ONCOLOGY

The outcome of surgical treatment for peri-acetabular metastases

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We reviewed the outcome of patients who had been treated operatively for symptomatic peri-acetabular metastases and present an algorithm to guide treatment.

The records of 81 patients who had been treated operatively for symptomatic peri-acetabular metastases between 1987 and 2010 were identified. There were 27 men and 54 women with a mean age of 61 years (15 to 87). The diagnosis, size of lesion, degree of pelvic continuity, type of reconstruction, World Health Organization performance status, survival time, pain, mobility and complications including implant failure were recorded in each case.

The overall patient survivorship at five years was 5%. The longest lived patient survived 16 years from the date of diagnosis. The mean survival was 23 months (< 1 to 16 years) and the median was 15 months. At follow-up 14 patients remained alive. Two cementoplasties failed because of local disease progression. Three Harrington rods broke: one patient needed a subsequent Girdlestone procedure. One ‘ice-cream cone’ prosthesis dislocated and was subsequently revised without further problems. We recommend the ‘ice-cream cone’ for pelvic discontinuity and Harrington rod reconstruction for severe bone loss.

Smaller defects can be safely managed using standard revision hip techniques.

Cite this article: Bone Joint J 2014;96-B:132–6.

Approximately half of all primary cancers spread to the skeleton, which is the third most frequent site of metastases after the lung and liver.1 Those cancers more likely to spread to bone are prostate (32%), breast (22%), kidney (16%), lung and thyroid.1 The pelvis is the second most frequently involved site after the spine.2

Metastatic disease of the acetabulum and its surrounding bone causes major disability and may restrict or prevent walking. Some metastatic deposits are associated with disruption of the acetabulum, causing instability.3 Correction of mechanical instability can restore or preserve the ability to walk allowing the patient to remain independent and comfortable during the final stages of their life.3

Non-operative management includes restriction of weight-bearing, use of bisphosphonates, chemotherapy, radiotherapy, immunotherapy and hormonal manipulation. Palliative surgical management is eventually considered in approximately 15% of patients with bony metastases.4

Operative treatment is indicated for patients whose acute symptoms do not resolve with non-operative treatment, or if there is an impending or established ipsilateral fracture of the femur.5 The aim is to remove the tumour, reconstruct the iliofemoral weight-bearing axis by bridging the mechanical defect. The outcome should be pain relief, maintenance of function and improvement in quality of life.5

Harrington6 classified metastatic lesions of the acetabulum and designed a method of reconstructing the hip in the presence of extensive loss of peri-acetabular bone. He showed that reconstruction of the hip could reduce pain and improve function.6 Other studies have used his methods and confirmed his findings.7,8

Since then other methods of stabilising the hip have been developed. These include the techniques of filling metastatic cavities with bone cement (cementoplasty),9 acetabular cages,9 custom-made pelvic endoprostheses10-12 and the more recent ‘ice-cream cone’ prosthesis.13,14

The ice-cream cone prosthesis was developed in 2003 (Coned Hemi Pelvis; Stanmore Implants, Elstree, United Kingdom). The concept is based on the design of the McKee Farrar stemmed hip replacement (Howmedica, Staines, United Kingdom).14 It looks like an inverted ice cream cone (hence its name), and when inserted the stem is directed towards the posterior superior iliac spine. The authors believe this prosthesis is better used in cases of severe bone loss. It has previously been described to reconstruct defects after the en bloc excision of pelvic tumours.13
We evaluated the functional outcome of acetabular reconstruction for the treatment of acetabular metastases in our unit and present an algorithm for the management of these lesions based on our findings.

**Patients and Methods**

This was a retrospective study of prospectively collected data from the database in our unit. Between 1987 and 2010, 81 patients with painful metastatic disease and structural insufficiency of the acetabulum (classified as pelvic discontinuity, central fracture/dislocation or uncontained large defects) were treated operatively at the Royal Orthopaedic Hospital, Birmingham. No patient was specifically recalled for this study: all data were collected from the clinical records and imaging systems as part of routine follow-up; institutional review board approval was therefore not required.

There were 27 men and 54 women with a mean age at the time of presentation of 61 years (15 to 87). The most common site of the primary tumour was breast (36%), followed by kidney (31%) and prostate (7%) (Table I). The median time from the diagnosis of the primary to the manifestation of acetabular disease was 30 months (0 to 118).

We collected data about the pain and mobility of the patients pre-and post-operatively. Pain was graded as none, mild, moderate or severe. Mobility was assessed using a graduated scale of the walking aids used at home (no aids, one stick, two sticks, crutches, frame and wheelchair). Post-operative function was also assessed using the Eastern Cooperative Oncology Group (ECOG)/World Health Organization (WHO) performance status (Table II). We designed to withstand localised disease progression. All patients were allowed to bear weight fully in the immediate post-operative period.

### Statistical analysis.

Results were analysed using Kaplan–Meier survival analysis, Student’s t-tests, chi-squared test and the Kruskall–Wallis analysis of variance (ANOVA) with the limit of significance set at \( \alpha = 0.05 \). All statistical analysis was done using StatView v5.0.1 (SAS Corp., Cary, North Carolina).

### Results

The Kaplan–Meier survivorship from the time of pelvic reconstruction was 45% at one year, 30% at two years and 5% at five years (Fig. 2). The longest-lived patient survived 16 years from the date of diagnosis. He had a nephrectomy and total excision for a renal-cell carcinoma metastasis. The mean survival was 23 months (< 1 to 16) and the median 15 months (interquartile range (IQR) 18).
follow-up, 14 patients remained alive. The cause of death for most of these patients was progression of their disease.

The mean survival time of patients with breast cancer was 21 months (median 14 (0.3 to 86)), kidney 27 months (median 20 (1 to 190)), prostate 17 months (median 9 (9 to 23)) and other 19 months (median 9 (1 to 61)). Two patients developed local recurrence. The mean operating time and blood loss are shown in Table III, and Table IV shows there was a significant improvement in mobility post-operatively (p = 0.03, chi-squared test).

All patients were in pain pre-operatively. At a mean of 351 days (4 to 2686) post-operatively, 48% had no pain, 24% had mild pain, 21% had moderate pain and 7% had severe pain. In total, nine patients (11%) were fully active and able to carry on all pre-disease performance without restriction, 28 (35%) could do everything apart from heavy physical work, 31 (38%) were mobile for more than half the time and only two were bed-bound. Patients with a WHO performance status of grades 0 or 1 had a mean survival of 41 months (5.3 to 189.9) compared with 25 months (0.3 to 126.4) for those with a WHO performance status grades 3 or 4 (p = 0.005, Kruskall–Wallis). The full distribution of WHO performance statuses is given in Table V. The mean time between surgery and the recording of the post-operative WHO performance score was 351 days (4 to 2686). Post-operative mobility was recorded at the same time.

There were 34 complications in 16 patients. One patient had a non-fatal cardiac arrest immediately after their operation. Two superficial infections were successfully treated with oral antibiotics. No patient had a deep infection. Two patients developed symptomatic deep vein thromboses and were treated with anticoagulants. There were four dislocations: three were treated by closed reduction and one needed a change of liner and has had no further dislocation.
A total of eight patients had a failure of their implants. Two who had undergone cementoplasty developed further lysis around the cement (Fig. 3). One did not wish to have a further procedure, as her pain was manageable: the other was revised to a THR with Harrington rods.

There were three fractures of Harrington rods (Fig. 4): one patient had a Girdlestone procedure, and the other two declined further intervention due to disease progression. Only one ice-cream cone dislocated one month post-operatively because the acetabular component was anteverted. This was revised: the patient suffered no more dislocations and survived for a further 15 months after the original operation. None of the other ice-cream cone prostheses failed.

**Discussion**

Metastatic lesions affecting the wing of the ilium, sacroiliac joint and the anterior arch of the pelvis can usually be treated successfully by radiotherapy. By contrast, peri-acetabular lesions are usually painful and at risk of mechanical failure resulting in acetabular protrusio, central fracture-dislocation or pelvic discontinuity. The aims of surgery are to relieve pain, restore function and permit early weight-bearing. Reconstructing the peri-acetabular region is an orthopaedic challenge.

Our results differ from those of other studies in terms of survival and functional outcome. Harrington reported that 30 of 58 patients (52%) survived for more than two years post-operatively. Other studies have presented worse survival figures. This study shows that our two-year survival from the date of operation is 30%. The difference might be due to differences in case selection.

In terms of mobility, 68 patients (84%) in our cohort could walk comfortably (WHO grades ≤2). This is comparable to Harrington, who reported that 39 of 51 patients (76%) could walk and function in the community. Another study has shown a less marked improvement. We used a different implant (ice-cream cone) in 14% of the procedures, which has been shown to have good functional results and may account for our outcomes.

The main advantage of the ice-cream cone prosthesis over an acetabular cage is that the stem follows the line of force through the iliolumbar bar and is fixed in proximal bone stock, which is rarely involved in metastatic disease. The distal defect is filled with cement, which prevents fracture at the bone-cement interface, provides a reservoir of antibiotics and might cause local thermal necrosis of residual disease. Some authors have reported good results using cages to treat metastatic disease, while others have reported less favourable results. The line of force with Harrington rods is often perpendicular to the rods and may induce fatigue fracture and further symptoms (Fig. 4).

We have shown that operating on patients with metastatic disease of the acetabulum can relieve pain and allow a patient to mobilise with a degree of independence. It is important that the appropriate surgery is performed for
Fig. 5
Algorithm for the management of peri-acetabular metastases.

each type of acetabular lesion. We have formulated an algorithm to guide surgeons to the right decision (Fig. 5). For an isolated renal metastasis, an en bloc excision should be performed, as it offers a small survival advantage; in this series, however, all renal metastases were multiple and treated by curettage. Radiotherapy is more appropriate for a sclerotic prostatic lesion. It is also indicated post-operatively if there is any residual macroscopic disease.

The management of lytic lesions depends on the extent of the disease. Cavitatory defects are treated with a THR and with Harrington rods if there is significant bone loss. Some contained cavitatory defects may be suitable for percutaneous cementoplasty. However, in our experience cavitatory defects which breach one of the cortices are usually structurally unstable and require surgical reconstruction. With any central fracture–dislocation Harrington rods or even the ice-cream cone can be implanted. We advise that the ice-cream cone prosthesis is used in cases of pelvic discontinuity.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

This article was primary edited by A. Ross and first-proof edited by D. Rowley.

References