The Harrington reconstruction for advanced periacetabular metastatic destruction

Good outcome in 32 patients

Johan Nilsson[1], Pelle Gustafson[1], Per Fornander[2] and Ewald Ornstein[2]

Departments of Orthopedics, [1]University Hospital, SE-221 85 Lund, Sweden. Tel +46 4617 10 00.
E-mail: johan.nilsson@ort.lu.se; [2]Hässleholm-Kristianstad Hospital, Hässleholm, Sweden
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ABSTRACT – We report the outcome in 32 patients operated on for advanced periacetabular metastatic destruction, where all but 2 had Harrington class III destruction. The patients were operated on using the Harrington reconstruction technique, where threaded pins and cement and a total hip replacement are used to reconstruct the acetabulum and ilium.

The median survival was 11 (0–106+) months. 13 patients lived for a year or more. At follow-up after 1 year, 10 of the 13 were free of pain at rest and weight-bearing, 6 were walking with and 7 without support, and 11 lived outside a health care facility.

2 patients died within 2 weeks of surgery, both of excessive peroperative bleeding. 2 patients had dislocations, 1 developed a deep infection, and 2 patients deep vein thrombosis. There were no complications caused by erroneous pin placement or intraoperative thromboembolic incidents. There were no mechanical failures, or radiographic signs of loosening, of the pelvic components.

The Harrington reconstruction technique is an effective and long-lasting method to relieve pain and restore function in patients with advanced periacetabular metastatic destruction.

Various reconstruction techniques have been proposed for periacetabular metastatic destructions—e.g., total hip replacement with or without support rings, pelvic reinforcement with threaded pins, allografts, or saddle prostheses (Harrington 1981, Levy et al. 1982, Walker 1993, Aboulafia et al. 1995, Allan et al. 1995, Stark and Bauer 1996, Kusuzaki et al. 1998, Vena et al. 1999).

Harrington (1981) described a reconstruction technique for advanced destruction where the destroyed ilium is reinforced with 2 groups of threaded pins that converge in the supraacetabular region. The pins are then cemented together with an acetabular support ring and a total hip replacement. The advantages of this technique are that, by virtue of a limited exposure and operation time it creates, a long-lasting reconstruction, permitting immediate weight-bearing. However, few reports have evaluated outcome; apart from the first publication with 25 patients, no study has evaluated the original technique. 3 reports covering 50 patients have shown good results with various modifications of this technique (Walker 1993, Allan et al. 1995, Vena et al. 1999).

We report our results with the original Harrington reconstruction, performed on 33 hips in 32 patients.

Patients and methods

Patients

From 1991 through 1999, we operated on 32 patients (18 women) with advanced periacetabular metastatic destructions using a combination of total hip replacement and threaded pins. 1 patient was operated on bilaterally, giving 33 operations in all.

In all patients, the indication for surgery was supraacetabular metastatic destruction (Harrington class II or III) where conventional arthroplasty, or enhancement with only a reinforcement ring, was deemed insufficient (Harrington 1981). The medi-

an age was 62 (29–82) years, and the commonest diagnosis breast cancer. The primary tumor was not known in 4 patients at the time of surgery. In 4 patients, the destruction was caused by a solitary metastasis, the others had widespread metastatic disease. In 1 patient, the acetabular lesion was caused by direct overgrowth of an intrapelvic tumor. The median time from diagnosis of the primary tumor was 4 (0–24) years. All patients had pain on weight bearing, 16 also had a pathological fracture (femoral neck or acetabulum). 30 patients (31 hips) had class III destruction. 13 patients had received radiation therapy prior to surgery (Table 1). Preoperatively, plain radiographs of the whole femur were also taken.

Surgical technique

This procedure was performed as described by Harrington (1981). With the patient in the lateral position, we used a slightly extended conventional posterolateral approach to the hip. Tumor tissue was curetted until a supraacetabular defect was created. Thereafter, the medial group of 5 or 6 mm diameter threaded Steinmann pins (1–4 pins) was drilled under fluoroscopic guidance from the defect up to or across the sacroiliac joint until a good grip was achieved. The lateral pin group (1–5 pins) was drilled from the crest down to the defect through a separate incision, normally less than 10 cm long, over the lateral iliac crest. If possible, the defect was bridged by advancing 1–3 pins down into the os ischium. After thorough irrigation, the destruction was filled with gentamycin-containing PMMA and the acetabular component positioned (Figure). An acetabular reinforcement ring was used in 11 patients. The femoral component was then cemented. In 15 patients (16 hips) with metastatic lesions further down the femoral shaft, or where long survival could be expected, long-stemmed implants (250–350 mm) were used. The median operating time was 180 (120–310) minutes, and the median intraoperative bleeding was 2.0 (0.4–11) L. In 1 patient (no. 29 in Table 1), we made a preoperative embolization of the tumor in the pelvis.

All patients received standard doses of low-molecular heparin derivatives as thrombosis prophylaxis, and prophylactic antibiotics with penicillinase-stable penicillin. Following surgery, the patients were mobilized as after a conventional cemented THA, allowing full weight bearing from the first day. Walking aids were used as needed.

Follow-up was scheduled at 1 week, 6 weeks, 4 months and 1 year, thereafter individualized. In patients where distance or general condition made travel difficult, follow-up was done at the local hospital. No patient was lost to follow-up. Minor pain was defined as pain requiring intermittent or regular use of mild analgetics (e.g., paracetamol), moderate pain was defined as pain requiring regular use of mild opioids (e.g., tramadol or dextropropoxyphen), and severe pain was defined as pain requiring regular use of strong opioids, either perorally or parenterally. ADL was evaluated with the Karnofsky index, where the highest score (100) signifies normal function, whereas a score of 20 means confinemet to a health care facility (Karnovsky and Burchenal 1949).

Results

All patients improved, and none deteriorated, as regards pain at rest or on weight bearing, and walking ability after surgery (Table 2).

Although the Karnovsky index may be influenced by factors other than hip pain, all patients improved, and none deteriorated after surgery (Table 2).

The median survival was 11 (0–106+) months. 6 patients did not survive 3 months, 2 of whom died within 2 weeks ofsurgery. 13 patients have lived for 1 year or longer after the operation (Tables 1 and 2).

Complications

In 3 patients, the peroperative bleeding exceeded 5 liters; 1 of these died during surgery due to hypovolemia, another 2 weeks after surgery. 2 patients dislocated the arthroplasty at 4 and 5 weeks, respectively; 1 of these was treated with closed reduction, the other with open reduction and the addition of a screw-on posterior rim. 1 patient acquired a deep infection (coagulase-negative Staphylococcus aureus) with fistulation and discharge, requiring life-long antibiotic treatment, but no further surgery. No other wound complications were seen. 2 patients developed deep vein

Table 1. Clinical data in 32 patients operated on with the Harrington reconstruction for advanced periacetabular metastatic destruction

A	B	C	D	E	F	G	H	I	J	K	L	M
1	f / 72	breast	solitary	0.5	pain	III	5 / no / Scanhip / 170	180	1.9	preop	none	alive / 106
2	m / 73	prostate	widespread	6	pain	III	5 / no / Lubinus / 150	270	4.2	preop	deep vein thrombosis	died / 12
3	f / 66	breast	widespread	5	pain	III	5 / no / Lubinus / 150	240	2.4	postop	none	died / 12
4	f / 65	breast	widespread	15	pain	III	5 / no / Lubinus / 170	210	2.0	postop	none	died / 3
5	f / 67	breast	widespread	8	pain	III	6 / yes / Scanhip / 300	215	3.0	postop	none	died / 27
6	m / 67	uroepithelial	widespread	0.5	pain	III	5 / yes / Lubinus / 250	310	7.6	postop	deep vein thrombosis	died / 3
7	f / 71	breast	widespread	8	pain	III	4 / yes / Scanhip / 250	190	0.9	postop	none	died / 20
8	m / 73	lung	widespread	0.5	fracture	III	4 / yes / Scanhip / 300	130	0.8	preop	none	died / 4
9	m / 82	prostate	solitary	0	fracture	III	3 / no / Scanhip / 170	145	1.0	none	none	died / 24
10	f / 60	breast	widespread	24	fracture	III	2 / no / Scanhip / 300	185	1.3	postop	none	died / 27
11	f / 50	breast	widespread	2.5	fracture	III	5 / no / Scanhip / 170	120	2.0	postop	none	died / 6
12	f / 67	breast	widespread	22	pain	III	4 / no / Scanhip / 130	180	1.7	pre+postop	femoral fracture 24 mo	died / 42
13	f / 55	breast	wide-spread	6	fracture	III	5 / no / Charnley / 350	180	3.5	postop	none	died / 11
14	f / 61	uroepithelial	wide-spread	2	fracture	III	4 / yes / Scanhip / 130	130	0.4	postop	dislocation 4 weeks	died / 4
15	m / 54	unclear	solitary	0	fracture	III	6 / yes / Scanhip / 150	180	1.3	postop	none	alive / 48
16	m / 65	prostate	widespread	6.5	pain	III	5 / yes / Lubinus / 150	200	9.3	preop	perioperative death	died / 0
17	m / 82	prostate	widespread	4	pain	III	4 / no / Lubinus / 150	160	1.5	postop	femoral fracture 26 mo	died / 30
18	f / 67	breast	widespread	8	pain	III	5 / yes / Lubinus / 150	180	3.1	postop	dislocation 5 weeks	died / 6
19	f / 66	breast	widespread	7	pain	II	5 / no / Scanhip / 130	160	1.5	postop	none	died / 21
20	m / 67	myeloma	widespread	1	fracture	III	5 / no / Scanhip / 170	155	1.1	preop	deep infection	died / 20
21	m / 60	rectum	widespread	5	fracture	III	7 / yes / Scanhip / 300	210	3.0	preop	none	died / 10
22	m / 79	thyroid	widespread	0	fracture	II	5 / yes / Scanhip / 300	150	0.5	postop	none	died / 9
23	f / 29	vulvae	solitary	1	fracture	III	4 / no / Scanhip / 130	200	2.9	none	none	died / 2
24	m / 75	prostate	widespread	7	fracture	III	5 / yes / Exeter / 260	120	0.8	preop	none	died / 5
25	f / 46	breast	widespread	4.5	pain	III	3 / no / Scanhip / 130	140	0.8	postop	none	died / 10
26	m / 63	prostate	widespread	0	fracture	III	5 / no / Scanhip / 130	180	1.7	postop	none	died / 13
27 left	m / 43	thyroid	wide-spread	19	fracture	III	5 / no / Lubinus / 350	180	5.2	postop	none	died / 11
27 right	m / 43	thyroid	wide-spread	19	fracture	III	5 / no / Lubinus / 350	140	3.0	preop	none	died / 9
28	m / 51	myeloma	widespread	0.5	fracture	III	5 / no / Lubinus / 350	130	2.5	preop	none	alive / 13
29	f / 78	kidney	widespread	2	pain	III	8 / no / Lubinus / 350	150	3.5	preop	none	died / 1
30	f / 44	breast	widespread	11	pain	III	4 / no / Lubinus / 350	180	2.6	preop	none	alive / 8
31	f / 45	breast	widespread	1	pain	III	4 / no / Lubinus / 350	120	1.4	postop	none	alive / 6
32	f / 58	breast	widespread	1	pain	III	5 / no / Lubinus / 350	180	11	preop	died 2 weeks postop	died / 0.5

A Patient
B Sex / age
C Primary tumor
D Metastatic burden
E Latency, years
F Indication for surgery
G Harrington class
H Reconstruction # pins / ring / femoral component / length (mm)
I Operating time (min)
J Bleeding, L
K Radiation therapy
L Complication
M Follow-up status / months

thrombosis, both were uneventfully treated with anticoagulants. 2 patients, operated on with short-stemmed femoral components, had pathologic fractures below the stem at 24 and 26 months. Both were reoperated on using long-stemmed femoral components and recovered uneventfully (Table 1).

There were no complications caused by intraoperative embolization, despite the fact that half of the patients were operated on with femoral components 250 mm or longer. There were no complications due to erroneous pin placement, but in 1 patient, 1 of the lateral pins had to be removed because of skin irritation at the iliac crest. There were no mechanical failures, or radiographic signs of loosening, of the pelvic components. No patient developed postoperative sciatic or femoral nerve symptoms that could be attributed to the surgery.

Discussion

Destruction of the periacetabular bone can be divided into 3 classes: class I where the lateral cortices and the superior and medial walls are structurally intact, class II where the medial wall is deficient, and class III where the lateral cortices, the superior wall, and the medial wall are all deficient

Table 2. Outcome after the Harrington reconstruction for advanced periacetabular destruction in 31 patients alive 1 week after surgery

Factor n =	Preop. 31	1 w 31	6 w 28	4 mo 23	1 yr 13
Pain at rest					
no	1	16	24	19	10
minor	12	12	2	4	1
moderate	14	3	2	–	2
severe	4	–	–	–	–
Pain on weight bearing					
no	–	14	23	20	10
minor	–	17	5	3	1
moderate	1	–	–	–	2
severe	30	–	–	–	–
Ambulation					
walks without support	–	–	2	9	7
walks with support	17	30	24	14	6
bedridden	14	1	2	–	–
Karnovsky index					
> 20	18	26	27	21	11

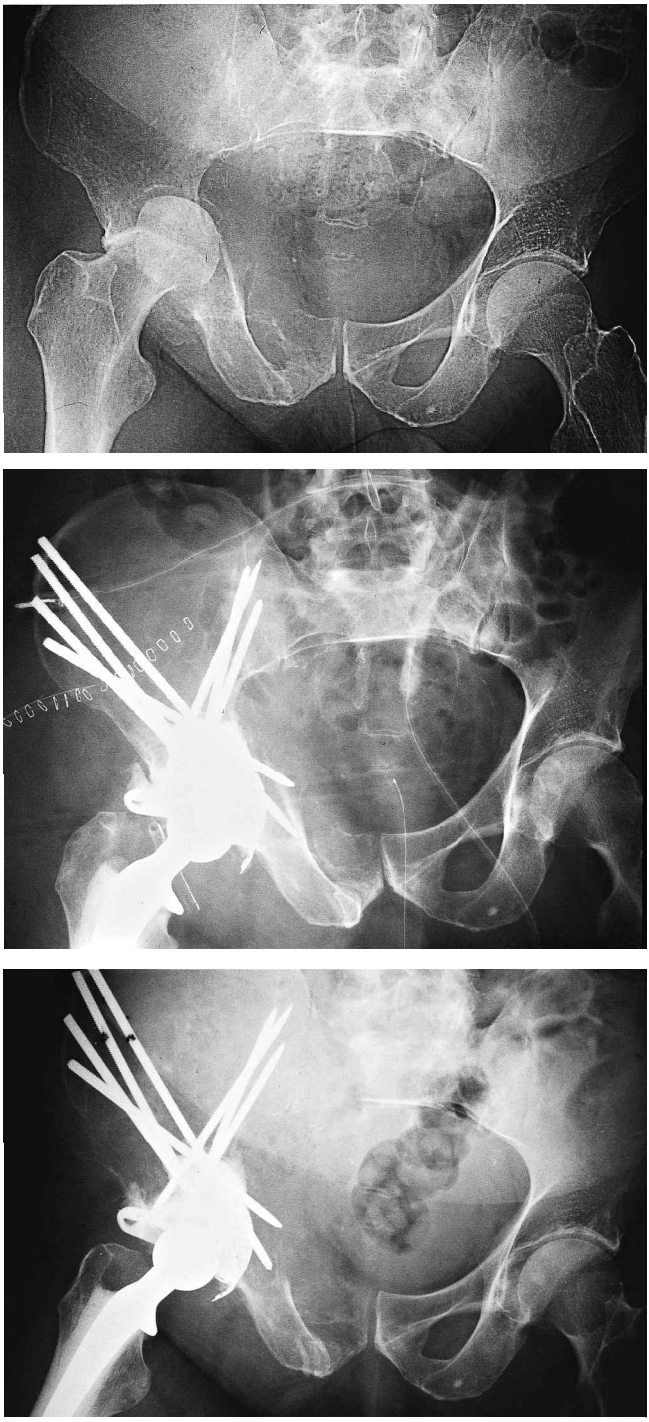
Minor pain = pain requiring intermittent or regular use of mild analgetics (e.g., paracetamol), moderate pain = regular use of mild opioids (e.g., tramadol or dextropropoxyphen), severe pain = regular use of either peroral or parenteral strong opioids (e.g., morphine). Karnovsky index > 20 = not confined to a health care facility.

(Harrington 1981). Total hip replacement with or without acetabular support rings has been described as a useful method when treating class I and II destructions (Harrington 1981, Stark and Bauer 1996). These techniques are seldom sufficient for treating class III destruction; even if they relieve pain, they will loosen with greater destruction. Few studies have addressed how best to handle class III destruction. Harrington (1981) reported good results in 58 patients who underwent surgery for metastatic periacetabular fractures, but without specifically describing the outcome in 25 patients with class III destruction. In a study of 4 patients, Walker (1993) described the results of pin reinforcement using several pins placed in an antegrade fashion from an extensive exposure of the iliac crest and the anterior iliac wing, giving good relief of pain and restored walking ability in all 4 patients. Stark and Bauer (1996) had 7 of 12 patients with class III destructions in their series. They reported good results after total hip replacement and support rings. However, in1 of their 7 class III patients the reconstruction rapidly failed and the patient became bedridden again. Allan et al. (1995) used 2 modifications of the Harrington reconstruction, and reported satisfactory results in 25 patients with 1 loosening of the acetabular cup. Aboulafia et al. (1995) treated 9 patients having metastatic periacetabular destruction with a saddle prosthesis. After follow-up, 4 of the 9 patients used wheelchairs or were bedridden. Finally, Vena et al. (1999) used a modified Harrington technique to reconstruct class III destruction in 21 patients, and reported good results; 16 of 21 returned to an independent status with no failures of the acetabular construct.

We have shown that the original Harrington reconstruction technique is an effective way to reconstruct a pelvic wing destroyed by metastases. All destructions were reconstructed, and the method promptly relieved pain and restored/retained walking ability. We saw no mechanical failures of the pelvic components, and no radiographic loosening. The operation can be performed even in patients severely ill with generalized metastatic disease. One of the main concerns is the risk of excessive peroperative bleeding. We considered preoperative embolization when there was a large intrapelvic soft tissue component, especially when the primary tumor was a thyroid or renal carcinoma. However, only 1 patient underwent preoperative embolization, and it is our view that few patients with periacetabular destruction have a large soft tissue component. 3 patients with cancer (uroepithelial, prostate, breast) developed massive bleeding. 1 died during surgery and 1 after 2 weeks. The main source of bleeding was exposed tumor in or around the acetabulum before the pelvic components were cemented. Severe bleeding from major vessels in the pelvis or around the sciatic notch did not occur.

Another concern is blind placement of the pins, especially the medial group which is drilled retrogradely from the acetabulum up to or across the sacro-iliac joint. In our opinion, this is a minor problem; normally the cortices are strong enough to guide the pins and if not, the correct direction can be found by cautious probing with K-wires. Another aid for the surgeon is to place his index finger in the sciatic notch. He can then feel whether the most medial pin is extracortical.

A third concern is to avoid deep infection, as revision surgery after this procedure is virtually im-



A 60-year old man (no. 21 in Table 1) with rectal carcinoma had severe pain on weight bearing emanating from his right hip (top). Massive tumor destruction of the right pelvis, Harrington class III, with protrusion and deformation of the caput. Reconstruction (middle) of the right acetabulum with rods and a total hip replacement. The patient was discharged to his home 3 weeks after surgery, using a cane but without pain on weight bearing. At follow-up 7 months after surgery (bottom), continuous tumor growth had destroyed virtually the whole load-bearing part of the ilium, but the patient still had no pain on weight bearing and could walk.

possible. The duration of the operation should be kept as short as possible and prophylactic antibiotics should be given. Such patients may be immunocompromised, and the choice of drugs may need to be discussed with specialists in infectious diseases.

There were no mechanical failures due to inadequacy of the pelvic reconstruction, but the two fractures below short-stemmed prostheses may indicate that longer femoral implants are advisable. In consequence, today we always use a long femoral component, and have found that the modular 350 mm Lubinus SP II (Waldemar Link GmbH & Co, Hamburg, Germany) can be inserted with limited additional reaming of the femur. We advocate this, despite the increased risk of fatal embolization (Kerr et al. 1993, Pell et al. 1993, Persson and Bauer 1994, Roumen et al. 1995).

We used support rings in only 11 of the 33 operations and found no difference in outcome between patients with rings and those without. The ring contributes little to the mechanical strength, as in most cases it rests on weakened bone, and the load instead is distributed via the pin-cement-cup reconstruction. The ring may, however, aid in positioning of the cup.

Clearly, the reconstruction described here is not a first-hand procedure for patients with pelvic skeletal metastases; most of them are helped by conventional treatment such as radiotherapy and analgetics.

However, if this has been tried without improvement, or if there is an obvious fracture of the acetabulum, surgery should be carefully considered, especially in patients who can be expected to survive more than 2 months. The need for this reconstruction will probably increase because as oncological care of cancer patients improves, more of themwill live long enough to develop symptomatic metastatic periacetabular destruction.

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Aboulafia A J, Buch R, Mathews J, Li W, Malawer M M. Reconstruction using the saddle prosthesis following excision of primary and metastatic periacetabular tumors. Clin Orthop 1995; 314: 203-13.

Allan D G, Bell R S, Davis A, Langer F. Complex acetabular reconstruction for metastatic tumor. J Arthroplasty 1995; 10 (3): 301-6.

Harrington K D. The management of acetabular insufficiency secondary to metastatic malignant disease. J Bone Joint Surg (Am) 1981; 63 (4): 653-64.

Karnovsky D A, Burchenal J H. The clinical evaluation of chemotherapeutic agents in cancer. Evaluation of chemotherapeutic agents. Columbia University Press, New York 1949: 199-205.

Kerr P S, Jackson M, Atkins R M. Cardiac arrest during intramedullary nailing for femoral metastases. J Bone Joint Surg (Br) 1993; 75: 972-3.

Kusuzaki K, Shinjo H, Kim W, Nakamura S, Murata H, Hirasawa Y. Resection hip arthroplasty for malignant pelvic tumor. Acta Orthop Scand 1998; 69 (6): 617-21.

Levy RN, Sherry HS, Siffert RS. Surgical management of metastatic disease of bone at the hip. Clin Orthop 1982; 169: 62-9.

Pell A C H, Christie J, Keating J F, Sutherland G R. The detection of fat embolism by transoesophagal echocardiography during intramedullary nailing. A study of 24 patients with femoral and tibial fractures. J Bone Joint Surg (Br) 1993; 75: 921-5.

Persson E V, Bauer H C F. Sudden hypotension and profuse bleeding during intramedullary nailing of the femur in cancer patients. Acta Orthop Scand 1994; 65 (5): 564-7.

Roumen R M H, Lako S J, Schoots F J. Acute lung damage after bilateral insertion of femoral intramedullary interlocking nails for metastatic bone disease. Eur J Surg 1995; 161 (6): 451-3.

Stark A, Bauer H C F. Reconstruction in metastatic destruction of the acetabulum. Acta Orthop Scand 1996; 67 (5): 435-8.

Walker R H. Pelvic reconstruction/total hip arthroplasty for metastatic acetabular insufficiency. Clin Orthop 1993; 294: 170-5.

Vena V E, Hsu J, Rosier R N, O'Keefe R J. Pelvic reconstruction for severe periacetabular metastatic disease. Clin Orthop 1999; 362: 171-80.