

Hemipelvis reconstruction in trauma: A case report and literature review

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Composite reconstruction of the pelvis in the setting of trauma is challenging. In addition to coverage and containment of the abdominal viscera, recreating a robust sitting surface is critical. However, there is a paucity of literature to guide the reconstructive surgeon. The authors present a case of traumatic hemipelvectomy, and describe their application of the 'spare-parts' concept to successfully reconstruct the bony pelvis and provide soft tissue coverage.

Key Words: *Fillet flap; Pelvectomy; Pelvis; Spare-parts; Trauma*

The management of a significant defect of the pelvic ring presents a formidable challenge to the reconstructive surgeon; however, there is a paucity of literature describing reconstructive techniques. The majority of descriptions for pelvic reconstruction describe oncological cases (1-7). Very few describe options for pelvic reconstruction in the setting of trauma (8-10), and these only describe cases of soft tissue coverage. There has not been a description of the reconstruction of the bones of the pelvis in the setting of trauma because complete hindquarter amputation is generally recommended (11-13). However, a case of replantation has been described (14).

Pelvic reconstruction in the setting of trauma presents unique challenges compared with oncological defects; radiated fields and ongoing chemotherapy complicate reconstruction after oncological resections, but trauma cases often have more significant soft tissue loss, contaminated wounds and compromised vascularity (14). Reconstruction in both settings may benefit from the application of the 'spare-parts' concept, which refers to the use of amputated or nonviable limbs to reconstruct remaining defects to avoid additional donor site morbidity (15,16).

Fillet flaps are commonly applied in this setting (2,6,15-17). Fillet flaps can be defined as axial pattern flaps, and can be harvested as pedicled or free tissue for composite reconstruction. Fillet flaps are classified by Küntscher et al (15) based on location and vascular supply: type A and B flaps are harvested from injured nonviable fingers and limbs, respectively, while type C flaps are harvested from intact body areas (15). Each category is subdivided based on vascularity, where types 1, 2 and 3 describe pedicled, island and free flaps, respectively. In the present report, we discuss the use of a pedicled fillet flap including vascularized femur and tibia from a nonfunctional right leg to reconstruct the left hemipelvic ring. The goal of this reconstruction

was to provide this patient with a stable platform for sitting and mobilizing in a wheelchair.

CASE PRESENTATION

An otherwise healthy 40-year-old woman was hit by a snowplow while walking. Her entire lower abdomen, including her left hemipelvis, was sheared open with evisceration and traumatic hemipelvectomy. The left leg was mangled and nonviable, and the right leg was cool and poorly perfused. There had been lacerations to the aorta and the common iliac arteries, and the left external and internal iliac arteries had been avulsed. The left-sided vessels were ligated during completion of the partial traumatic left hemipelvectomy. She had additional injuries that required removal of her bladder, uterus, lower colon and rectum. Initial coverage of the resulting defect was achieved with a remaining flap of local skin and muscle, and a vacuum-assisted closure dressing was applied (Figure 1). Once it became clear that she would likely survive these injuries, reconstruction became the focus.

The patient required multiple staged debridements as the tissue viability demarcated, including debridement of the remnant psoas, iliacus, paraspinous muscles, the uterus, the left buttock and a significant portion of the right buttock. Coverage of the femoral vessels, spine, bladder and the remnants of her lower gastrointestinal tract was achieved by combination of a sartorius flap from the right leg and a flap from residual rectus abdominis. Her right transverse acetabulum fracture was treated using percutaneous column screws. Remaining open areas were dressed with negative pressure wound therapy.

Her course was complicated by two successive acute ischemic events to the right iliac and femoral arteries. These were treated with stenting by interventional radiology; however, flow was eventually compromised, leaving her right leg dependent on collateral vessels for inflow. She lost sciatic nerve function to that leg and continued to have large areas lacking adequate soft tissue coverage. Physiatry assessed the patient and concluded that because she sustained no significant upper extremity injury, she had the potential to be able to use a wheelchair if she could sit upright; however, the lack of a stable pelvic construct for sitting balance would necessitate a specialized chair and would prevent independent transfer. The remaining leg was painful, insensate and nonfunctional and, thus, the option of sacrificing it to reconstruct the pelvic ring and provide a sitting surface was discussed with the patient. This made her an excellent candidate for this reconstruction.

A preoperative computed tomography angiogram confirmed patency of the necessary collateral vessels to reconstitute the femoral vessels and maintain vascularity to the bone flaps and fillet flap. To avoid injury to the proximal vessels, a segmental femorectomy was performed through a lateral incision 15 cm distal to the greater

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Figure 1 Photograph taken after initial multidisciplinary surgery to stabilize the patient, with radiograph in inset. Here, initial closure was achieved with a flap of remaining tissue that subsequently necrosed and a vacuum-assisted closure dressing. Inset: A Sawbones (Pacific Research Laboratories Inc, USA) model of the remaining bones of the pelvic bones is shown

trochanter and a 10 cm segment of femur was excised. The distal femur and proximal tibia were exposed, preserving attachments to the superficial femoral artery. The foot was amputated by ankle disarticulation and the distal portion of the tibia and the entire fibula were removed. The geometry of the construct required that the knee hyperextend for the tibial shaft to join the remnant sacral ala and the femoral shaft to join the remnant pubis. The distal femur was cut with an anterior 45° wedge to expose cancellous bone; the right proximal tibia was cut at 45° in the opposing direction so that the two cancellous surfaces would meet in hyperextension and form a 90° angle. The hyperextended knee, therefore, became the neoischium and the new seating surface (Figures 2 and 3).

For soft tissue coverage and recreation of the buttocks, the entire lower extremity fillet flap was rotated over the pelvic reconstruction and inset into the remaining soft tissue defect in the area (Figure 4). Postoperatively, the patient was kept non-weight-bearing for eight weeks. Hyperbaric oxygen therapy was used successfully during a period of early postoperative flap ischemia. Due to traumatic ankylosis of the remaining right hip, the proximal femoral segment could not flex. This was addressed with a Girdlestone procedure three months after the reconstruction.

Computed tomography scans at one year show stability of the neopelvis with atrophic thinning of the cortex with minimal resorption of the cancellous bone of both the femur and tibia and moderate hypertrophic bone formation. A bone scan performed at one year shows uptake in both the femur and tibia confirming vascularity to the neopelvis. She is currently able to transfer independently to a wheelchair and able to use a standard motorized wheelchair. She describes her quality of life as significantly improved.

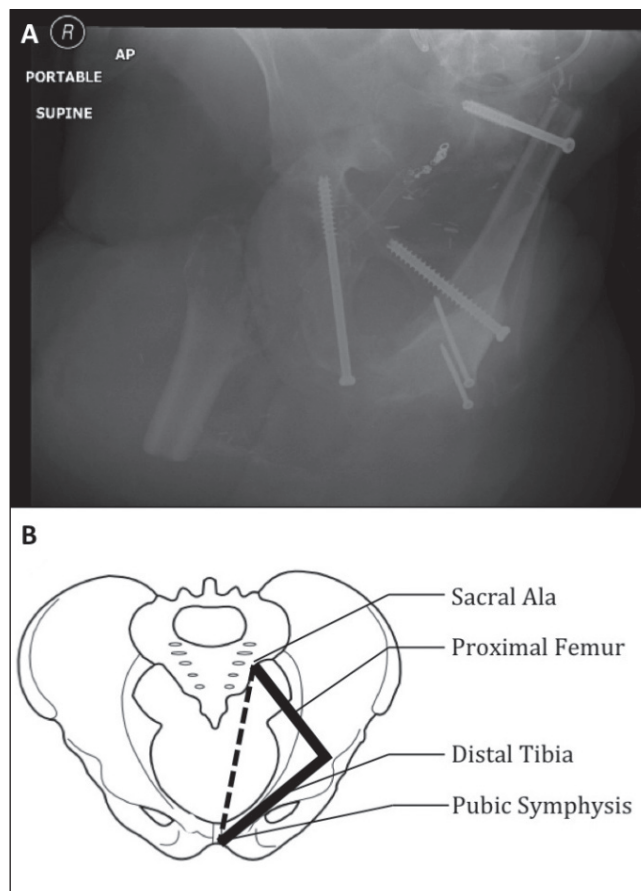


Figure 2 A Radiograph of final pelvic reconstruction using the femur and distal tibia. The distal right femur and proximal tibia were harvested and used to fashion the apex of a triangle with the pubis and sacral ala forming the base. B Schematic representation of the reconstruction of the pelvis

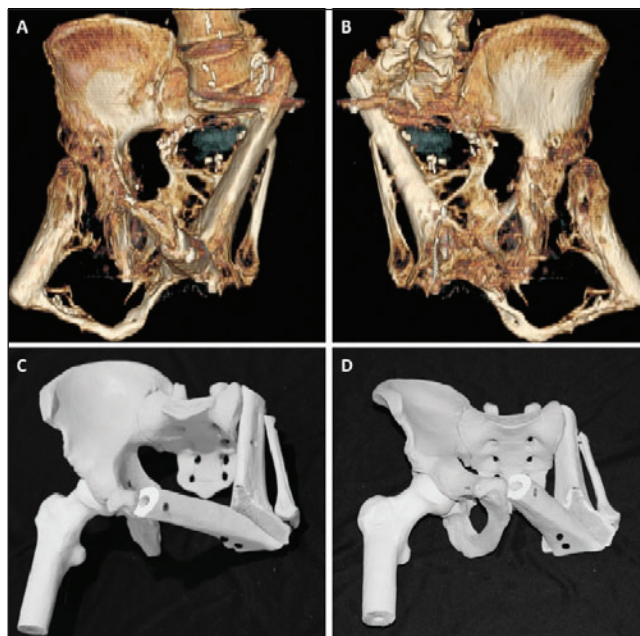


Figure 3 Final reconstruction of the neoischium. Anterior (A) and posterior (B) views of three-dimensional reconstructions from postoperative computed tomography images of the newly created neoischium are shown. Similar views of a Sawbones (Pacific Research Laboratories Inc, USA) model of the completed reconstruction is shown in C and D

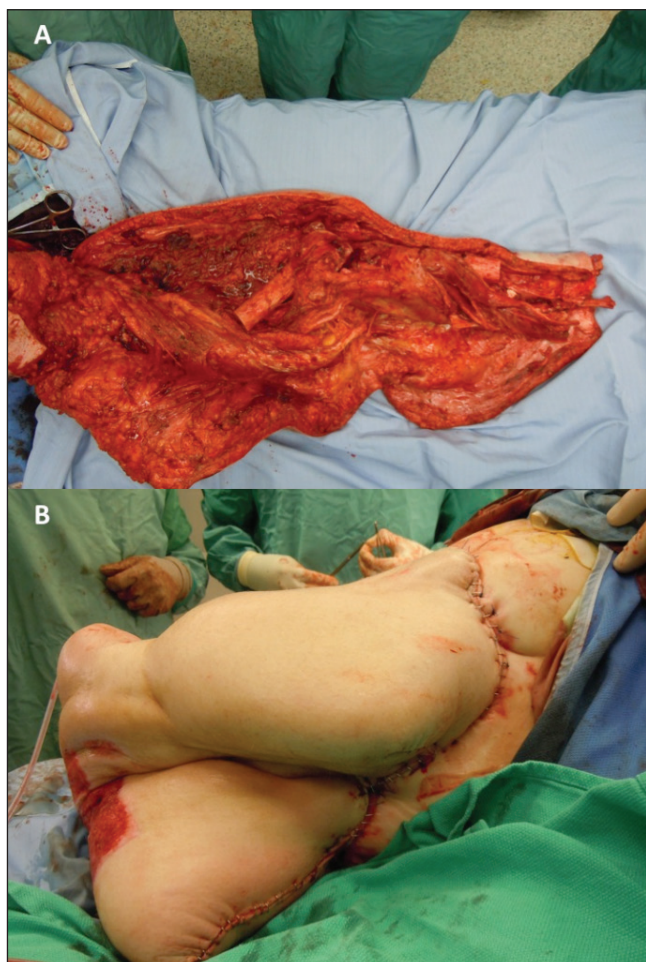


Figure 4) Intraoperative photographs of pelvic reconstruction using the femur and distal tibia to recreate the pelvic ring, and a filet flap for soft tissue coverage. **A** The filet flap is shown after dissection and removal of the proximal femur and distal tibia, before inset. **B** After reconstruction of the pelvic ring, the flap was inset for coverage of the neo-ischium to create a new seating surface

DISCUSSION

The present case demonstrates use of the 'spare parts' concept and the application of a type B1 fillet flap in the setting of traumatic hemipelvectomy. Similar cases have been described more commonly in the setting of oncological resection (1-6). Kong et al (18), for example, performed a pelvic reconstruction using a tibia-hindfoot rotationplasty and fish-mouth flap after oncological external hemipelvectomy. This case highlights the utility of this concept in the trauma setting and describes a novel method of reconstructing the bony pelvis to provide a sitting surface. The importance of a stable pelvic platform for sitting cannot be overstated. This allows for use of a standard wheelchair without custom seating and also enables for the ability to independently transfer.

Other donor sites were considered for this patient, but ultimately ruled out. Use of the latissimus dorsi or serratus muscles would compromise upper body strength. Both rectus abdominis muscles were violated with ileostomy and colostomy surgeries, as well as bladder

ileoconduits and percutaneous nephrostomy tubes. In addition, use of the recti as donors would potentially compromise core strength for sitting and transfers. While this was a technically difficult case because blood supply to the donor leg had become tenuous and relied on collateral vessels, application of the spare parts strategy provided this patient with a fully functional sitting surface by sacrificing a non-viable leg, leaving her core and upper body strength intact for improved independent transfer and activities of daily living.

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