Ilio-Inguinal Approach

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Lorenz Büchler and Helen Anwander

Abstract

The ilio-inguinal approach is an anterior approach to the pelvis, introduced by Letournel in 1965. With its use, the results of surgical treatment of acetabular fractures with the main dislocation in the anterior column were greatly improved. The anatomical dissection leads to a low complication rate and fast recovery of the patient. Three anatomical windows are developed: The first exposes the anterior sacro-iliac joint and iliac fossa, the second exposes the anterior column, the anterior wall, and the quadrilateral surface, and the third exposes the superior pubic ramus. The main advantage of the ilio-inguinal approach is that by using all three windows, an extended direct view on the entire inner side of the pelvis can be achieved for fracture reduction and plate positioning. Main disadvantages are the lack of direct visualization of the acetabular surface, the impaired view on the posterior column, and the need to open the inguinal canal.

Keywords

Acetabulum · Fractures · Ilio-inguinal · Anterior pelvic approach · Letournel

4.1 Introduction and History

Before the groundbreaking work from Letournel and Judet in the early 1960s, fractures of the acetabulum were mainly treated conservatively. Results were generally poor due to persisting dislocation, femoral head necrosis, and early progression to osteoarthritis. In his thesis under the supervision of Judet in 1961, Letournel classified the fractures of 75 cases and suggested surgical approaches according to the specific fracture patterns [1, 2]. The postero-lateral approach had been the one most frequently used. Two cases (transverse fracture, anterior column/post-hemitransverse fracture) were treated with a modification of the ilio-femoral approach developed by Smith-Petersen [3, 4]. It was however mentioned that the approach caused great difficulties, as the large vessels prevented access to the quadrilateral plate [2]. To improve the access, anatomical studies were performed for a new anterior approach where the distal part of the incision was curved upwards towards the midline and the entire internal iliac fossa as well as the pelvic brim was exposed. This research culminated in the *ilio-inguinal approach* to the pelvis, an anatomical

L. Büchler (✉)
Department of Orthopaedic Surgery, Kantonsspital Aarau, Aarau, Switzerland
e-mail: lorenz.buechler@ksa.ch

H. Anwander
Department of Orthopaedic Surgery and Traumatology, Inselspital, Bern University Hospital, Bern, Switzerland

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muscle-sparing approach with extended visualization of the anterior column, ideally exposing the inner aspect of the ilium and pubic bone from the sacro-iliac joint to the pubic symphysis [5]. Since 1965, this new approach was frequently and successfully used by Judet and Letournel and has become the gold standard in the treatment of anterior column fractures [5–7]. The surgical exposure allows the development of three working windows: The first (lateral) window extends between the sacro-iliac joint and the iliopsoas, providing access to the sacro-iliac joint, the internal iliac fossa, and the proximal pelvic brim. The second (middle) window extends between the iliopsoas and the external iliac vessels, providing access to the distal pelvic brim, the quadrilateral surface, the acetabular roof, the greater sciatic notch, and the anterior acetabular wall. The third (medial) window extends between the iliac vessels and the symphysis, providing access to the space of Retzius, the pubic symphysis, the superior pubic ramus from the pubic tubercle to the pectineus recess and includes the spermatic cord (male) or round ligament (female) [8]. Limitations are the limited access to the posterior column and the inferior quadrilateral surface as well as the lack of direct visualization of the acetabular surface.

4.2 Indications

The ilio-inguinal approach is the gold standard for anterior wall and anterior column fractures as an excellent, direct visualization of the anterior column can be achieved [9]. The posterior column and the quadrilateral plate can be visualized indirectly through the second window; subsequently, this approach can also be used for more complex acetabular fractures with the main displacement in the anterior column, such as two column fractures, anterior column-posterior hemitransverse fractures as well as some t-type and transverse fractures. Articular reduction is done indirectly based on the extraarticular anatomy, as the joint cannot be directly visualized. Consequently, the quality of the articular reduction relies on the quality of cortical osseous reductions of the innominate bone and the confirmation provided by intraoperative fluoroscopy or CT. Acetabular fractures are mainly addressed using the second window, with extensions proximal or distal for plate fixation.

The direct anterior visualization of the sacro-iliac joint and the inner aspect of the ilium through the first window can be used for reduction and internal stabilization of sacro-iliac injuries such as sacro-iliac dislocation in a type C pelvic ring fracture, reposition and internal fixation of a transiliac fracture (crescent fracture) as well as a fracture of the wing of the ilium and treatments of infections of the sacro-iliac joint or abscesses and hematomas of the iliopsoas. Over the second window, a fracture of the quadrilateral surface can be reduced and fixated. This may occur in the case of an internal luxation of the hip or in an intrapelvic protrusion of the acetabular component following total hip prosthesis. Injuries to the anterior pelvic ring, such as transpubic fractures and disruptions of the symphysis can be addressed using the third window (Fig. 4.1).

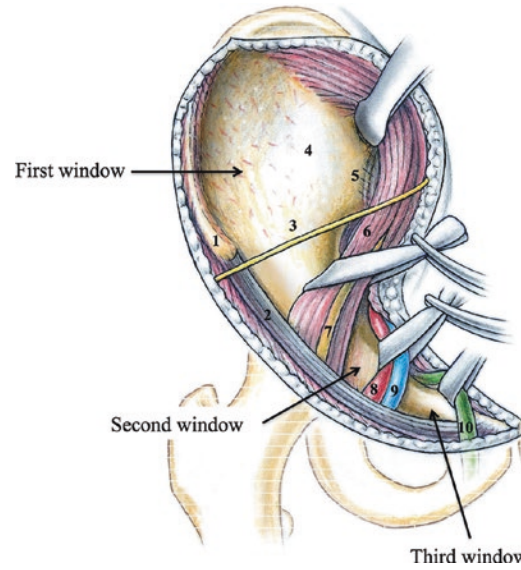

Fig. 4.1 Overview of the three windows of the ilio-inguinal approach with the relevant anatomical structures. (1) Anterior superior iliac spine, (2) Inguinal ligament, (3) N. cutaneus femoris lateralis, (4) Ala ossis ilii, (5) ilio-sacral joint, (6) M. iliopsoas, (7) N. femoralis, (8) A. femoralis communis, (9) V. femoralis communis, (10) Ductus spermaticus/Lig. rotundum. Adopted and reproduced with permission and copyright © of Der Unfallchirurg, Springer [9]

4.3 Technique

4.3.1 Preparation, Patient Positioning

The patient is put under general anesthesia with complete muscle relaxation. Due to the often prolonged operation time and wide exposures, temperature regulation is important to prevent a decrease of core temperature of the patient. Intraoperative blood salvage with the use of cell savers and reinfusion after processing should be considered. A urinary catheter should be inserted to empty the bladder. The patient is placed in supine position with the greater trochanter at the rim of a radiolucent table. The leg of the fractured side is draped freely to enable hip flexion during surgery for relaxation of the iliopsoas and traction via a subtrochanteric pin for fracture reduction. The fluoroscope is tested for unrestricted positioning for AP, ala- and obturator images as well as 3D reconstructions if available.

4.3.2 Incision

The landmarks are the crista iliaca, the anterior superior iliac spine (ASIS), and the pubic symphysis. The incision follows the crista iliaca to the ASIS, and then slightly curved medially following the inguinal ligament to the midline 2 cm proximal to the symphysis. After skin incision, the subcutaneous fat is dissected (Fig. 4.2).

4.3.3 Exposure of the First Window

After releasing the external oblique muscle insertion from the lateral iliac crest, the inner side of the ilium is exposed through subperiosteal elevation of the M. iliacus from the internal iliac fossa to the anterior sacro-iliac joint posteriorly and the pelvic brim inferiorly. Medial retraction of the M. iliopsoas requires placement of retractors on the quadrilateral surface and flexion of the hip to release muscle tension. Bleeding from the nutrient foramina can be controlled using bone wax and temporary packing the iliac fossa. The first window provides access to the sacro-iliac joint, the internal iliac fossa, and the proximal pelvic brim (Fig. 4.3).

4.3.4 Exposure of the Second Window

The aponeurosis of the external oblique is incised from the ASIS to the lateral border of the rectus

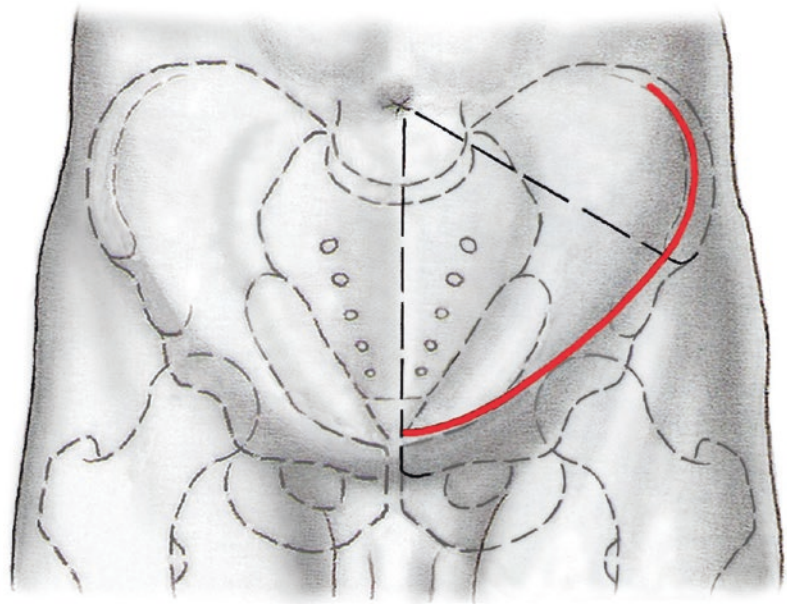

Fig. 4.2 Skin incision for the ilio-inguinal approach (red line). The incision begins cranially at the posterior superior iliac spine (PSIS) and follows the iliac crest to the anterior superior iliac spine (ASIS). The incision is then slightly curved medially towards the midline proximal of the symphysis. Adopted and reproduced with permission and copyright © of Der Unfallchirurg, Springer [9]

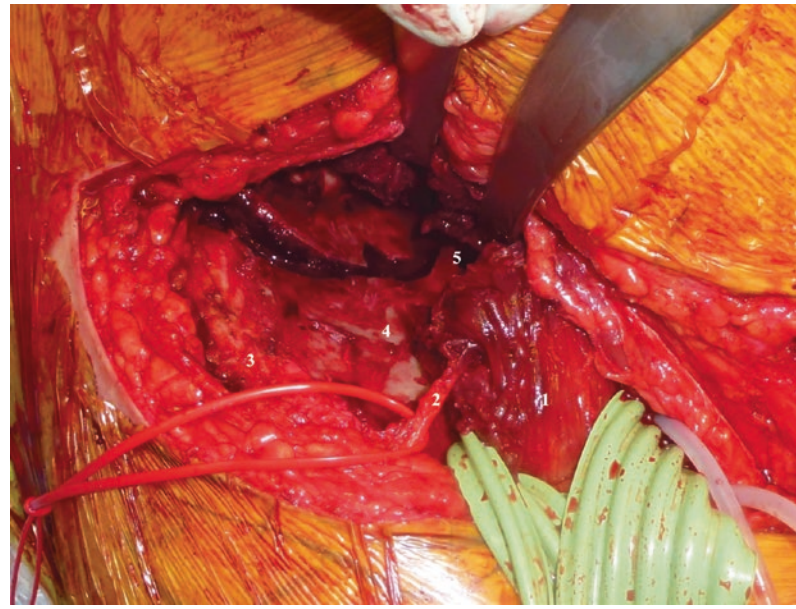

Fig. 4.3 Intraoperative view of the first ilio-inguinal window (right hip). (1) M. iliopsoas, (2) lateral femoral cutaneous nerve, (3) Spina iliaca, (4) Iliac fossa, (5) Pelvic brim

sheath, passing 1 cm cranial to the inguinal canal, identifying and protecting the lateral femoral cutaneous nerve, which usually lies on the lateral border of the iliacus muscle and passes 1–2 cm medial of the ASIS below the inguinal ligament into the compartment of the sartorius muscle. The conjoint tendon of the internal oblique and the transversus abdominis muscles is incised two to three millimeters cranial of the inguinal ligament and the ilio-inguinal nerve is identified. It emerges from the lateral border of the psoas major muscle, passes across the iliacus muscle, the anterior part of the iliac crest and the internal oblique muscle to follow the spermatic cord/round ligament. Next, the spermatic cord/the round ligament is identified and mobilized.

To develop the second window, the iliopectineal arch, a thickened band of fused iliac and psoas fascia that separates the inguinal canal, is incised (Fig. 4.4). On the lateral side, the lacuna musculorum contains the M. iliopsoas, the femoral nerve and the lateral femoral cutaneous nerve. On the medial side, the lacuna vasorum contains the external iliac artery and vein and the surrounding lymphatics. The M. iliopsoas and the femoral nerve are mobilized laterally, the external iliac vessels medially. The iliopectineal arch is divided distally and the fascia following the terminal line to the sacro-iliac joint is opened. This exposes the iliopectineal eminence, the acetabular roof, and the quadrilateral space (Fig. 4.5). To expose the greater sciatic notch and the entire quadrilateral space to the sciatic spine, the pectineus and the internal obturator muscles are elevated subperiosteally. Anteriorly, the anastomoses between the obturator vessels and either the inferior epigastric or external iliac vessels (the corona mortis) have to be ligated. If torn, they can lead to major bleeding.

4.3.5 Exposure of the Third Window

The plane between the pubic symphysis and the bladder (space of Retzius) is bluntly dissected. The bladder can be identified by palpating the urinary catheter bulb. In acute trauma, wound hematoma frequently dilates this space and is easily removed. In revision surgery significant adhesions have to be expected, which render the dissection more difficult with the risk of injuries to the bladder or peritoneum. Mobilizing the bladder cranially provides visualization of the space between the rectus and the spermatic cord/round ligament. Infrapectineal dissection carefully proceeds along

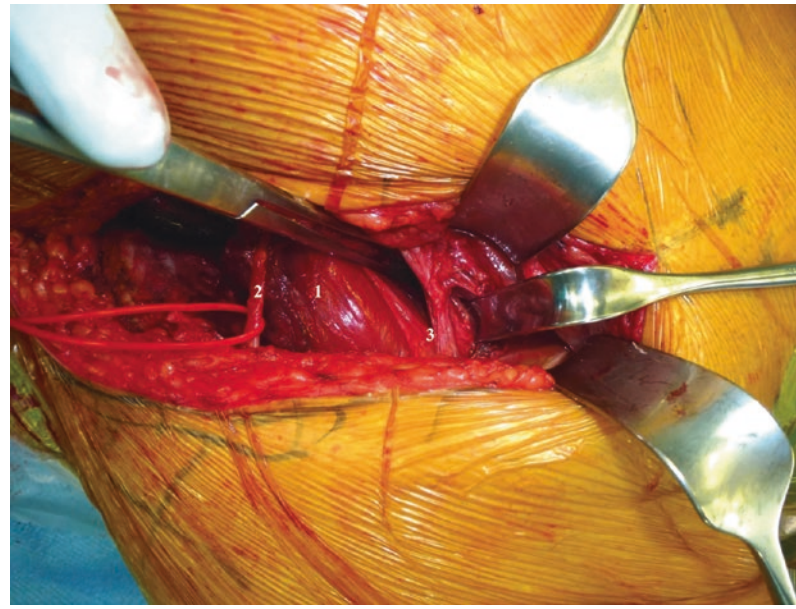

Fig. 4.4 Intraoperative view of the iliopectineal arch. The lateral femoral cutaneus nerve is identified and marked with a red rubber strap. (1) M. iliopsoas, (2) lateral femoral cutaneous nerve, (3) iliopectineal arch

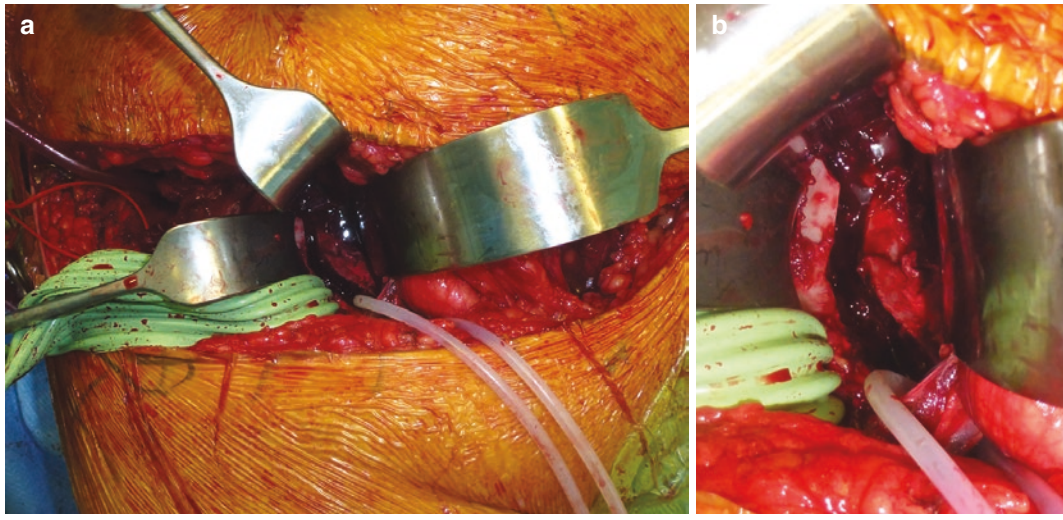

Fig. 4.5 (**a**) Intraoperative view of the second ilio-inguinal window. The M. iliacus and femoral nerve are retracted laterally and the inguinal vessels (marked with the transparent rubber strap) retracted medially to expose the quadrilateral plate. (**b**) close-up view of a dislocated fracture of the anterior column

the medial surface of the pubic ramus and posteriorly following the pelvic brim. The iliopectineal fascia has already been released allowing elevation of the external iliac vessels. The third window provides access to the space of Retzius, the pubic symphysis, the superior pubic ramus and includes the spermatic cord (male) or round ligament (female). The third window can be expanded to allow direct, intrapelvic access to the entire quadrilateral surface and the posterior column (Fig. 4.6).

If a visualization of the contralateral side of the symphysis is required, the ipsilateral rectus insertion is released or the linea alba between the two rectus heads is split in the midline similar to the Stoppa approach (fourth window) (Fig. 4.7).

Fig. 4.6 Intraoperative view of the third ilio-inguinal window. (1) Inguinal artery (2) Inguinal vein, (3) spermatic cord

4.3.6 Fracture Reduction

Simultaneous exposure of all three windows is not possible. The iliopsoas with the femoral nerve, the external inguinal vessels with the surrounding lymphatics and the spermatic cord/round ligament are mobilized and retracted alternating. Fractures are reduced sequentially, usually working from dorsal to ventral using the appropriate clamps or ball spike pushers. In medially displaced fractures, lateral traction of the femur can be applied with the help of a pin inserted in the proximal femur or femoral neck. Preshaped plates can be inserted and fixed from anterior to posterior with the alternating use of the different windows. Anatomical reduction and correct screw placement is verified with the fluoroscope using different image settings.

4.3.7 Wound Closure

Before closure, drains are placed in the space of Retzius and along the quadrilateral surface.

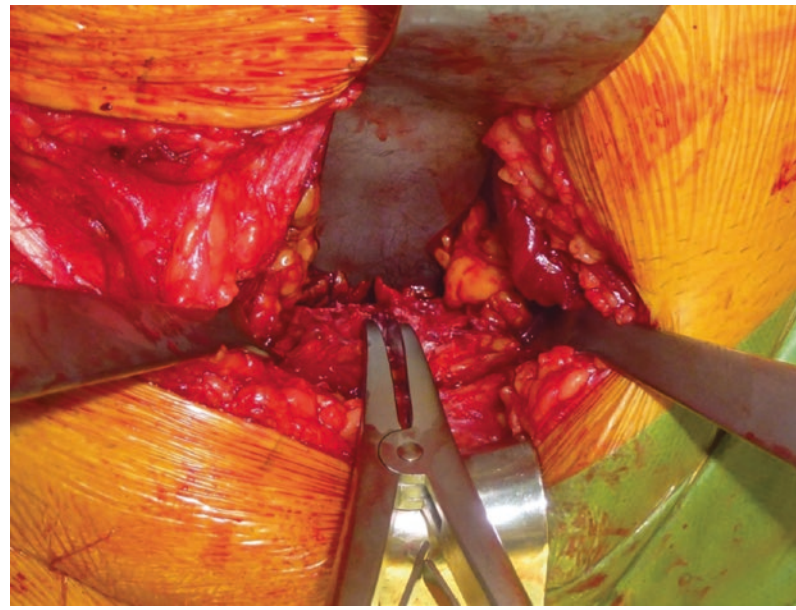

Fig. 4.7 Far medial dissection of the ilio-inguinal approach (fourth window). The left and right portions of the M. rectus abdominis and the spermatic cord are retracted with Hohmann-retractors placed on the superior pubic ramus. The bladder is retracted cranially using a malleable retractor. In this case, a laminar spreader is placed in the symphysis to facilitate fracture reduction

Closure of the different wound layers begins with reattachment of the conjoint tendon of the internal oblique and the transversus abdominis muscles to the inguinal ligament. The roof of the inguinal canal is repaired by closure of the aponeurosis of the external oblique muscle and the rectus sheath, followed by secure reattachment of the abdominal wall origin to the iliac crest. A hernia-free repair and avoidance of entrapment of the spermatic cord and the inguinal nerve should be achieved. The iliopectineal fascia is not repaired. Finally, closure of the subcutaneous tissue and skin is performed.

4.4 Structures at Risk and Complications

4.4.1 Nerves

The overall risk of an intervention-related nerve injury is 2–20% [10–12]. Damage to the lateral femoral cutaneous nerve is the most common complication of the ilio-inguinal approach. Transient neuropraxia can result from tension of the nerve with retractors. Due to its anatomical proximity, damage frequently occurs during the incision of the conjoint tendon or during closure of the aponeurosis of the internal oblique muscle due to its anatomical proximity, leading to various degree of dysesthesia or anesthesia in the lateral thigh. Damage to the femoral or obturator nerves are rare but can lead to significant impairment with weakened hip flexion and knee extension or weakened hip adduction and anesthesia of the medial thigh, respectively. The inguinal nerve follows the spermatic cord/round ligament and is mainly at risk when closing the inguinal canal.

4.4.2 Blood Vessels and Lymphatics

Dissection of the perivascular tissue around the inguinal vessels should be minimized. This limits the risk of vascular injury and also preserves the path of the primary lymphatic trunk to the lower extremity, which passes medial to the vein. Damage to the iliac vessels or corona mortis can lead to severe bleeding and ischemia of the leg. Prolonged excessive retraction of the vessels should be avoided to prevent thrombosis and pulmonary embolism [11].

4.4.3 Spermatic Cord

The spermatic cord contains the vas deferens and the testicular artery. Damage can cause testicular ischemia or infertility.

4.4.4 Heterotopic Ossification

There is a strong association between the operative approach and the prevalence and severity of ectopic bone formation. Letournel noted in a study of 195 acetabular fractures treated with the ilio-inguinal approach that no cases of heterotopic ossification occurred [7]. Matta reported a rate of 2% heterotopic ossifications following an ilio-inguinal approach, versus 20% after an ilio-femoral and 8% after a Kocher-Langenbeck approach [12].

4.4.5 Inguinal Hernia

Closure of the inguinal canal must be conducted carefully to avoid hernias. 2–3.5% suffer of an inguinal hernia after the ilio-inguinal approach [5, 7]. Current inguinal or femoral hernias or previous hernia surgery may complicate the surgical approach, particularly in older individuals. In these cases, it may be prudent to limit or omit the second window exposure, and expand visualization through the first and third windows.

Case Report (Figs. 4.8, 4.9, 4.10 and 4.11)

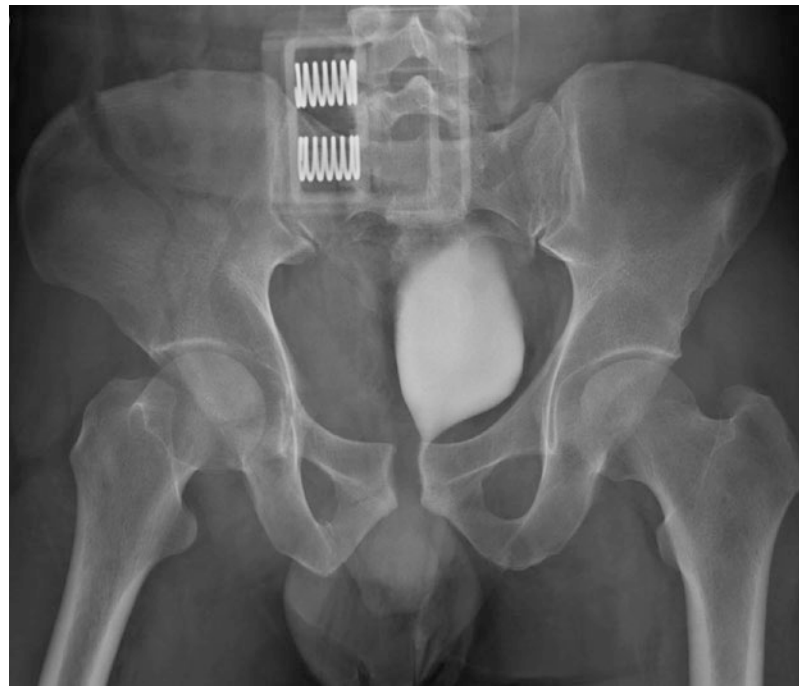

Fig. 4.8 36 year old polytraumatized male patient after a high-energy base-jump accident. The AP-pelvis X-ray shows a dislocated anterior column fracture extending in the ilium, an undislocated hemitransverse fracture, and a pelvic ring fracture type B (open book with rupture of the symphysis and transforaminal fracture of the sacrum left)

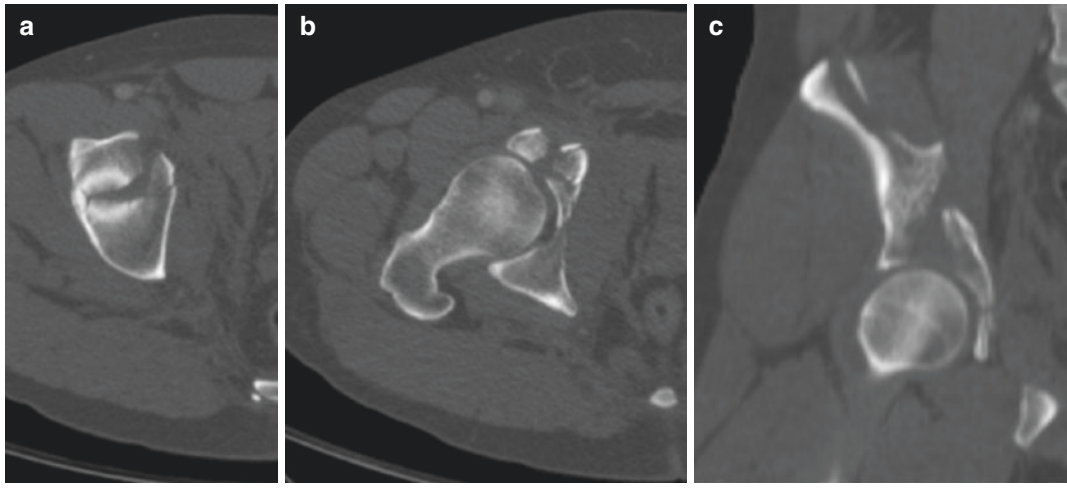

Fig. 4.9 Pre-operative CT scan of the same patient. Axial (**a**, **b**) and coronal (**c**) planes of the fractured acetabulum. Open reduction and internal fixation of the fractures was performed via the ilio-inguinal approach

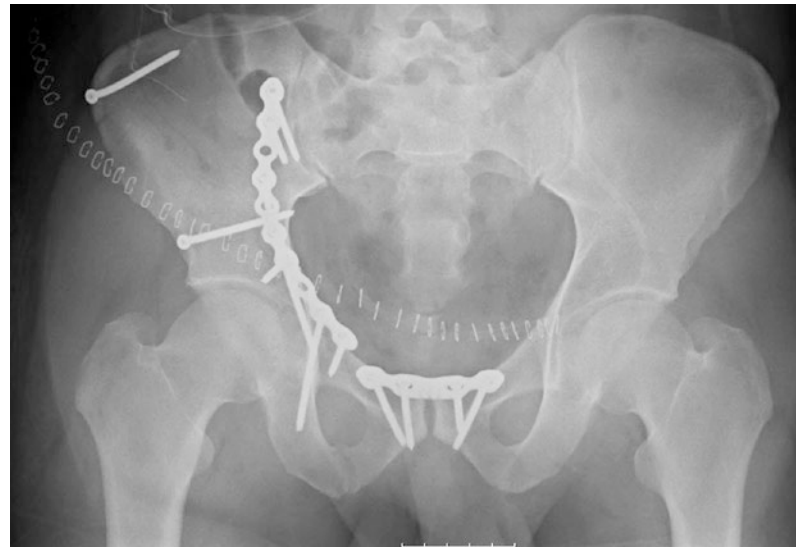

Fig. 4.10 Postoperative AP-pelvis view after fixation of the anterior column with a plate, reduction of the symphysis with a plate and fixation of the ala fracture with two free 3.5 mm cortical screws

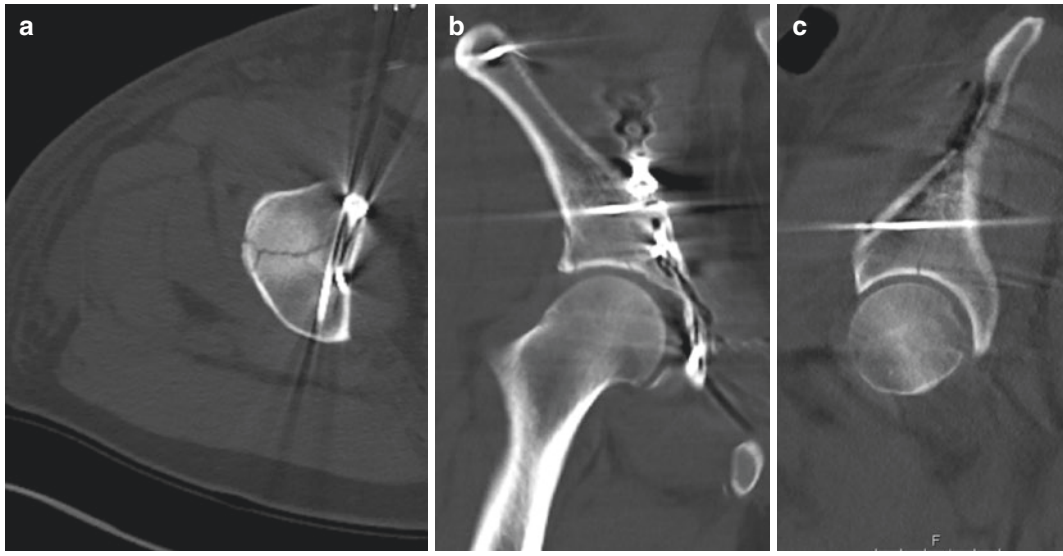

Fig. 4.11 The postoperative CT scan shows anatomical reduction of the fractures in the axial (**a**), coronal (**b**), and sagittal (**c**) planes. Compared to Fig. 4.9, the fracture lines are anatomically reduced

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