12 Reconstruction After Ilium Resection

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The ilium serves two primary functions: it provides continuity between the acetabulum and the sacrum by means of the sacroiliac joint; it also provides a major soft tissue attachment site for the abdominal, gluteal, pelvic floor, rectus femoris, sartorius, and the iliacus muscles within the pelvis. Variations within this subset of resections include complete removal of the ilium and removal of partial ilium. Certainly, complete removal of the ilium "disconnects" the acetabulum from the ipsilateral sacroiliac joint and may cause significant destabilization of the remaining segment because it now hinges on the pubic symphysis. Partial resection of the iliac wing, by contrast, is a much less morbid procedure if continuity is maintained between the acetabulum and the axial skeleton.

Restoration of pelvic ring integrity has typically been achieved using bone allograft, autologous nonvascularized or vascularized fibular grafts, or iliac crest pedicle graft [1] because reconstruction of the pelvic ring and lumbar-pelvic junction is necessary to reduce rotational and translational instability essential for weight-bearing and ambulation. Failure to reconstruct the lumbar-pelvic junction and restore abdominal wall integrity may also result in symptomatic visceral herniation.

Regardless of the techniques chosen to reconstruct the posterior pelvis after creation of large bony defects that disrupt the pelvic ring and lead to instability, there are inherent difficulties in achieving sacroiliac arthrodesis. Occasionally, the distance between the remaining ilium and the sacrum is small enough that it can be closed primarily and wired in order to achieve direct bony healing. The remaining sacroiliac joint is denuded of cartilage, and a wire or suture construct may be used to "close down" the pelvis by hinging the remaining hemipelvis through the flexible symphysis pubis joint anteriorly [2]. Fixation of structural bone grafts to the residual supra-acetabular pelvis and sacrum also is problematic. Most of the patients required a posterior osteotomy through sacral ala to achieve safe margins of resection such that the amount of residual of sacrum available for fixation is limited.

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When the gap is too large to be closed using the direct apposition, a strut graft may be introduced to span the gap. Autograft fibular struts should be considered (with or without vascularity) to facilitate the bony healing. In younger patients with a favorable soft tissue envelope, allograft fibula [3] is a good option that has been shown to incorporate reliably and avoid donor site morbidity. Autoclaved autograft and vascularized iliac wing autograft have also been described. Biological reconstruction has the potential for permanent consolidation with bone and the avoidance of revision arthroplasties; however, prosthetic reconstruction has the advantages of early mobilization, acceptable cosmesis, long-term stability, and satisfactory function. With the advent of 3D printing technology (additive manufacturing or rapid prototyping), Guo et al. [4] reported a 3D-printed iliac prosthesis which can be used for ilium defect due to tumor resection. The prosthesis has features including preoperatively designed screw holes for acetabular side fixation, soft tissue reattachment anchorage, and structure connecting with screw-rod system. The bone-implant interface is porous on metallic side, which facilitates bone ingrowth, and osseointegration can be achieved between host bone and prosthesis.

12.1 Surgical Techniques

The patient is positioned in a semimobile lateral position. An extensile incision is made from the posterosuperior iliac spine extending anteriorly along the area of the iliac crest to the anterosuperior iliac spine and then directed distally along inguinal ligament, curving anteriorly, ending just proximal to the pubic tuberosity. The anterior abdominal wall is detached from the iliac crest, and the retroperitoneal space is exposed. The dissection then is developed between the iliacus and psoas. The iliacus muscle then is identified at the level of the intended iliac osteotomy just at the line of the anteroinferior iliac spine directly toward the sciatic notch.

When the inner and outer tables were thoroughly exposed, two Gigli saws then are passed through the notch with

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particular care of sacral nerve, and the osteotomy are performed just superior to acetabulum, normally at the level of the anteroinferior iliac spine. The other Gigli saw is then sued for osteotomy near iliosacral joint according to the preoperative plan. The remainder of the gluteus medius and minimus is transected along the line of intended resection from the sciatic notch up toward the anteroinferior iliac spine. Then the resection is completed, and there may be hemorrhage near superior gluteal vessels. Ligation and cautery are necessary.

Pedicle screws are placed into the lower lumbar spine, sacral pedicles, and vertebra body if necessary as anchors for the reconstruction using a spinal instrumentation system. Typically, we use a 6.0-mm titanium rod system rather than a 5.5-mm diameter rod system to perform the reconstruction as it may not be strong enough to support the reconstruction. Usually, a 7.5-mm diameter titanium multiaxial pedicle screw is placed in the sacrum through S1 pedicle. The screw lengths range from 35 to 45 mm depending on the size of the patient. We then identify another start point medially along the cut portion of the ischium and used a pedicle finder to probe in a lateral-to-medial direction distally in the remainder of both anterior and posterior columns. Fluoroscopy is used to ensure the trajectory not violating the notch or acetabulum. We then implant a 7.5-mm or 8.5-mm diameter titanium multiaxial pedicle or specially designed iliac screw after tapping the hole created by the pedicle finder. The screw lengths range from 50 to 75 mm depending on the size of the remaining ilium. Both screws are confirmed with fluoroscopy.

After confirmation of the screw position, titanium mesh, vascularized or nonvascularized fibular, or endoprosthesis was utilized to reconstruct the continuity of the pelvis keyed into the remaining ilium and sacrum. A 6.5-mm rod is measured to fit the distance spanned between the two screws, then contoured, connecting the two screws, and secured to the screws with the appropriate set screws. Compression is applied across the construct, ensuring that the graft is stable. Then the gluteus fascia is sutured to the abdominal wall. The skin was closed in layer fashion (Figs. 12.1, 12.2 and 12.3).

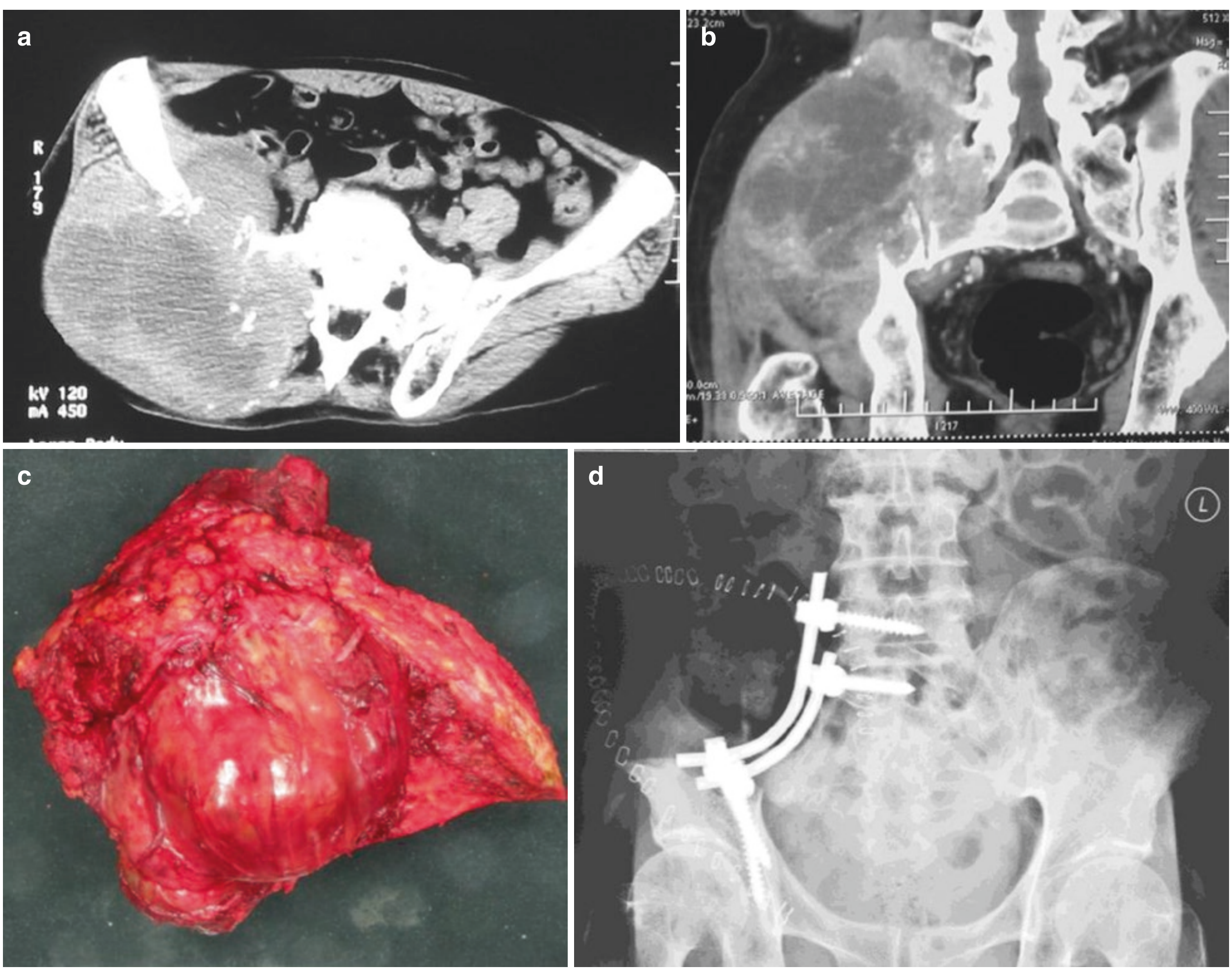

Fig. 12.1 The patient was a 72-year-old female with diagnosis of giant cell tumor of right ilium. Preoperative axial and coronal CT showed the lytic destruction of right pelvis with sacroiliac joint involved (**a**, **b**). (**c**) Tumor specimen after resection. (**d**) Postoperative X-ray showed the reconstruction with screw-rod system

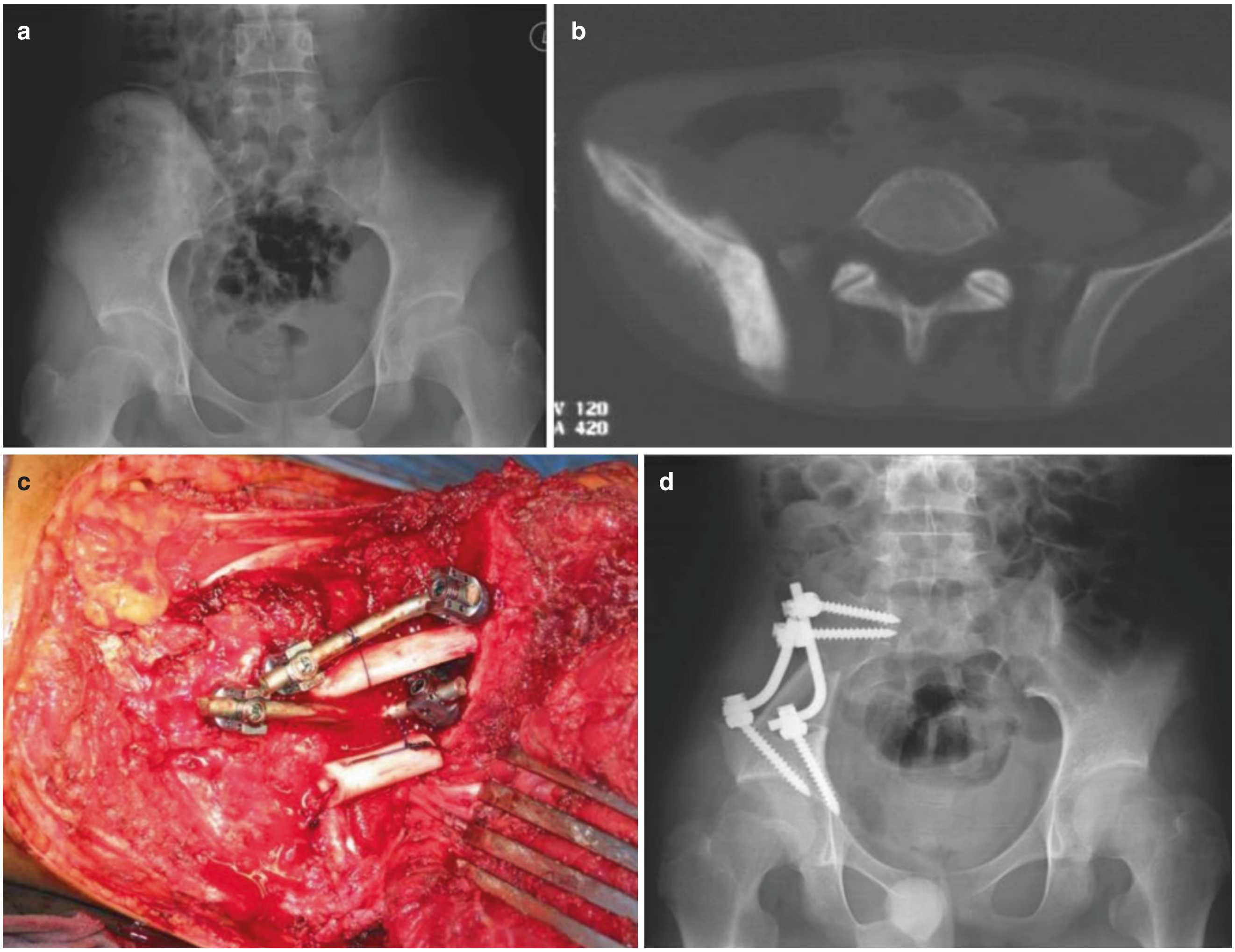

Fig. 12.2 The patient was a 14-year-old male with Ewing's sarcoma of right pelvis. Preoperative X-ray (**a**) and CT scan (**b**) showed the lesion. (**c**) Intraoperative photograph showed fibular graft combined with screw-rod system being used for reconstruction. (**d**) Postoperative X-ray

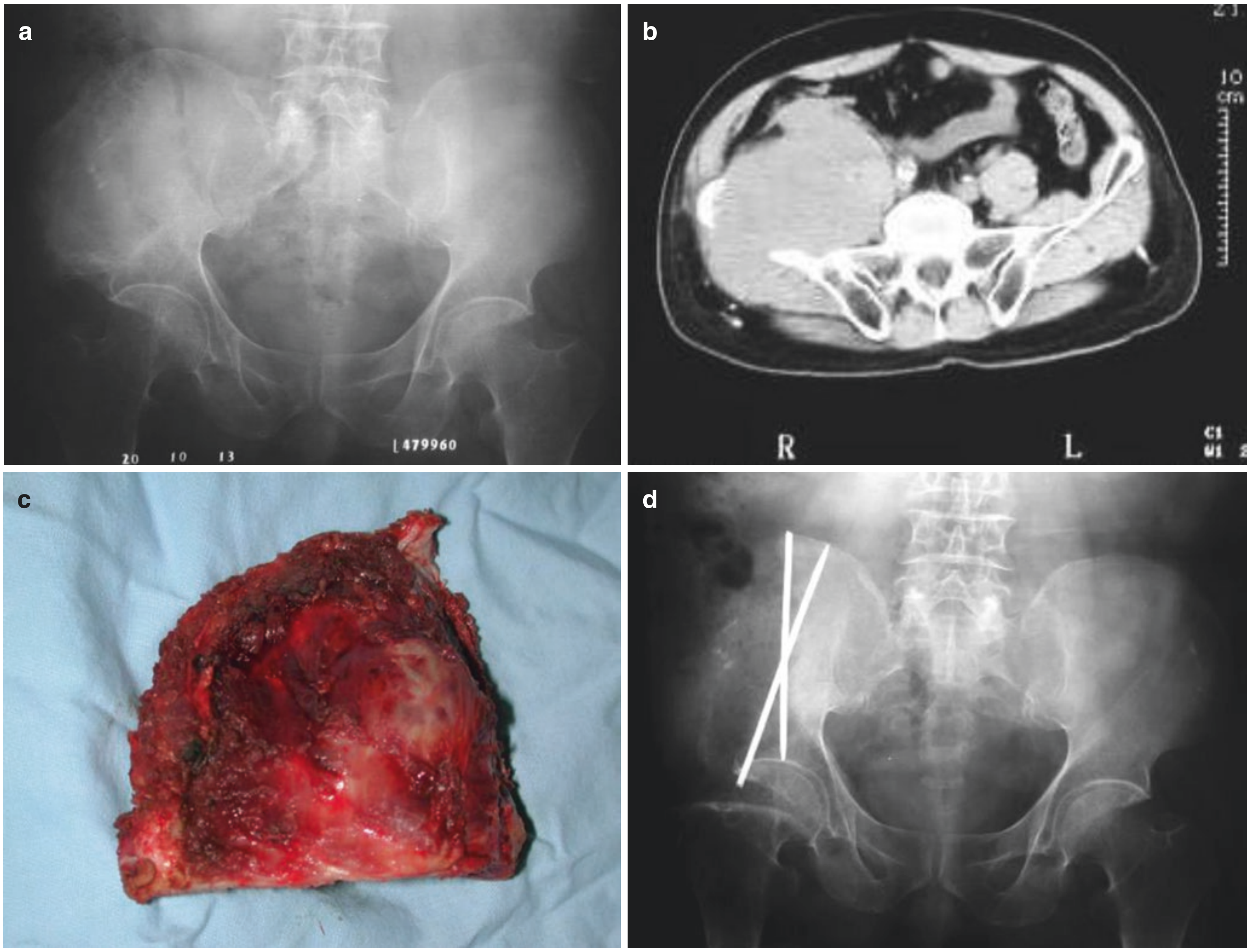

Fig. 12.3 The patient was a 58-year-old male with huge mass in the right pelvis. Multiple myeloma was diagnosed by core-needle biopsy (**a**, **b**). The tumor was resected (**c**), and Steinmann pins augmented with bone cement were used to reconstruct (**d**)

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