# Major reconstruction for periacetabular metastasis

## Early complications and outcome following surgical treatment in 40 hips

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**ABSTRACT – We performed 40 total hip arthroplasties with pelvic reconstruction in 37 patients with metastatic periacetabular tumor. 3 patients underwent bilateral periacetabular reconstructive surgery and 2 of these had bilateral procedures at the single operation. There were 8 Harrington class I, 7 class II, and 25 class III lesions. A modified Harrington procedure was employed. All patients showed improvements in hip pain, analgesic use, ambulation and mobility postoperatively. 1 prosthetic dislocation occurred after a fall at home 2 months following surgery. 2 patients had pulmonary emboli during the femoral procedure, 1 of whom died during surgery. There were no prosthetic loosenings. Preoperative CT and/or MRI are important for the study of metastatic involvement of acetabular bone. Durability of reconstruction requires appropriate use of acetabular mesh, Steinmann pins, acetabular reinforcement rings and long-stem femoral prostheses. Careful patient selection may improve quality of life. A sequential bilateral procedure should be considered for some patients.**

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Patients with pathological fractures of the neck of the femur are commonly treated surgically. Since severity of hip pain and limitation of mobility are similar in patients with periacetabular pathologic fracture, the indication for surgery for pathologic fracture of the acetabulum resembles that for neck of femur fractures (Stark and Bauer 1996). Harrington (1981) showed that hip reconstruction for periacetabular metastasis could improve functional status and reduce pain. We present our experience of Harrington's procedure for periacetabular metastases paying special attention to our complications and patient outcomes.

## Patients and methods

We performed 40 total hip arthroplasties with pelvic reconstruction in 37 patients (27 women) having metastatic periacetabular tumor between 1995 and 1999. 3 patients underwent bilateral periacetabular reconstructive surgery and 2 of these underwent bilateral procedures at the single operation. The median age at operation was 61 (35–86) years. The original tumor consisted of breast carcinoma in 21 patients, prostate carcinoma in 5, lung carcinoma in 3, multiple myeloma in 2 and others in 4. 2 patients had unknown primary cancers.

The indication for surgery included impending and pathological fracture, or pain from metastatic disease that was unresponsive to radiation therapy or chemotherapy. Preoperative pathological fracture was noted in 15 of 40 hips, of which 8 were acetabular fractures and 7 fractures of the neck of the femur.

The extent of the metastatic tumors was investigated with preoperative nuclear scan, radiography, CT or MRI (Figure 1).

We subdivided periacetabular metastatic tumor into 3 groups according to Harrington's (1981) classification. Class I (8 patients): the lateral cortices and the superior and medial walls are structurally intact. Class II (7): the medial wall is deficient. Class III (25): the lateral cortices, superior

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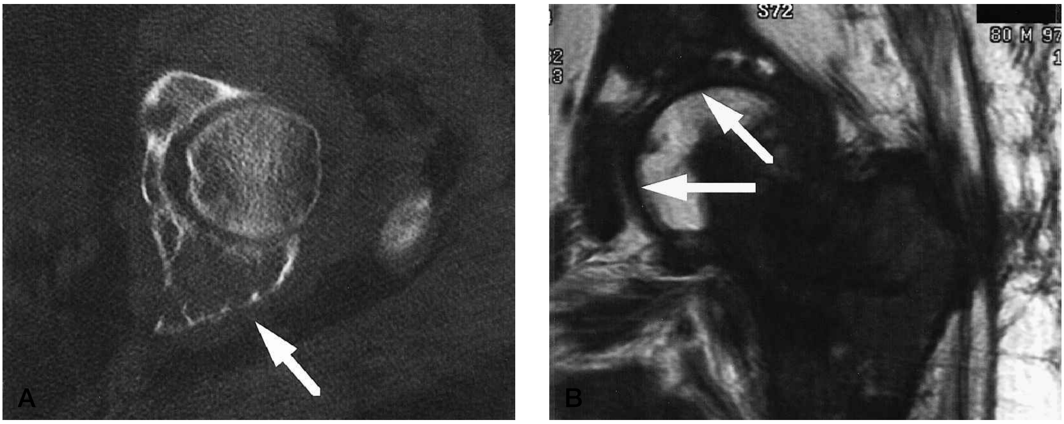


Figure 1. Preoperative assessment of the extent of metastatic tumor with (A) CT and (B) MRI.

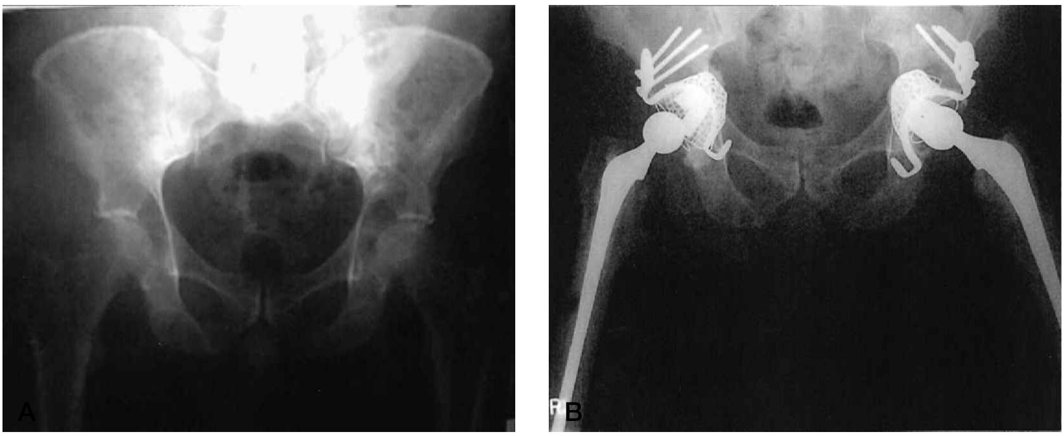


Figure 2. Bilateral procedure in patient with bilateral class III lesions (53-year-old man with metastatic renal carcinoma). (A) Preoperative and (B) postoperative radiographs.

wall, and the medial wall are all deficient.

### *Surgical treatment*

Like Harrington (1995), we performed conventional cemented total hip arthroplasty in patients with class I. In those with class II, we combined total hip arthroplasty with an acetabular reinforcement shell (Kerboull Mk.III acetabular shell, Howmedica) stabilized by 2 or 3 cortical screws, to prevent medial migration and loosening of a cemented cup. Mesh was placed along the medial aspect of the wall in some patients. Patients with class III lesions required reconstructive techniques that transmitted load-bearing stresses to intact bone. After excising a sufficient amont of metastatic tumor, mesh was placed in the medial defect and the reinforcement shell was inserted over this and held with multiple cortical screws directed into intact bone of the ilium (Figure 2). A latticework of several large Steinmann pins was also inserted in 7 patients with class III lesions who had a big cavity around the acetabulum after excising the metastatic tumor (Figure 3). 2 groups of nonparallel Steinmann pins were inserted, one group from the anterior superior spine of the ilium to the deficient medial wall of the acetabulum and a second group from the superior deficient roof of the acetabulum to the superomedial ilium and across the sacroiliac joint. After resection of metastatic bone tumor, the periacetabular cavity was packed with antibiotic-loaded polymethylmethacrylate and the acetabular component was cemented into the ring. A cemented long-stem component was used for all patients to reduce the risk of future fractures due to femoral metastases. All but 2 patients with a class I lesion were operat-

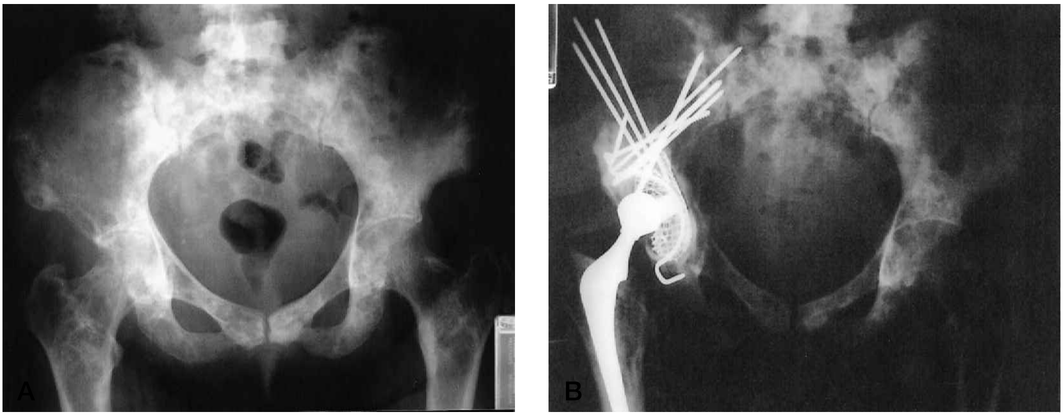


Figure 3. A latticework of Steinmann pins transmitting load-bearing stresses to intact bone in patient with a class III lesion. (A) Preoperative and (B) postoperative radiographs.

ed on via a direct lateral approach (Hardinge 1982). 2 patients with a class I lesion were operated on via a standard posterior approach. Prophylactic antibiotic drugs were administered intravenously to all patients intraoperatively, and for 48 hours postoperatively.

Analgesic use, independence, and mobility were graded according to Allan et al. (1995), and hip pain was also graded with the pain scale of the functional assessment rating scale, as described by Enneking et al. (1993) (Table). These assessments were done at regular follow-ups and their best scores after surgery were used in the current study. Wilcoxson signed rank tests were used for statistical analysis of preoperative and postoperative pain, mobility and use of analgesics.

**Scoring system**

| Score |
|---|
| *Ambulation and mobility* |
| 1 Bedridden |
| 2 Wheelchair |
| 3 No weight bearing, household |
| 4 Partial weight bearing, household |
| 5 No weight bearing, community |
| 6 Partial weight bearing, community |
| 7 No walking aids |
| *Pain* |
| 5 None |
| 4 Insignificant |
| 3 Mild |
| 2 Moderate, intermittent |
| 1 Moderate, constant |
| 0 Severe |
| *Analgesic use* |
| 5 Constant narcotic |
| 4 Intermittent narcotic |
| 3 Constant nonnarcotic |
| 2 Intermittent nonnarcotic |
| 1 None |
| *Independence* |
| Total care |
| Partial independence |
| Independence |

## Results

### *Duration of surgery*

Excluding 2 cases with sequential bilateral procedures, the median operative time was 130 (75–257) minutes.

### *Blood loss*

The median decrease in hemoglobin within 24 hours after surgery was 13 (-23–72) g/L. The median number of packed cell units for transfusion was 3 (0–12).

### *Bilateral procedure*

The operative timed in 2 cases with sequential bilateral procedures were 257 and 395 minutes, the blood transfusion, 5 and 11 units, and the decrease in hemoglobin, 24 and 28 g/L, respectively.

### *Follow-up*

The median duration of hospitalization of all patients was 10 (4–31) days. 1 patient died during surgery. The median survival time of all other patients was 8 (1–24) months. 18 patients were alive at the last follow-up, with a median survival time of 10 (2–24) months after surgery.

### Mobilization

The patients were mobilized after removal of the suction drain and all patients could manage weight-bearing and start of physiotherapy with walking-aids by the end of the first postoperative week. All patients improved their ambulatory and mobility status after the surgical intervention. The mean ambulatory score was 5.4 (SD 1.4) postoperatively and 3.2 (SD 2.2) ($p < 0.001$) preoperatively. 14 of 15 patients who had had a preoperative pathological fracture of the acetabulum or neck of the femur acquired ambulation independently of walking-aids. 1 patient who had a preoperative pathological fracture of the femoral neck was doing physiotherapy with walking-aids after surgery, but was later confined to bed because of a deterioration in her general condition from progression of her metastatic disease.

### Pain relief

All patients had relief of pain after surgery, with a mean score of 1.4 (SD 1.2) compared with a preoperative score of 4.3 (SD 1.5) ($p < 0.001$). 14 patients had no pain in the operated hip at last follow-up with or without narcotic medication. Moreover, the postoperative score for the use of narcotic analgesics of 3.4 (SD 1.4) also improved compared with the preoperative score of 4.0 (SD 1.3) ($p = 0.02$). Although eventually some patients increased narcotic use and their mobility status gradually deteriorated after developing other metastatic tumors, no patient showed deterioration of pain at surgery site.

### Independence

20 patients improved their independent status to independence and 13 patients to partial assistance; 2 patients required total care after surgery.

### Complications

1 patient died intraoperatively after developing hypotension, tachycardia and arterial oxygen desaturation after reaming of the femoral canal and cementing of the femoral stem. This was caused by massive tumor and non-tumor microembolism. 1 patient suffered from a slight arterial oxygen desaturation after reaming the femoral canal. However, he recovered without further complication.

1 prosthetic dislocation occurred after a fall at home 2 months following surgery in a patient who had no acute postoperative complication and whose hip joint was known to be stably reduced at the time of her index surgery. Radiologically, there was no local progression of metastatic tumor nor loosening of the prosthesis.

There was no nerve palsy related to insertion of cortical screws and Steinmann pins. 1 patient had a superficial wound infection and 1 developed a subcutaneous hematoma postoperatively. 1 patient had residual postradiotherapy erythema which was noted preoperatively and persisted postoperatively. 1 patient had a mild pressure sore around the sacral area. 1 patient had a slight peroneal nerve palsy on the second postoperative day, which was probably caused by compression of the peroneal nerve by the straps of a Charnley pillow. These complications all cleared spontaneously without a second procedure. 1 patient had thrombocytopenia postoperatively because of liver dysfunction that had existed preoperatively, and required transfusion of 10 units of platelets.

## Discussion

Pelvic surgery for metastatic disease is challenging, because of the close proximity of vital neurovascular structures and the peculiar bone anatomy of the periacetabulum. The periacetabular area is commonly affected in patients with metastasis, and impending and complete pathologic fractures around the hip can cause severe pain and limitation of mobility. When such a situation is encountered in patients with a reasonable life expectancy, surgical intervention should be considered, although the surgery for periacetabular tumor is associated with significant morbidity.

Our results showed that postoperative hip pain was significantly reduced and, moreover, that the postoperative use of narcotic analgesics significantly improved, compared with preoperative use. However, most patients needed to control ongoing pain at other metastatic sites. Vena et al. (1999) found significant improvement after surgery in the use of narcotic analgesics, but Allan et al. (1995) reported no difference in the narcotic pain score before and after surgery. The discrepancy between these results is possibly related to the differing stages of metastasis in each patient. Ambulation and mobility also improved significantly after surgery in our patients, indicating that pelvic reconstruction for metastasis may be valuable for improving the quality of life of patients with metastasis.

In our series, 2 patients were considered to have cardiopulmonary embolic events during the femoral procedure, 1 died due to cardiac failure following a presumptive massive pulmonary embolic event and the other had a slight arterial oxygen desaturation without significant hypotension. The senior co-author (PC) has previously reported oxygen desaturation and hypotension in 11 of 45 patients during intramedullary manipulation for femoral metastasis and of these, 3 died (Barwood et al. 2000). Patterson et al. (1991) highlighted the increased risk of cardiovascular complications associated with a cemented long-stem component during hip arthroplasty, especially in patients with bone metastasis. A cardiopulmonary embolic event following femoral reaming and cementation may be an important complication of surgery for periacetabular metastasis. To avoid high pressurization while inserting the femoral stem, we now routinely insert the femoral component early following cement injection, while the cement remains in its low viscosity state. In addition, we perform invasive hemodynamic monitoring when operating on these patients. We have had no patient with pulmonary emboli during Harrington's procedure for the last 2.5 years. Deaths have also been described in other series. Harrington (1981) reported 2 deaths in a series of 58 patients: 1 due to extended blood loss and another due to myocardial infarction. Vena et al. (1999) had 3 deaths in a series of 21 patients during the perioperative period: 1 due to chronic obstructive pulmonary disease, 1 to acute respiratory distress from late pulmonary embolus, and the other due to extended brain metastasis. Levy et al. (1982) reported 2 cardiac arrests coincident with the injection of bone cement among 20 patients with hip metastasis while performing total hip arthroplasty, both of whom were successfully resuscitated.

A high rate of dislocation has been reported previously with this procedure, which may be caused by the extended surgical exposure, a large acetabular bone defect and loss of anatomic landmarks (Allan et al. 1995, Stark and Bauer 1996, Vena et al. 1999). Careful reconstruction with the acetabular prosthesis in the anatomical position is required. We took care to preserve the superior-lateral rim of the acetabulum, an important landmark for orientating the acetabular component. If we were obliged to excise the lateral rim of acetabulum, we would do this just before inserting the cup in order to preserve it so long as possible as a landmark. Stark and Bauer (1996) performed the extended posterior approach and used a 22 mm prosthetic femoral head in patients with class III. They reported that 5 of 12 patients had prosthetic dislocation, and they discussed whether use of a 32 mm head could reduce the risk of dislocation. We used 28 mm prosthetic femoral heads and performed an extended Hardinge approach in all patients with class III. In our series of 40 arthroplasties, there was only 1 dislocation of the prosthesis, which was caused by a fall 2 months after surgery. In our hands, familiarity with the Hardinge approach, which we commonly use in primary arthroplasty of the hip together with the 28 mm prosthetic femoral head, and anatomic reconstruction of the periacetabulum may have lowered the dislocation rate.

Although 1 patient died during surgery, there was no other major complication related to surgical treatment in our series. Harrington (1981) reported that a patient with a class III lesion developed a femoral nerve palsy caused by Steinmann pin insertion. Vena et al. (1999), who used multiple cancellous screws instead of Steinmann pins, also reported a complication of femoral nerve palsy. Steinmann pins and screws inserted into intact bone provide good stability of the acetabular prosthesis, but this maneuver requires careful attention to the major neurovascular bundle, which lies adjacent to the sacroiliac joint, and also anterior to the hip joint. With the patient in the lateral position, a finger placed laterally and posteriorly to the acetabulum will identify the sciatic notch and pins directed superiorly 45° and posteriorly 45° from the anterosuperior margin of the acetabulum should allow the pins to remain within the bone, while crossing the sacroiliac joint. However, in the current study, fixation, using multiple screws without Steinmann pins in patients with class 3 lesions caused no loosening or prosthesis instability of the acetabular component, indicating that Steinmann pins may not be necessary in all class 3 lesions, particularly if there is no large tumor cavity, and multiple screws can lead to stable fixation of the acetabular ring.

In Harrington's (1981) series, 5/58 patients had loosening of the prosthetic acetabular component that was caused by recurrent tumor osteolysis. Such patients had probably developed tumor osteolytic loosening with metastases involving periacetabular bone that could not be detected on plain radiographs. We performed preoperative CT and/or MRI to study metastatic invasion into the periacetabular bone, in order to optimize excision and assess remaining bone stock. Our results showed no loosening of the prosthesis and no local tumor recurrence, which may also be because of the limited lifespan of our patients.

We performed sequential bilateral pelvic reconstructions in 2 patients. Both had been confined to bed preoperatively for more than a month because of bilateral severe hip pain, and 1 of them had suffered a pathological fracture of the left acetabulum. Although they died 3 months and 4 months after surgery, their quality of life was markedly improved. Ambulation and mobility of both patients changed postoperatively into partial weight bearing in the household with walking aids. Although a sequential bilateral procedure might be more invasive treatment, it could provide better quality of life with careful patient selection.

Substantial blood loss is a potential complication of this procedure. To avoid exsanguination, we use preoperative arterial embolization if vascular tumors are expected, e.g., myeloma, kidney, thyroid. In addition, rapid infusion pumps are also employed that can deliver between 0.5–1 L/min of blood products, if required. This is combined with invasive intra-arterial and central-venous monitoring.


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