the fracture was not initially diagnosed and conservative management was performed. The skeleton was immature with naturally open physis of the triradiate cartilage.

A few days later, the patient experienced severe pain in the groin after bending forward.

Imaging studies

A new radiological examination with a computer tomographic scanning was performed, showing a fracture of the posterior wall with a bone fragment measuring 30 mm × 6 mm, and damage to the transverse fracture line of the triradiate cartilage in its most posterior part. The articulation was still congruent without any signs of subluxation. Analysis of the relative location of the osseous borders of the anterior and posterior walls on the transvers CT scans revealed retroversion of the acetabulum.

Clinical findings

The patient was able to walk without crutches and the clinical examination revealed groin pain when testing the mobility of the hip. Flexion was pain-limited to 70° and tenderness on palpation of the external rotators muscles. Due to the pre-existing acetabular retroversion and the traumatic partial deficiency of the posterior wall, the indication for open reduction and fragment fixation was given to improve joint containment (Fig. 1).

Operative management

With the patient in a lateral position, a Kocher-Langenbeck approach with trochanter-flip osteotomy and subsequent surgical hip luxation was performed. Intraoperatively, a partial tear of the piriformis muscle and tendon was visualized indicating the pathway of the traumatic hip dislocation. After dislocation of the joint, a tear of the labrum was detected next to the distal fracture line, whilst towards proximally the labrum remained attached to the dislocated fragment of the posterior wall (Fig. 2). The cartilage of the acetabulum was intact, but, on the femoral head some small (not full cartilage thickness) scratches were identified. The perfusion of the femoral head remained undisturbed during the whole operative procedure proven by normal bleeding through a 1.5 mm borehole.

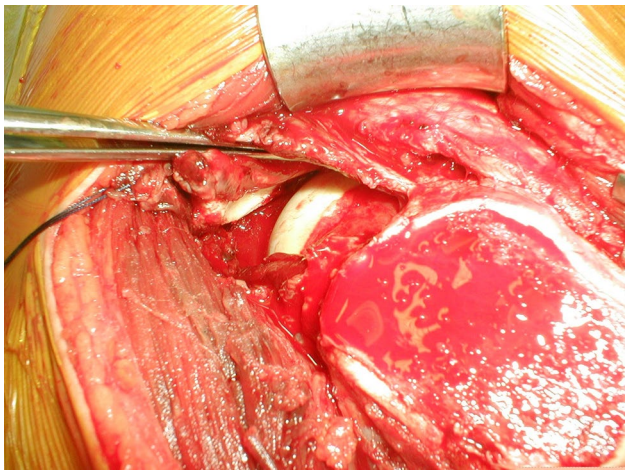

Fig. 2 Intraoperative picture showing a tear of the labrum next the distal fracture line, with proximally labrum attached to the dislocated fragment of the posterior wall. The patient was in lateral position

The fragment of the posterior wall and the attached labrum were anatomically reduced and stabilized by means of two 2.4 mm titanium T-plates (Fig. 3).

Outcome and follow-up

After surgery, the patient respected a partial weight-bearing with crutches for 12 weeks. He received an Indocid therapy for 4 weeks to prevent heterotopic ossifications. 6 months after the operation, return to previous activities was possible. Due to discomfort caused by the screws used for refixation of the greater trochanter osteotomy, implant removal was

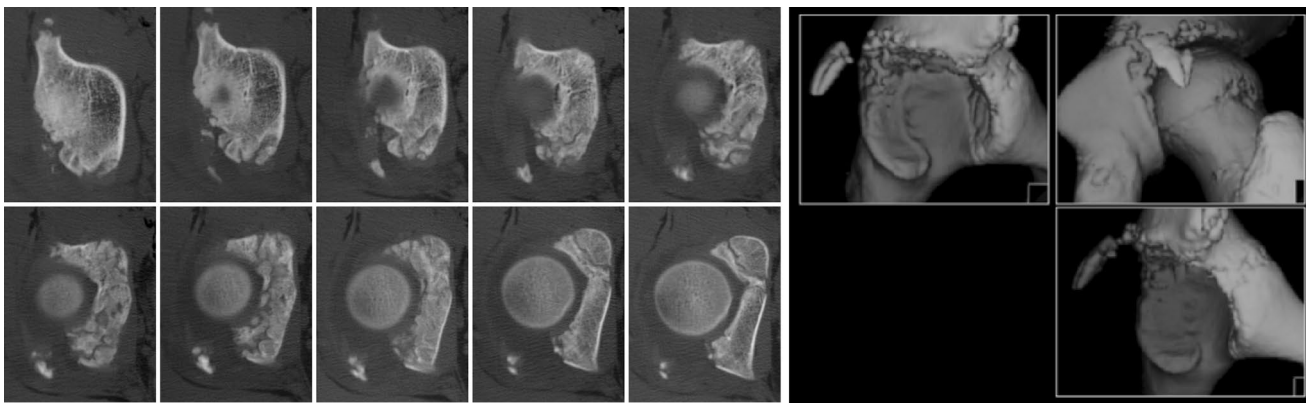

Fig. 1 Preoperative CT-scan, axial view and 3D reconstruction, showing acetabular fracture with displacement of a bone fragment of the posterior wall and involvement of the posterior part of the transverse growth line. The acetabulum is retroverted

performed one year after the operation. At 5 years follow-up, the CT scan showed a good congruence of the joint (Fig. 4). The growth line was closed without callus formation, implants were intact and remained extra-articular.

At 17-year follow-up (Fig. 5), the functional outcome was measured with the Harris Hip score which was 96 out of 100 (score between 90 and 100 means excellent), with the HOOS (Hip disability and Osteoarthritis Outcome Score) which was 97.5%, with the UCLA Activity score of 10/10 and the Merle d'Aubigné score of 18 on 18. Radiographic examination included an anteroposterior pelvic as well as the standard Letournel views (iliac oblique and obturator oblique views). First signs of osteoarthritis was seen at last follow-up on both sides with osteophyte formation around both femoral heads (on the left side more important than on the right) and loss of cartilage thickness in the weight-bearing area of the joint bilaterally due to a cam morphology of both proximal femora. Clinically the patient was able to walk without any restriction and to perform sports activities (soccer). Clinically, no limp and no leg length discrepancy were present. Mobility testing revealed a slight reduction of hip flexion on the right, while mobility was found to symmetric

Fig. 3 Postoperative radiographs with three pelvic views showing good fracture reduction

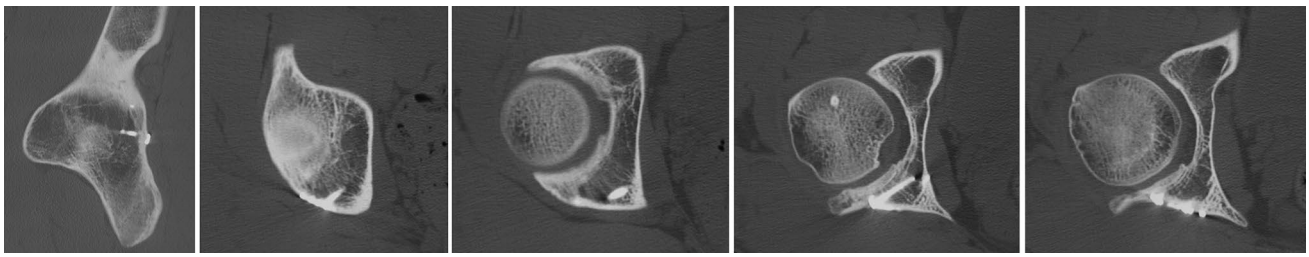

Fig. 4 5-year follow-up CT-scan showing appropriate joint congruence. No signs of femoral head necrosis. Implants are intact and remain extra-articular

Fig. 5 17-year follow-up radiographs with three pelvic views showing first signs of osteoarthritis on both sides due to a cam deformity of both proximal femora

Table 1 Range of hip motion at 17-year follow-up

Side	Flexion (°)	Internal rotation with 90° of flexion/extension	External rotation with 90° of flexion/extension	Abduction in extension (°)	Adduction in extension (°)
Left	105°	5°/25°	30°/25°	40°	20°
Right	100°	5°/25°	25°/25°	40°	20°

for abduction–adduction and internal–external rotation of the flexed and extended hip joint (Table 1).

Discussion

Limited papers about acetabular fractures among adolescents are available in the literature, and only a few series describe long-term follow-up of surgical management [10, 12]. The correct management of acetabulum fractures in children is particularly important due to the risk of premature closure of the triradiate cartilage. This may lead in the short-term to acetabulum growth disorders with thickening of the acetabular teardrop and hip subluxation. Moreover, there is a risk of premature osteoarthritis if the articulation remains incongruent.

First, the diagnosis of isolated acetabulum fractures can be difficult, because of the very thick cartilage of the joint and the immature surrounding skeleton. An anteroposterior pelvic radiographs as well as Letournel views are required for radiographic analysis.

In the literature, authors report between 22 and 80% of missed diagnosis of acetabular fractures on initial standard radiographs [3, 6, 10, 15]. As per our case, a CT scanner examination is often required to reveal the fracture. It was long thought that the immaturity of the acetabulum allowed sufficient remodeling without surgical management and these fractures were often treated conservatively. The risk of harming the growth of immature triradiate cartilage was also a reason to prefer conservative treatment [3, 13].

Only few authors analyzed the outcome of nonoperative versus surgical treatment for acetabular fractures of the children and adolescents and no specific treatment algorithm is reported in the literature [6]. Recent studies highlighted the long-term effects of conservative treatment, including the risk of early osteoarthritis [10, 12, 14]. Generally, there is an indication for surgical management in case of remaining fracture displacement, joint incongruence, or incarcerated fragments [7–9]. The surgical stabilization techniques and the choice of implants vary widely according to the different authors and the individual need for stabilization of the different acetabular fracture types. Small plates, single screws or the use of K-wires are reported for fracture fixation [6]. Slongo et al. recommended 2.7 mm or 3.5 mm reconstruction plates 2. But, the choice of implants has to be adapted to the size of the fragments and the individual fracture pattern.

In our case, the posterior wall fragment was relatively small; thus, we had to use very small plates positioned very closed to the joint allowing fixation without the interference of the implant with the posterior joint space. Surgical hip luxation using the Kocher-Langenbeck approach is a very convenient approach with a very low risk of circulatory disorders and avascular necrosis of the femoral head [4, 5]. This approach allows a complete view of the acetabulum and the femoral head allows at the end of the procedure the control of the quality of reduction and assure the safe extra-articular position of all implants used. Finally, one could argue that a conservative management would have been possible in our case. However, there were early signs of osteoarthritis at last follow-up, after 17 years. With a non-operative management, it is likely that this would have been happening before. This could have then required other more invasive surgical procedures.

Conclusion

We present a case of surgical management of an acetabular fracture in an adolescent with immature cartilage, using surgical hip dislocation for reduction and fracture fixation using mini-plates. Our favorable long-term result, suggests that aggressive management with an adapted technique of internal fixation of those rare fractures should be considered. An open reduction and internal fixation by mini-plates was a safe and long-term successful surgical option in our case.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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