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The Harrington Reconstruction for Patients with Advanced Periacetabular Metastatic Disease

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Introduction

The goal of surgery for metastatic bone disease is to relieve pain and allow patients to return to function as soon as possible. Pathologic fractures that involve the acetabulum present a unique challenge to orthop edic surgeons. Because of insufficient periacetabular bone in cases of extensive tumor destruction, fracture repair is not feasible and conventional total hip replacement is not a viable treatment option for most patients. Reconstructing the pelvis requires creating a stable construct in the context of substantial bone loss; moreover, given the underlying pathology, this must be achieved without relying on biologic healing of the bone.

While various reconstruction techniques may be utilized, the Harrington reconstruction is a well-described surgical option for patients with advanced periacetabular metastatic disease. In 1981, Harrington described a technique whereby the structure of the pelvis is recreated with threaded Steinmann pins that are fixed in the intact, proximal ilium and converge in the destroyed supra-acetabular region. The defect surrounding these pins is then filled with cement and an acetabular liner is embedded. Finally, a femoral stem is placed to complete the total hip arthroplasty, creating mechanical stability and permitting immediate, full weight bearing.

Classification

Periacetabular metastatic destruction is graded according to the Harrington classification. This categorizes periacetabular fractures into subgroups based on their underlying bony defect and, hence, their specific biomechanical deficiency.

Case Report

History

This is a 56-year-old male patient who presented to the emergency department with a pathologic left acetabular fracture in the setting of high grade urothelial carcinoma of the left renal pelvis. The patient was initially diagnosed one year previously, after which he underwent total left nephrectomy and pelvic lymph node dissection. He was treated with adjuvant Gemcitabine and Cisplatin as advised by his outpatient oncologist.

Nine months later, the patient reported insidious onset left hip pain and had a left ischial bone biopsy confirming osseous metastasis. Following this diagnosis, he presented to an outside hospital with intractable left hip pain and inability to bear weight; he also reported numbness and weakness of his left lower extremity and was admitted for ambulatory dysfunction. During admission, an X-ray and CT scan of the abdomen and pelvis demonstrated progressive osseous metastasis to the left acetabulum (Figure1). Orthopaedic surgery advised use of a walker, with weight bearing on his left lower extremity according to pain.

Approximately two weeks after this admission, the patient initiated palliative radiotherapy with radiation oncology (1200/3000 cGy 4/10 fx, 300 cGy/fx). Unfortunately, he sustained a mechanical fall shortly after starting and X-rays taken at the time of injury revealed a comminuted pathologic fracture involving the superolateral aspect of the left acetabulum. Additionally, there was evidence of a smaller lytic lesion of the inferior pubic ramus with a nondisplaced pathologic fracture (Figure 2). The patient

Table 1 Harrington classification of periacetabular destruction[2]

Harrington Classification	Characterization
Class I	Deficient lateral cortices with intact superior and medial wall
Class II	Deficient medial wall
Class III	Deficient lateral cortices and superior wall
Class IV	Isolated lesion that can be resected in an attempted curative procedure

was transferred to our emergency department for further management.

Figure 1. X-ray with lytic osseous metastasis in the weight-bearing region of the left acetabulum.

Figure 2. X-ray with comminuted, pathologic fracture of the superolateral left acetabulum. Non-displaced, comminuted fracture of the inferior pubic ramus.

Examination

On exam, the patient complained of severe pain and was intermittently confused due to medications but answered all questions appropriately. The left lower extremity was without gross deformity or skin defects; there was no significant swelling, erythema, or ecchymosis. He was diffusely tender to palpation about the left hemipelvis and had significant pain with log roll of the left lower extremity. Active and passive hip flexion and extension were deferred in the setting of his acute injury. He was otherwise neurovascularly intact.

Imaging

X-rays of the pelvis and left hip and were obtained confirming a pathologic fracture of the left acetabulum. Subsequent CT abdomen and pelvis revealed a pathologic, comminuted fracture of the left acetabulum through an underlying lytic lesion (6cm x 6cm) and further involvement of the surrounding bone, including the anterior wall/column and ischium (Figure 3).

Figure 3. CT pelvis with pathologic fracture of left acetabulum through extensive lytic lesion.

Clinical Management

The patient was admitted to the orthopaedic surgery service for preoperative work-up and surgical management. Anesthesia was consulted for perioperative pain control and cardiology was consulted for pre-procedure risk stratification given the patient's history of inferior right bundle branch block and ascending thoracic aortic aneurysm. Medical co-management and radiation oncology were also consulted for perioperative management. The patient was made touch-down weightbearing but, due to pain, was effectively on bedrest pending operative intervention.

Surgical Management

Indications

The patient's prognosis was discussed with his oncology team and noted to be uncertain. The surgical team therefore offered the patient the options of Girdlestone procedure (femoral head resection to reduce pain by removing pressure from the fractured acetabulum) and Harrington reconstruction. The latter is associated with higher function but also greater risks, which include but are not limited to blood loss, infection, dislocation, and mechanical failure due to progressive disease. After extensive discussion involving the patient and his family, the decision was made to pursue operative management in the form of a left hip tumor curettage and Harrington reconstruction. Indications for the procedure included intractable pain resulting in immobilization and high narcotic requirements in this patient with metastatic disease.

Description of Procedure

The patient was placed in the lateral decubitus position and a standard posterior approach to the hip was performed. The hip could not be dislocated, having migrated into the pelvis; therefore, the neck was cut in situ and the head was fragmented with osteotomes and removed piecemeal. The acetabulum was visualized and found to have extensive lytic destruction. Copious necrotic material and osseous fragments were removed from the acetabulum under direct visualization using rongeurs, curettes, and pituitaries. After debridement to mechanically stable bone, there was no significant medial wall remaining.

While the curettage was being performed, a second incision was made laterally over the iliac crest and dissection was carried down to the abdominal wall muscles, which were released from their insertion, exposing approximately 6cm of the iliac crest. Under fluoroscopic guidance using obturator oblique and anterior-posterior views, four 4mm threaded Steinmann pins were inserted from the crest into the acetabular defect and then driven into the ischium distally. A polyethylene acetabular liner was selected to fit within the defect, recreating appropriate hip center and offset, while allowing for a 40 mm femoral head. The back of the cup was scored using a bur to improve cement fixation. The wound was then very thoroughly irrigated, taking care to remove any remaining loose particles of bone. Three batches of cement were then mixed and injected into the acetabular defect around the pins, and the cup was embedded in the cement. This was allowed to dry completely, while carefully maintaining appropriate inclination and version of the cup.

Attention was then directed to the proximal femur, which was exposed and prepared to accommodate a standard uncemented femoral component, completing the total hip replacement. A trial stem and head were placed and the hip was assessed to ensure equal limb length and stability. Trial components were then exchanged for the true components. The posterior capsule and short external rotators were repaired to the proximal femur through drill holes with Ethibond suture, and the wound was closed in the standard fashion.

Postoperative Course

The patient was made immediately weight bearing as tolerated on his left lower extremity with a walker and posterior hip precautions, similar to a standard total hip replacement. He worked with PT/OT beginning post-operative day 0 and was discharged to an acute rehabilitation facility. He was indicated for post-operative radiation after soft tissue healing.

At his two-week follow-up appointment, the patient reported significant progress with PT at his rehabilitation facility; he ambulated 120 feet with a rolling walker with moderate pain. His exam was notable for 5/5 painless strength throughout his left lower extremity without tenderness or crepitus to palpation. His lower abdominal and left hip incisions demonstrated routine healing without signs of wound compromise. X-rays showed no acute pathology or evidence of hardware migration (Figure 4).

Unfortunately, the patient died from cancer-related complications approximately one month following his left hip reconstruction; however, with constantly improving medical treatment options for cancer, patients often live and benefit from the hip for several years.

Discussion

The Harrington reconstruction is a well-described surgical technique for managing advanced periacetabular metastatic destruction. For most patients, this is an effective and enduring surgery permitting early mobilization and pain relief . Several techniques can be helpful to minimize operative time, blood loss, and complications such as mechanical failure.

- IR-guided embolization 24-48 hours prior to the procedure can be performed to improve hemostasis during curettage of the large, uncontained and often hypervascular metastatic lesion. In addition to reducing intra-operative blood loss, the hemostasis improves cement fixation to the remaining bone and pins.

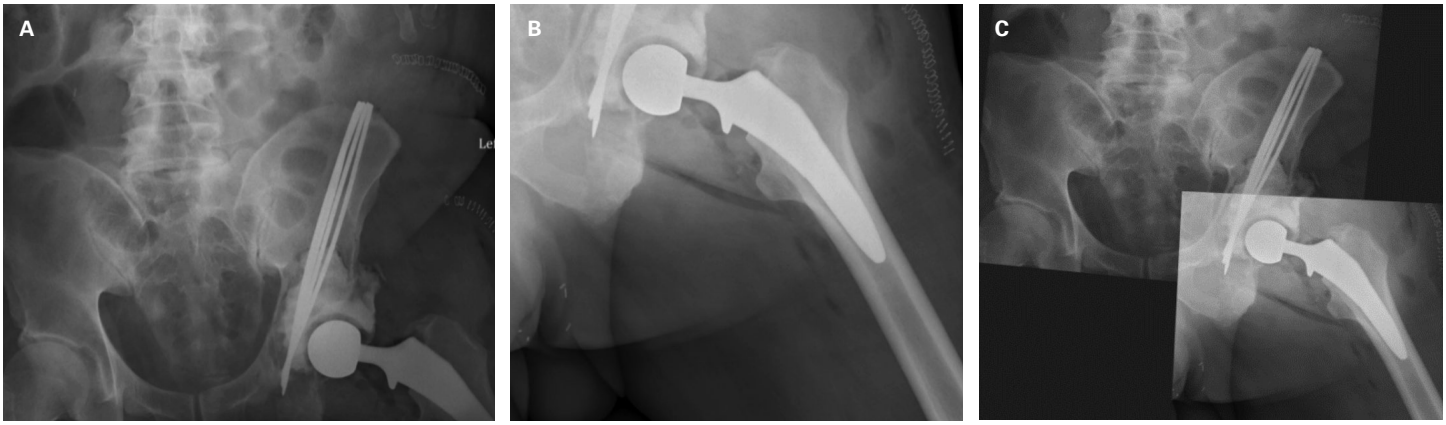

Figure 4. Post-operative X-ray status post left hip Harrington with total hip arthroplasty.

- When positioning the patient lateral, placing a bump under the contralateral hip allows easier access to the iliac crest for pin insertion, especially in larger patients.
- Checking fluoroscopic views before prepping and draping will ensure that unobstructed AP pelvis and obturator oblique images can be obtained for intra-operative guidance.
- Because the anterior and posterior columns are often absent, standard Hohmann-type retractors are not effective and large deavers should be available for exposure.
- Threaded rather than smooth Steinmann pins should be used, as the latter tend to migrate proximally in the months or years postoperatively. This causes point tenderness over the iliac crest at the site of the prominent pin and requires removal of the offending pin(s).
- The Harrington procedure classically describes placing pins in specific locations (i.e., one anterior, one posterior, and one superior). However, we recommend assessing the pattern of bone loss and placing the pins to compensate accordingly. For example, in the case presented here, the majority of the bone loss was posterior, so most of the pins were used to recreate the posterior column.
- Fixing the pins distally into the ischium or pubic ramus, if bone remains in those locations, provides additional stability (Figure 5). If needed, pins traversing the acetabular defect can be redirected into the ischium/ramus with a large right-angle clamp or army-navy retractor. For example, if the pin is directed medially, the instrument is used to pull it laterally while advancing the pin until it fixes in the bone distally (Figure 6).
- Once the pins are appropriately placed and confirmed to be in final position, trimming and burring down the ends to be flush with the iliac crest will avoid pin prominence and irritation. If they need to be removed at a later date, a rongeur can be used to debride a small portion of the iliac crest to expose and engage the end of the pin for removal.
- Depending on the size of the patient and pin configuration, a thinner acetabular liner may be helpful to maximize head size and stability. Thin liners are not designed for cementation but can be easily adapted for this purpose by scoring the outer surface with a bur.
- Steinmann pins passed from the iliac crest into the ischium may pass through the acetabular region and excessively lateralize the cup. In order to avoid this, pins should ideally be directed either anteriorly, posteriorly, or medially. Pins that would interfere with cup position can be reversed until they support the liner superiorly (Figure 7).
- Trialing and memorizing the placement, angulation, and version of the liner prior to cementing is helpful, as filling the defect with cement and thereby covering the bone and pins can be disorienting. If any portion of the acetabulum remains, such as a rim of the anterior/posterior wall or transverse acetabular ligament, this can be used as a landmark to accurately recreate hip center, version, and offset.
- Prior to cementing, pulse lavage, hydrogen peroxide, and epi-soaked packing can be used to remove blood and dry the bone surface for improved cement fixation.
- When the posterior column is absent, the sciatic nerve is unprotected; ensuring cement does not migrate posteriorly and irrigating with cool saline during the curing process can prevent thermal damage to the nerve.
- If patients do not have risk factors for fragility fracture (e.g., femoral metastases, age, osteoporosis) an uncemented femoral component may be used to reduce operative time.

Figure 5. Steinmann pins fixed distally into the ischium or pubic ramus provides additional stability.

Figure 6. Bent pins.

Conclusion

The Harrington reconstruction is an effective surgical technique to relieve pain and restore ambulatory function in patients with destructive periacetabular metastatic disease. This case reviews the surgical technique and treatment course for a patient with metastatic urothelial carcinoma. Despite his poor prognosis, the patient was able to ambulate and maintain a significant degree of functional independence during his remaining lifetime.

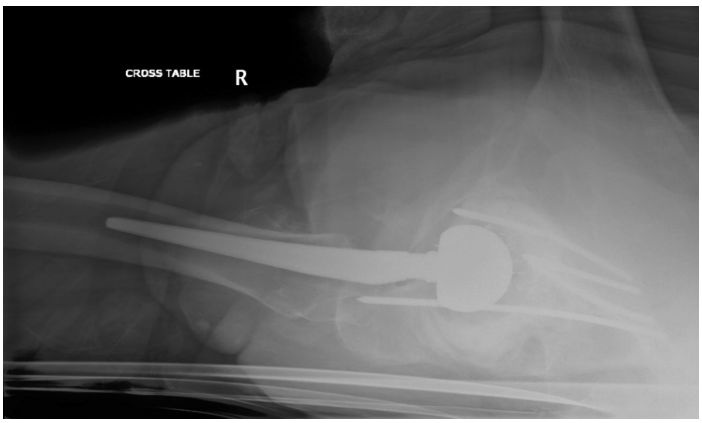

Figure 7. Pins that would interfere with cup position can be reversed until they support the liner superiorly.

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