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Case Report

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Late surgical correction after complex unstable pelvic fracture 61 C3 (OTA/AO) of an 18-year-old woman

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Abstract Surgical fixation of pelvic fractures is often necessary to restore fracture stability and improve patient outcomes. However, early operative management of pelvis fractures is not widely available in many health systems, resulting in conservative treatment approaches. Conservative approaches can lead to uncorrected pelvic deformities, which are challenging to treat and increase the risk of serious complications such as malunion. Treatment of pelvic malunion requires specialized care, access to necessary equipment, and a clearly defined treatment protocol. However, there is a lack of literature describing treatment algorithms for pelvic fracture malunion. This case report aims to incrementally fill this gap in the literature and highlight a logical step-by-step approach for reconstruction of pelvic malunion. This report is a single case of an 18-year-old woman who sustained complex unstable pelvic fracture, indicated for a 3-step reconstruction at a hospital with limited resources but access to computed tomography scan and some specialized pelvis reduction instruments. Postoperative imaging of the pelvis indicated satisfactory reduction and stable fixation of the pelvic reconstruction. After surgery, the patient was able to perform full axial load with no reported pain. This report provides a detailed description of each step of the operative management of a pelvic malunion case with clearly defined sequences, reduction tools, and positioning maneuvers necessary. Demonstrated in this case report, strategic preoperative planning is critical to successfully treating pelvic malunion and improving patient outcomes. This case report provides the necessary information on the management of pelvic reconstruction to inform other surgeons in underserved regions.

Keywords: case report, pelvis fracture, pelvic deformity, pelvic malunion, pelvic nonunion, pelvic malunion reconstruction, osteotomy, treatment algorithms for pelvic fracture malunion

1. Introduction

Surgical management of unstable or widely displaced pelvis fractures is necessary to improve patient outcomes. However, operative management of pelvis fractures is limited in many health systems with sparse resources. Medical facilities lacking pelvic fracture specialists, well-equipped operating rooms, or the ability to treat concomitant injuries are often forced to take nonoperative treatment approaches.[1–3] This can lead to pelvic deformities that are challenging to treat and increase the risk of serious complications.[4–7]

Treatment of pelvic malunion requires specialized care, access to necessary equipment, and a clearly defined treatment approach. The complexity of the surgery can lead to substantial blood loss, neurologic injury, venous thromboembolism, vascular or visceral injury, infection, and implant failure.[8,9] In underserved areas, correcting pelvic malunion is challenging, exacerbating socioeconomic disparities and poor patient outcomes.[10]

Depending on the rotational deformity and degree of vertical displacement, one-stage or multistage reconstruction is required.[2,7,11] Currently, there is a paucity of literature describing these treatment algorithms.[7,8,12] This lack of information is primarily due to the efficiency of acute care from highly resourced trauma centers and specialized pelvis surgeons.[10,13] To improve patient outcomes globally, this case report describes the principles and careful planning required to perform reconstructive osteotomies for pelvis malunion, specifically focusing on surgery within a middle-income country health care system that has some access to advanced imaging and surgical expertise.

2. Methods

2.1. Case Summary

The patient provided signed informed consent to allow publication of her case report. This is a single case of an 18-year-old woman who sustained a pelvic fracture during a road traffic accident. The patient presented to a regional hospital in Ukraine 8 weeks after the initial injury was provisionally treated with anterior external fixation through the iliac crests.

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Figure 1. Preoperative imaging of the pelvic fracture.

Her pelvic deformity was treated with a 3-step correction in a single operative setting. The treatment results were evaluated with the Iowa Pelvic Score.[14]

2.2. Physical Examination

The patient's main complaints were anterior and posterior pelvis pain, which worsened when changing positions supine in bed. The patient had shortening of the right limb by 4 cm with adductor and flexor contractures in the right hip, a visual change in the shape of the pelvis, lack of foot extension, and altered dorsal foot sensitivity on the same side.

2.3. Imaging

Anterior-posterior imaging showed a complex unstable pelvic fracture (OTA/AO 61-C3) with left sacroiliac joint disruption, left-side fracture of the pubic and ischial bones, symphysis disruption, and a right-side transforaminal sacral fracture combined with an incomplete transverse fracture of the right acetabulum (Fig. 1). Preoperatively, 3D computed tomography (CT) projections of the pelvic reconstruction were completed to plan the corrective osteotomies (Fig. 2).

2.4. Surgical Correction

The patient was indicated for a 3-step reconstruction due to the complexity of the deformity. The patient was positioned on a standard operating room table with a distal radiolucent extension to facilitate intraoperative fluoroscopy.

During the first step, the patient was positioned prone to start with the posterior pelvic ring deformity. The skin was prepped with a chlorhexidine-alcohol antiseptic solution, and occlusive drapes were applied to the surgical field of the lumbar and upper buttock area. The goal of step 1 was to perform a right posterior sacral osteotomy and insert guide wires to the midline from the left side at the S1 and S2 levels (Fig. 3). A paramedian approach to the upper segment of the right sacrum was performed. Using a 1″ osteotome, an osteotomy lateral to the neuroforamina through the sacral ala was performed along the entire vertical length of the sacrum to correct the healed sacral malunion. Transection of the iliolumbar ligaments was also required for mobilization of the right hemipelvis. Guide wires were placed from the contralateral side in preparation for final fixation but did not cross the osteotomy. Step 1 intentionally did not fix the posterior pelvis before performing the anterior pubic ramus osteotomy and symphyseal reduction. Although the author believes it is necessary to start with the posterior deformity, one is unable to predict if completing the anterior pelvic ring reduction will alter the posterior reduction or create a residual sacral defect that will require bone grafting. As a result of this limitation, the posterior wound was initially closed with skin sutures only.

During step 2, the patient was repositioned supine on the same table and fixation of the pelvis malunion was completed. Figures 4–9 outline the steps of the surgical plan. The entire abdomen, bilateral flanks, and left leg was prepped and draped. Using the Stoppa approach, the iliopectineal fascia was released along the pelvic brim to visualize the superior portion of the entire left pubic ramus and supra-acetabular region. During the anterior approach, the left hip was flexed over a triangle to relax the psoas muscle and protect the neurovascular bundle. Using an oscillating saw, an osteotomy of the left pubic root was performed and the distal segment of the pubic malunion was reduced. Next, the right hemipelvis was translated anteriorly using a Jungbluth clamp and inferiorly with a large femoral distractor. The reduction of the hemipelvis was assessed directly at the pubic symphysis and by fluoroscopy. The S1 and S2 guide wires were then passed across the osteotomy and percutaneously exited the lateral right buttock to maintain the posterior pelvis position and facilitate cannulated screw fixation from the right side (Fig. 7). Final fixation of the reduced pelvis was then sequentially performed. The anterior pelvis was stabilized with a 3.5-mm reconstruction plate (Fig. 8). Sacral fixation was performed with a 6.5-mm partially threaded and 7.5-mm fully

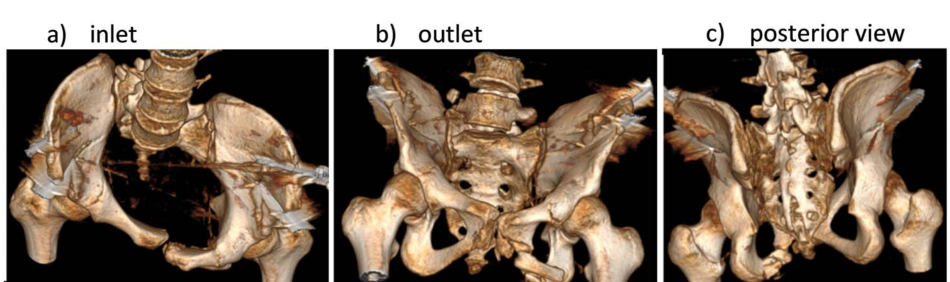

Figure 2. (A–C) 3D CT scan showing left sacroiliac joint disruption, left-side fracture of the pubic and ischial bones, symphysis disruption, and a right-side transforaminal sacral fracture combined with an incomplete transverse fracture of the right acetabulum.

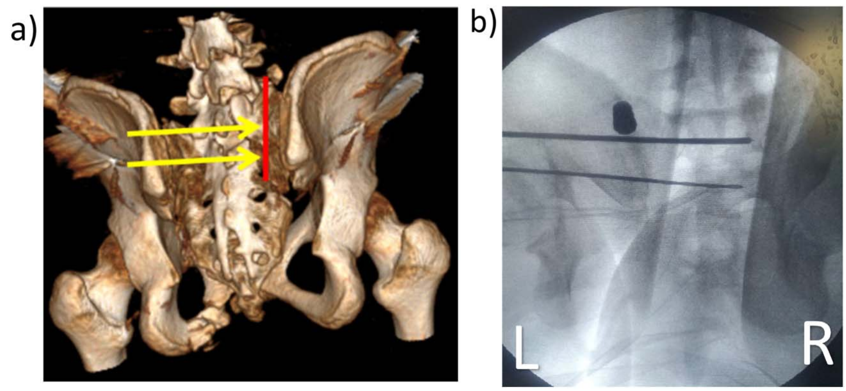

Figure 3. 3D planning of the osteotomy zone (red line) and the insertion of guide wires (yellow arrows) at the SI–SII level (A) from the opposite side (left) to the osteotomy zone; C-arm image of the inserted guide wires (B).

threaded cannulated screw (Fig. 9). A surgical drain was placed deep to the abdominal fascia in the space of Retzius. The Stoppa approach was closed by repairing the abdominal fascia, followed by the subcutaneous tissue and skin.

In step 3, the patient was repositioned prone to visually confirm the sacral reduction and to assess the possible need for additional plate fixation or bone graft. Adequate bone contact and stability were observed, and no bone grafting or additional fixation was

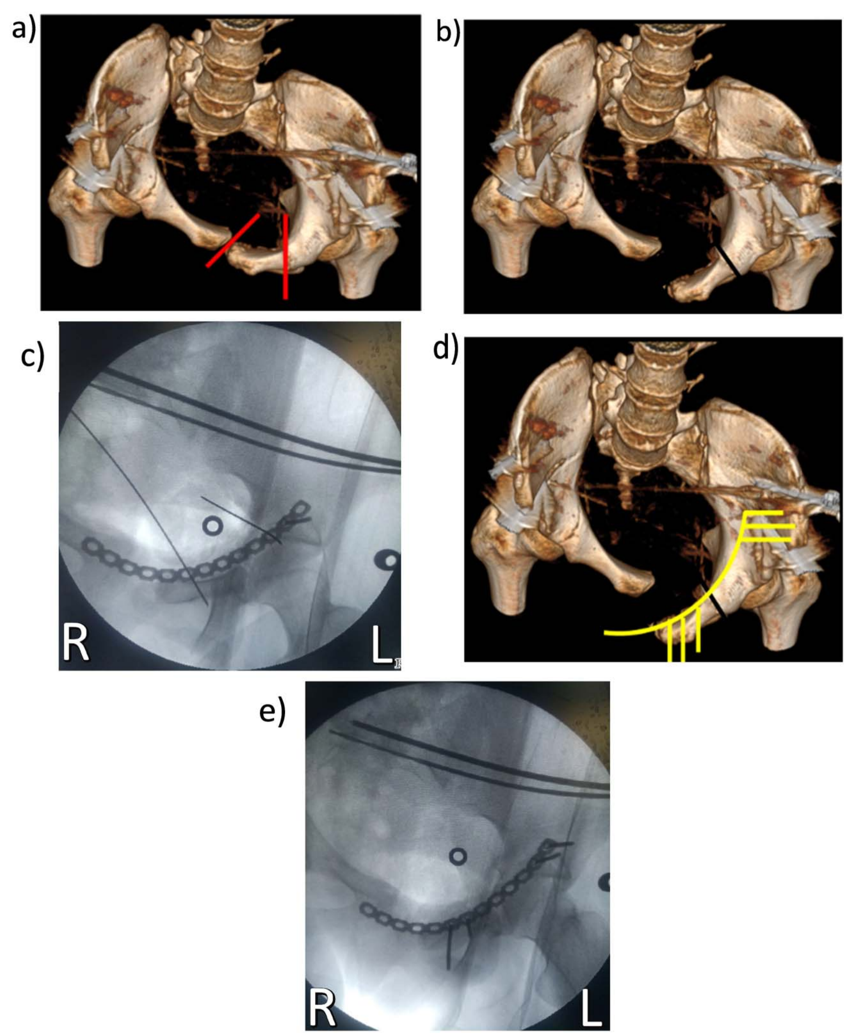

Figure 4. 3D planning of the symphysis cut and osteotomy of the pubic bone (red lines) at the site of malunion (A), reduction of the pubic bone in the anatomical position (B) and its image under C-arm (C); 3D planning (D) and C-arm image (E) of pubic bone reduction in an anatomical position and final fixation with a plate and screws (yellow lines).

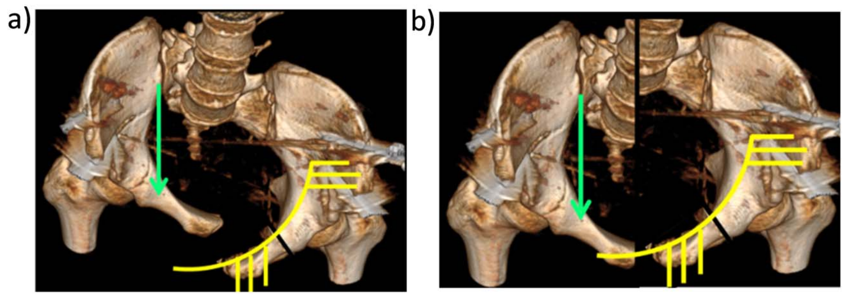

Figure 5. 3D planning: (A) direction of the reduction maneuver (green arrow) of the right hemipelvis in the anterior direction; (B) reduction after anterior translation of the right hemipelvis.

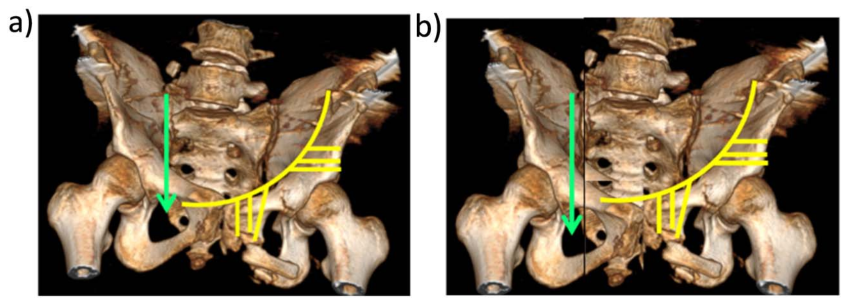

Figure 6. 3D planning: (A) direction of the reduction maneuver (green arrow) of the right hemipelvis downward; (B) reduction after it.

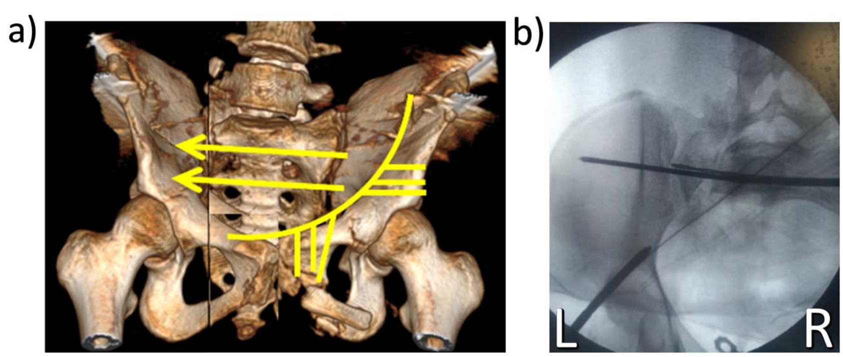

Figure 7. 3D planning (A) and C-arm image (B) of guide wire insertion (yellow arrows) at the SI–SII level through the osteotomy zone.

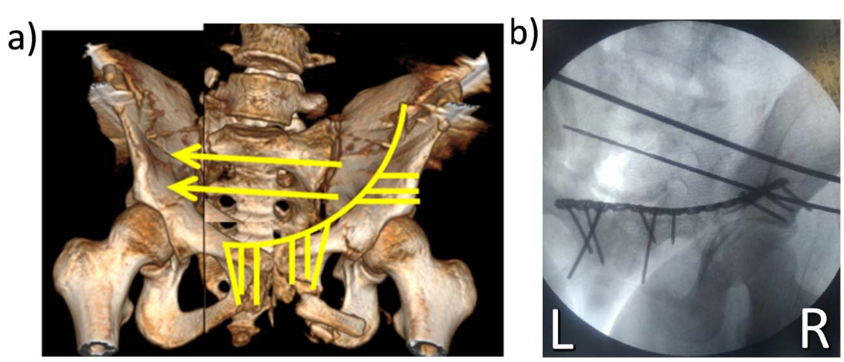

Figure 8. 3D planning (A) and C-arm image (B) of fixation of the anterior segment by insertion screws (yellow lines) through the plate into the right pubic bone.

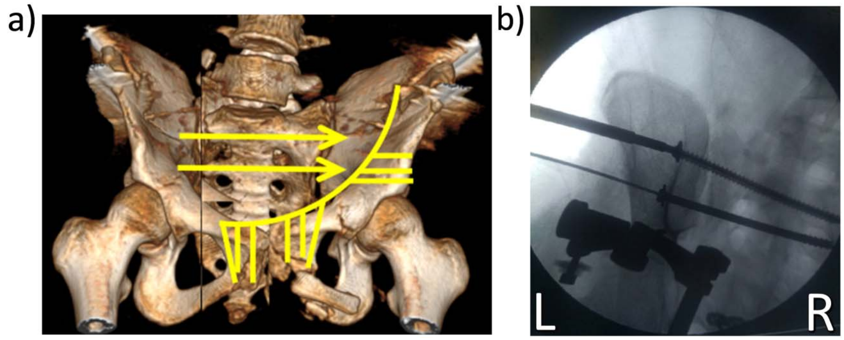

Figure 9. 3D planning (A) and C-arm image (B) of insertion of sacral cannulated screws (yellow arrows) from right to left for fixation of the posterior parts of the pelvis.

indicated. A 3-layer posterior wound closure of the fascia, subcutaneous tissue, and skin was achieved without a drain.

2.5. Perioperative Care

The patient received antibiotic prophylaxis with ceftriaxone and venous thromboprophylaxis with aspirin. The patient was restricted to non–weight-bearing for the right leg for 6 weeks before progressing to full weight-bearing as tolerated; there were no postoperative weight-bearing restrictions on the left lower extremity.

3. Clinical Outcomes

Postoperative x-rays of the pelvis indicated satisfactory reduction and stable fixation of the pelvic reconstruction (Fig. 10).

To assess the safe placement of the iliosacral screws and confirm the quality of the pelvic reduction, a postoperative CT scan of the pelvis was obtained. Comparative evaluation of the 3D reconstruction images before and after surgical treatment (Fig. 11) and on frontal sections for the analysis of vertical displacement correction (Fig. 12) was performed.

Postoperatively, the L5 neuropathy was initially worsened, but sensitivity progressively recovered with motor function restoration within 2 weeks. The patient was preoperatively counseled about this anticipated complication given the magnitude of pelvic deformity and planned correction.

Four months after surgery, the patient was able to perform full axial load with no reported pain and improved right ankle mobility and gait with continued rehabilitation. The patient's Iowa Pelvis Score functional result was 90 points.

Figure 10. Postoperative imaging of pelvis.

4. Discussion

This case report outlines a successful 3-step treatment approach for pelvic malunion. Surgical treatment of pelvic malunion is technically challenging and is associated with increased risk of complications, particularly in under-resourced areas.[8–10] Early specialized care to prevent pelvic deformity is preferable. However, if unintended malunion occurs, a systematic approach to correcting the deformity is essential for improving patient outcomes and preventing further complications.

The author has outlined a reproducible approach for the management of pelvic malunion; however, there are limitations. This is a relatively simple case of pelvic malunion given the young age of the patient, time to operation after the injury, and specific fracture pattern. Successfully applying the same reconstruction principles for a more complex case with comorbidities or preoperative complications would require more planning. Second, this brief report is unable to discuss all the nuanced benefits and limitations of the selected surgical approaches or order of reconstruction. Similarly, the risks and management of sciatic nerve palsy, vascular injury, or bladder injury during this procedure must be acknowledged; in this case, the transient worsening of the L5 neuropathy was presumably caused by translating the right hemipelvis to its anatomic location after months of shortening. Finally, this case was treated in a Ukrainian hospital with limited resources but access to CT scan and some specialized pelvis reduction instruments. Applying the presented treatment principles in health systems with less resources will likely add further challenges to the surgical reconstruction.

The treatment of pelvic malunion is complex and challenging and is exacerbated by a lack of access to specialized care in under-resourced areas. Demonstrated in this case report, strategic preoperative planning is critical to successfully treating pelvic malunion and improving patient outcomes. By providing a detailed approach and highlighting the need for access to specialized care, the author hopes to provide the necessary information on the management of pelvic reconstruction to inform other surgeons in underserved regions.

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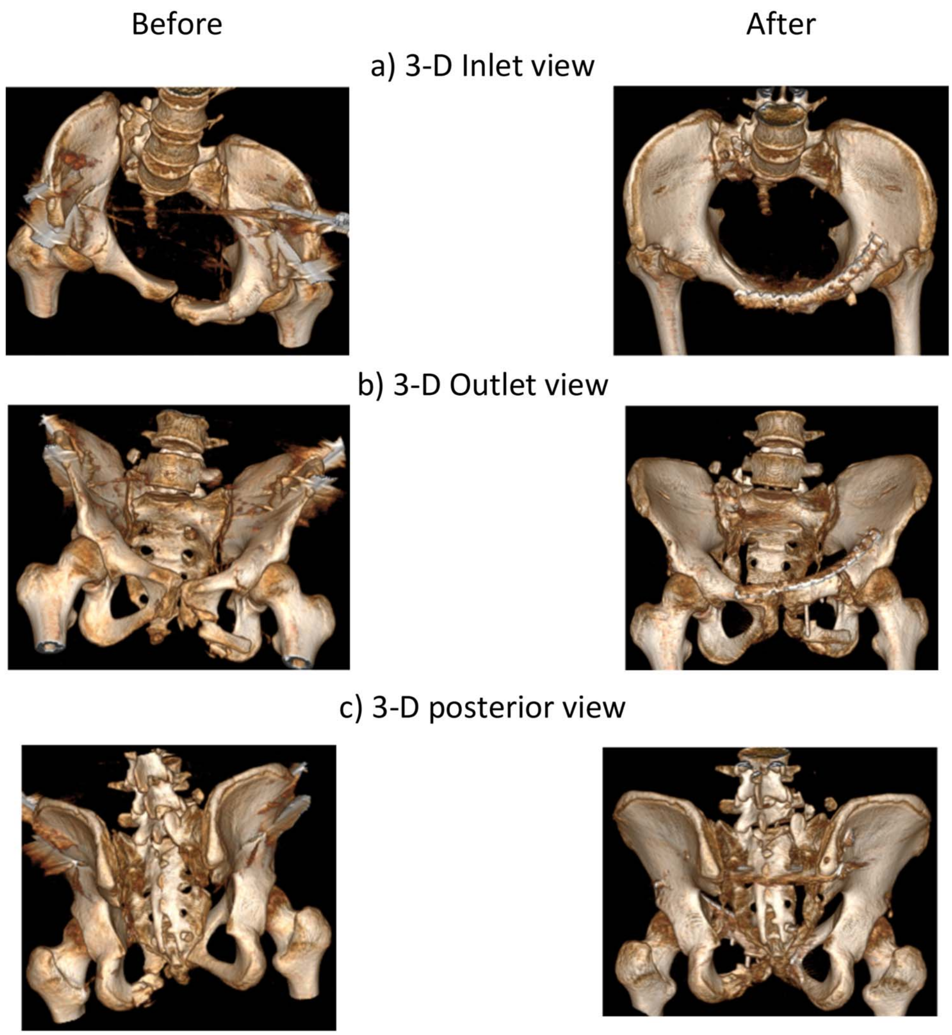

Figure 11. (A–C) 3D reconstruction images of the pelvis before and after surgical treatment.

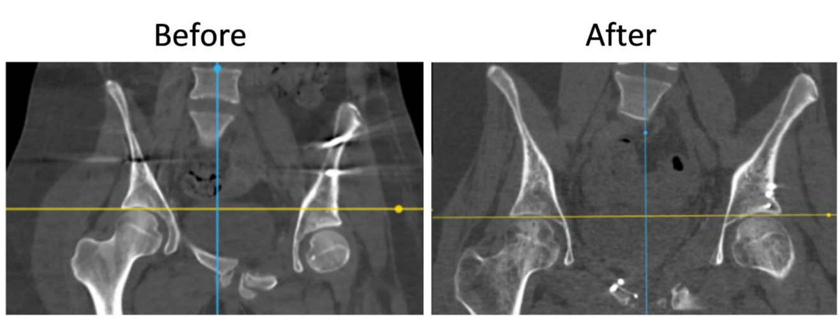

Figure 12. CT scans of frontal sections of the pelvis before and after surgical treatment for the analysis of vertical displacement correction.

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