8 Acetabulum Posterior Wall/Column Fractures

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Anatomical Fracture Location: Radiograph of Fracture Pattern

Posterior wall (PW) acetabulum fractures represents one of the elementary fracture patterns of the acetabulum, according to the Judet and Letournel classification [1]. It is considered as the most common fracture type comprising 23% of all acetabulum fractures [2]. On the contrary, posterior column (PC) fractures are rarer with a reported incidence of 3.5% [2]. The incidence of simultaneous existence of PW and PC fracture is slightly higher, approximately 6% [2]. Furthermore, fracture patterns involving the femoral head (Pipkin injuries) are less frequent and account for 2% of injuries sustained.

Both PW and PC acetabulum fractures are sustained following high-energy trauma. Posterior femoral head dislocation is a common finding following PW fractures (Fig. 8.1). Fracture-dislocation of the acetabulum with or without sciatic nerve palsy represents an orthopaedic emergency as there is a high risk of damage to the blood supply to the femoral head, increasing the risk of avascular necrosis (AVN). Prompt reduction of the dislocation and application of skeletal traction are common practices until definitive reconstruction of the acetabulum can be performed.

Fig. 8.1 AP radiograph right hip showing posterior fracture-dislocation of right femoral head

Whether these injuries present in isolation or in the context of polytrauma, initial management should be according to the ATLS guidelines.

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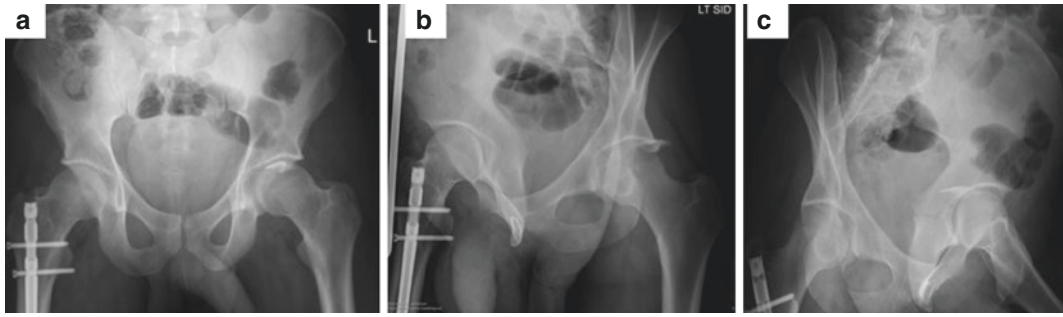

Fig. 8.2 (**a**) AP radiograph; (**b**) obturator oblique view of left hip; (**c**) iliac oblique view of left hip demonstrating a transverse posterior wall fracture

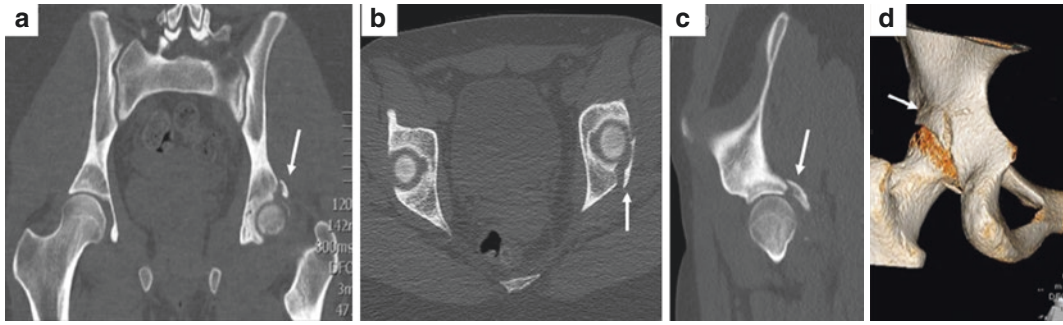

Fig. 8.3 (**a**–**c**) CT slices; (**d**) 3-D CT slice showing a posterior wall fracture of the left acetabulum

Assessment and accurate documentation of the neurovascular status of the affected extremity are essential prior to surgery. Routine initial radiographic workup includes an AP pelvic radiograph and Judet views (Fig. 8.2a–c). CT scan acquisition including 3-D reconstruction slices completes the radiological assessment of the joint as it allows accurate fracture classification, fracture topography and the diagnosis of marginal impaction, femoral head lesions and small fragment incarceration within the joint (Fig. 8.3a–d).

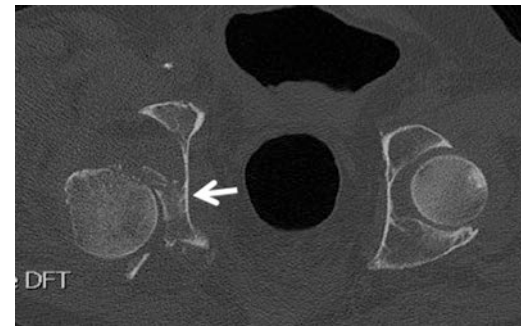

Fig. 8.4 CT pelvic slice axial cut slice demonstrating fracture-dislocation of right posterior wall with articular impaction (arrow)

Brief Preoperative Planning

Careful evaluation of the CT scan is of paramount importance in order to execute an appropriate and precise operative plan. The fracture pattern usually dictates the surgical approach to be utilised for fracture fixation. In addition, the size of the posterior wall fragment must be assessed. Fractures involving less that 20% of the PW surface may be stable during examination under anaesthesia and as such may be treated with no operative means. The Kocher-Langenbeck is the most common surgical approach used for PW and PC acetabulum fractures. The presence of comminution, impaction, femoral head lesions and small fragment incarceration in the acetabulum socket must be well documented prior to surgery (Fig. 8.4). A detailed plan must be compiled in terms of fracture reduction and stabilisation.

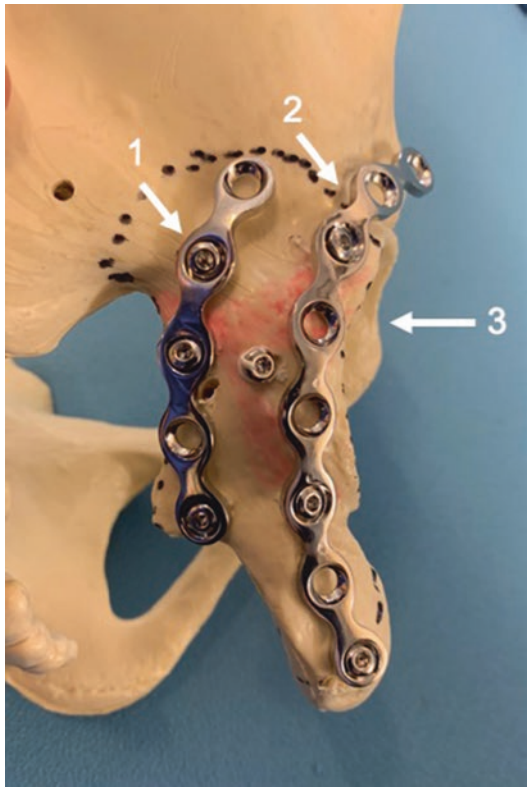

Fig. 8.5 The application of two plates is demonstrated on a plastic pelvic bone: arrows indicate *1* plate placed over posterior column, *2* plate placed over posterior wall and *3* socket of acetabulum

Isolated PW fractures usually represent straightforward cases for reconstruction. Acetabulum lip fractures with or without comminution represent unique cases where routine reconstruction may not be possible and the concept of 'spring plates' can be applied [3, 4]. Combined PW and PC fractures require careful planning and the application of two plates, one buttressing the PW fragment and the other one supporting the PC element of the injury (Fig. 8.5). Impaction injuries require the knowledge of special techniques in relation to reduction, management of the cancellous void created in the subchondral region (grafting options) and support of the impacted segment. The so-called two-level reconstruction technique can be considered as a treatment option with good results having been published in the literature [5].

Surgery is planned when the patient is physiologically stable and usually takes place 2–5 days after the injury. Two to four units of blood should be available operatively in case of bleeding relating to a pre-existing lesion or iatrogenic damage to the superior gluteal artery.

Patient Set-Up in Theatre

The patient receives general anaesthesia and prophylactic antibiotics as per hospital protocol. A Foley catheter is inserted prior to the operation. In our practice, we use the OSI radiolucent fracture table. This provides controlled traction through a distal femoral Denham pin (Fig. 8.6). Traction is applied with the knee flexed approximately 90° (this position minimises damage to the sciatic nerve). For reconstruction of these fractures, we use the Matta plating system. The patient is positioned prone with a well-padded radiolucent pudendal post. We are aware that other authors may prefer the lateral decubitus position, which allows performing trochanteric digastric osteotomy and surgical hip dislocation in complex cases. In order for the abdomen to hang free, padded supports are placed underneath the chest and the iliac spines. Both upper extremities are placed in abduction to reduce the risk of damage to the brachial plexus. The image intensifier is positioned on the opposite side of the surgeon, thus not interfering with the operative field. Prior to initiation of the procedure, the surgeon must check that he can obtain successfully all the fluoroscopic views required during the procedure (AP pelvis, Judet views: obturator oblique and iliac oblique views). The instrumentation is set up on the site of the operation.

Closed Reduction Manoeuvres

Closed reduction is necessary to reduce associated fracture-dislocations. This is usually done in the supine position under general anaesthetic and with good muscle relaxation. For posterior dislocations, the principles of reduction are flexion, internal rotation and adduction of the hip.

Fig. 8.6 Intraoperative picture showing the position of the patient (prone) on the OSI table with skeletal traction via a distal femoral pain and the knee flexed almost at 90°

Such techniques have been described as the Allis, Bigelow, Lefkowitz and Howard manoeuvres amongst others [6].

Reduction Instruments

The standard pelvic reduction set is mandatory in performing the procedure. Overall, reduction instruments that would aid fracture reduction include pelvic Hohmann and sciatic nerve retractors, forceps with handles and jaws of different lengths (straight and oblique versions), ball spike with pointed ball tip, round and rectangular disks, Farabeuf forceps, Jungbluth forceps and medium and large bone hooks. In addition, K-wires, Schanz screws, osteotomes and 2.0 mm cortical screws (application of the two-level reconstruction technique) can be useful.

Surgical Approach

The skin is prepared from above the posterior iliac crest to the distal femur. Good isolation of the pilonidal area and the gluteal crease is essential. The greater trochanter represents the centre

Fig. 8.7 Intraoperative image showing the skin incision for Kocher-Langenbeck

of the incision which is extended proximally (directed towards the posterior-superior iliac spine but ends approximately 5 cm short of it) and distally along the lateral aspect of the thigh (runs approximately 10–12 cm in length) (Fig. 8.7). The skin and the superficial fascia are incised exposing the fascia lata of the lateral thigh and the thin deep fascia overlying the gluteus maximus muscle.

Subsequently, the fascia lata is divided in line with the skin incision; proximally, it ends at the distal aspect of the gluteus maximus muscle fibres. Distally, the fascia should be split up to the level of the gluteus maximus tendon insertion. Proximally, the fibres of the gluteus maximus muscle are split to the extent that easy

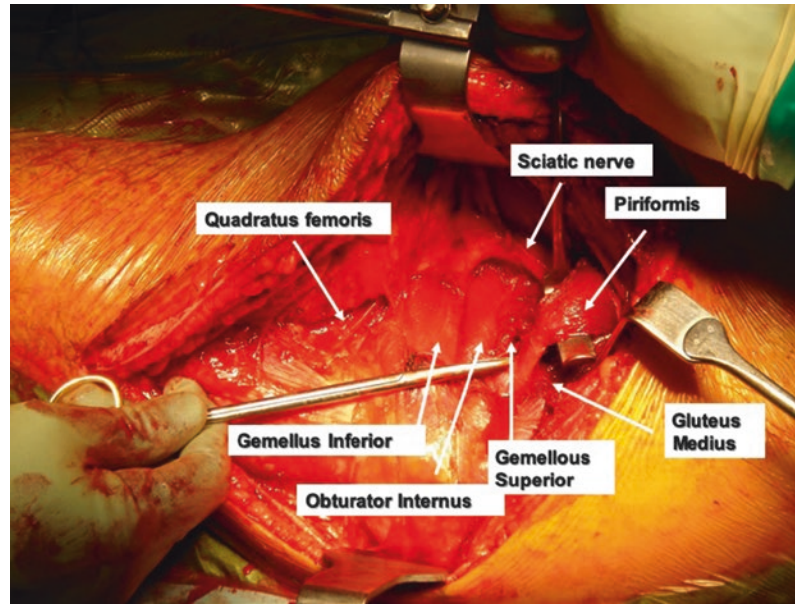

Fig. 8.8 Intraoperative picture of approach of Kocher-Langenbeck with important structures is recognised

access can be achieved to the deeper muscles of gluteus medius and minimus. To achieve adequate safe posteromedial retraction of the gluteus maximus muscle, release of the gluteus maximus insertion from the femur can be performed. Here, care should be taken to reduce the risk of causing damage to the perforating branch of the profunda femoris artery which is in close proximity. Identification of the sciatic nerve is the next important step of the procedure. The nerve can be traced over quadratus femoris muscle as it continues its path proximally to enter the greater sciatic notch. In case of a fracture-dislocation, bruising or even a hole may be seen/felt over the short external rotators. The piriformis tendon running next to gluteus minimus can be visualised or identified by palpation and smooth dissection (Fig. 8.8). It can be tagged with a stay suture and released from its insertion. Identification of the obturator internus tendon with the superior and inferior gemelli muscles should follow next (Fig. 8.8). Easy access to its deep surface can be achieved by rotating the hip externally. The tendon is tagged with a stay suture and released from its insertion. The incision for both the piriformis and the obturator internus should be at least 1.5 cm from their insertion into the greater trochanter in order to reduce the risk of damage to the blood supply to the femoral head. For better exposure, the obturator internus tendon and the gemelli should be elevated from the hip capsule allowing access to the lesser sciatic notch. Access to the greater sciatic notch is made by following the piriformis tendon in its pelvic origin. Here, care should be taken to avoid iatrogenic injury to the sciatic nerve and to superior gluteal neurovascular bundle. Usually, the extent of the fracture pattern commands the extent of the surgical approach. When a fracture-dislocation has taken place, visualisation of the hip joint is achievable without the need to perform capsulotomy. Moreover, good inspection of the joint can be performed through the fracture (fracture is reflected allowing better access to the joint) facilitating recognition and management of marginal impaction injuries (Fig. 8.9). Traction of the femur will allow better exposure of the intra-articular area of the hip joint. The femoral head must be inspected for any associated articular damage.

Open Reduction Manoeuvres

If there are any small osteochondral fragments in the joint (non-viable) which are not amenable to reconstruction, then they can be excised. If there is marginal impaction, it should be ele-

vated with an osteotome to its anatomical position. Usually, the femoral head is used as a template for the reduction. The articular depressed segment can be stabilised with K-wires and can be fixed with 2.0 mm cortical screws (if there is adequate subchondral bone available) (Fig. 8.10a, b). Any residual void in the subchondral area can be filled with a bone substitute or tricortical bone graft harvested from the posterior iliac crest (Fig. 8.11a, b). Any posterior column displacement (medial) can be addressed with a bone hook inserted into the lesser sciatic notch (Fig. 8.12).

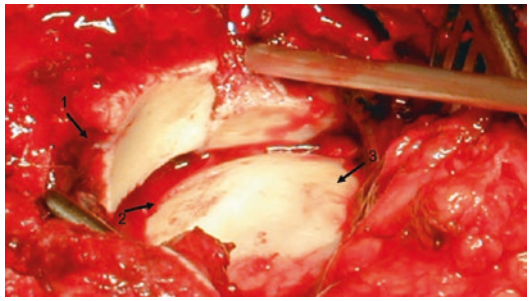

Fig. 8.9 Intraoperative picture demonstrating marginal impaction (1). Articular surface of acetabulum (2) and femoral head (3)

Implant Insertion

The outer posterior wall fragment(s) are reduced with a ball spike pusher and temporarily held with K-wires. The PW fragment can be fixed to the PC through the insertion of 1 or 2 lag screws (Fig. 8.13). The direction of screw insertion should be parallel to the ground to avoid intra-articular screw penetration. 3.5 mm screws are inserted in a lag mode from the wall to the posterior column. The screw length is determined through use of the measuring depth gauge. The reconstruction is neutralised with the application of 8- or 10-hole 3.5 mm reconstruction plate which is contoured to accommodate the shape of the posterior wall (Fig. 8.14a, b).

At least two screws proximally and distally should be inserted through the plate. When there is an associated PC fracture, another plate is required to secure the fixation. The second plate is placed over the medial aspect of the posterior column along the line of the ischial spine. The fixation has now been completed. A vacuum drain is inserted, and the wound is closed in layers with the appropriate sutures. Mobilisation should be planned usually 8–12 weeks post-operatively, with toe-

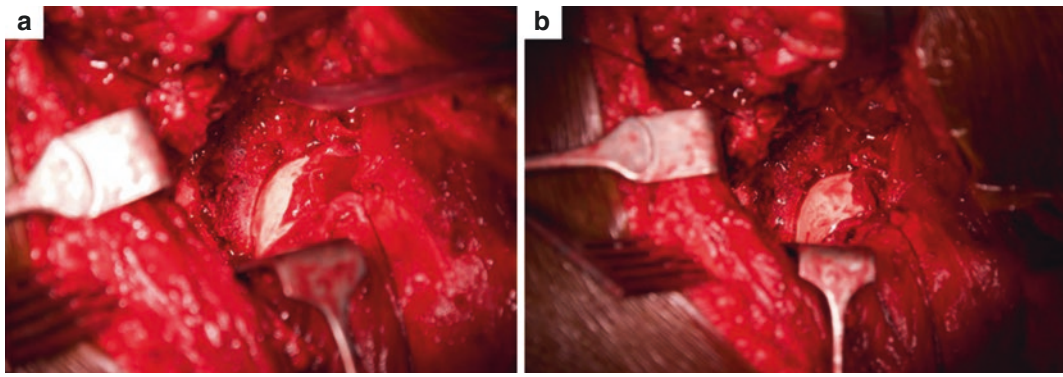

Fig. 8.10 (**a**) Impacted area reduced using the femoral head as template; (**b**) impacted fragment has been stabilised with two 2 mm screws

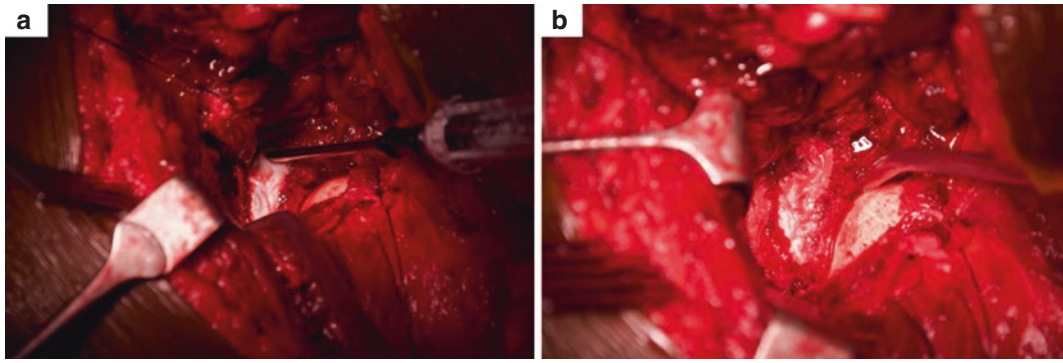

Fig. 8.11 (**a**) Void of impacted area is being filled with bone substitute (tricalcium phosphate); (**b**) bone substitute has set in the void

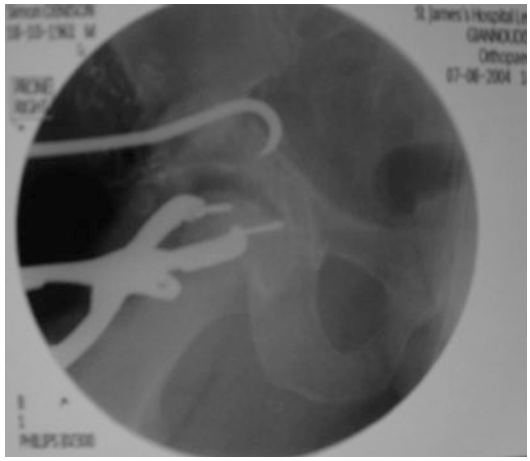

Fig. 8.12 Fluoroscopic intraoperative image demonstrating reduction of a previously displaced PC fracture

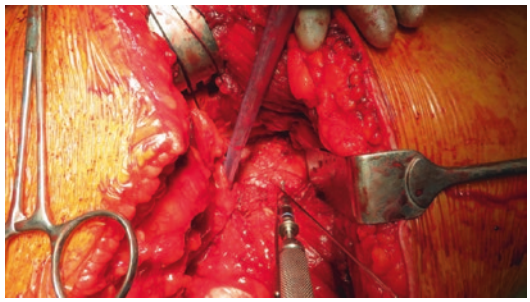

Fig. 8.13 Intraoperative picture of PW acetabulum fracture being held reduced with a K-wire. Screws are inserted for optimum stability

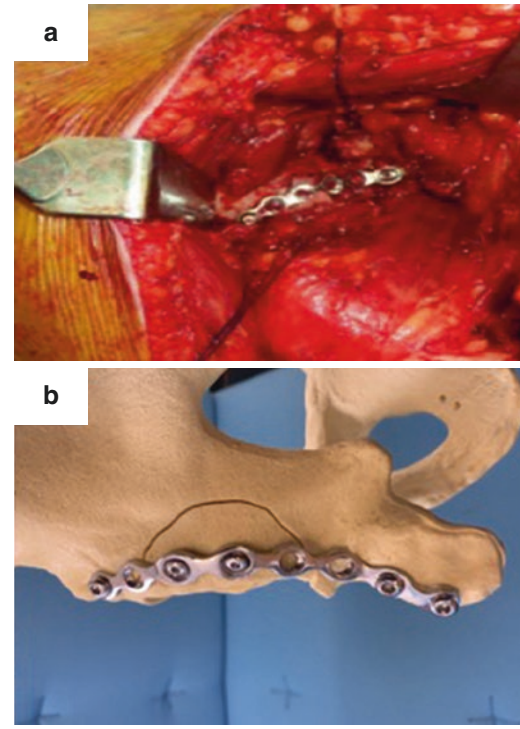

Fig. 8.14 (**a**) Intraoperative image showing the application of the buttress plate over the PW segment; (**b**) the position of the plate is demonstrated in a plastic pelvic model

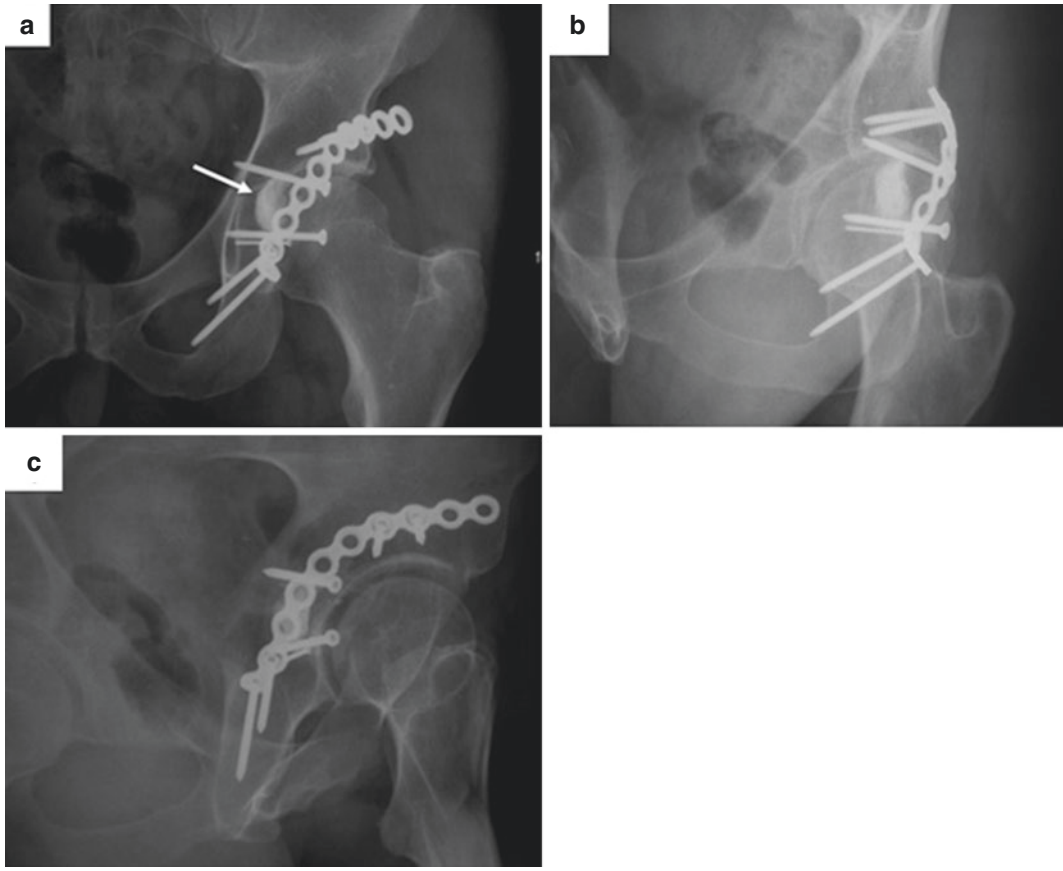

Fig. 8.15 (**a**) AP; (**b**) obturator oblique; (**c**) iliac oblique views of left acetabulum at 3-month follow-up showing a congruent hip joint (arrow indicates the area of the previous articular impaction where a bone substitute was used for support during surgery)

touch weight bearing. Post-operative radiographs must be obtained (Fig. 8.15a, b, c) and further follow-up in the outpatient clinic (4, 8, 12 weeks, 6, 12, 24 months to evaluate the development of post-traumatic arthritis and to exclude avascular necrosis of femoral head).

Summary of Tips and Tricks-Pitfalls

- Careful assessment of the CT scan is essential to diagnose impaction injuries.
- Good inspection of the joint prior to fixation of the posterior wall fracture is needed to remove any loose fragments that may be present.
- When there is a PC and PW fracture, reconstruction of the posterior column should take place first.
- The posterior wall plate should be curved adequately to buttress the wall area close to the posterior-superior acetabulum dome.
- Throughout the procedure, care should be taken to avoid injury to the sciatic nerve.
- Lag screws from the PW to the PC should be inserted carefully to avoid intra-articular penetration.
- In high transverse, T-type and superior acetabular fractures, a trochanteric osteotomy with an anterior surgical hip dislocation can enlarge the access area of the Kocher-

Langenbeck approach offering exposure to the superior and anterior aspect of the acetabulum (sparing the need for an additional ilioinguinal approach).

Conflict of Interest No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this chapter.

References

1. Judet R, Judet J, Letournel E. Fractures of the acetabulum: classification and surgical approaches for open reduction. preliminary report. J Bone Joint Surg Am. 1964;46:1615–46.
2. Giannoudis PV, Grotz MR, Papakostidis C, Dinopoulos H. Operative treatment of displaced fractures of the acetabulum. A meta-analysis. J Bone Joint Surg Br. 2005;87(1):2–9.
3. Zhang Q, Chen W, Wu X, Su Y, Hou Z, Zhang Y. Comparative study of W-shaped angular plate and reconstruction plate in treating posterior wall fractures of the acetabulum. PLoS One. 2014;9(3):e92210.
4. Kim HT, Ahn JM, Hur JO, Lee JS, Cheon SJ. Reconstruction of acetabular posterior wall fractures. Clin Orthop Surg. 2011;3(2):114–20. https://doi.org/10.4055/cios.2011.3.2.114.
5. Giannoudis PV, Tzioupis C, Moed BR. Two-level reconstruction of comminuted posterior-wall fractures of the acetabulum. J Bone Joint Surg Br. 2007;89(4):503–9.
6. Waddell BS, Mohamed S, Glomset JT, Meyer MSA. Detailed review of hip reduction maneuvers: a focus on physician safety and introduction of the Waddell technique. Orthop Rev (Pavia). 2016;8(1):6253. Published 2016 Mar 21. https://doi.org/10.4081/or.2016.6253.