



Limb-sparing surgery for primary malignant tumours of the pelvis

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Treatment of malignant tumours of the pelvis represents one of the most difficult problems in musculoskeletal oncology. The aim of this paper is to present our results in 16 cases of primary malignant pelvic tumours following resection only or following reconstruction with autogenous or allogeneous bone grafts without using megaprotheses, and to assess the possibility to restore acceptable function with autogenous or allogeneous bone grafts while avoiding the high risks of massive endoprotheses.

Wound complication was the most common complication in our series, with 10 patients requiring additional treatment in the form of local surgical debridement, appropriate multi-drug antimicrobial therapy and wound care. Secondary pelvic reconstruction was performed in two patients with chondrosarcoma, due to local recurrence. External hemipelvectomy was not required in any patient. Morbidity also included the sacrifice of nerve roots in 4 patients. The mean follow-up was 42.4 months (range, 24 to 60). One patient is alive with disease, five patients have died of metastatic disease (2 of them had evidence of local recurrence), and the remaining ten patients are alive with no evidence of disease.

Major blood loss and long operation time, aggressive radical surgery due to the frequent delay in diagnosis, and wound complications after surgery are important points that should be considered in the treatment of primary malignant pelvic tumours. Therefore, the management requires meticulous preoperative investigation, a multidisciplinary approach and experienced surgeons.

INTRODUCTION

Approximately 10% to 15% of all primary malignant bone tumours and approximately 5% of soft tissue sarcomas are located in the pelvis (1, 2, 6, 9, 24). Treatment of malignant tumours of the pelvis represents one of the most difficult problems in musculoskeletal oncology (9, 14, 17). As a consequence of the poor compartmentalisation and complicated anatomy of the pelvis, excision with wide margins is often difficult (4). Frequent local and systemic complications may affect the outcome (6).

Internal hemipelvectomy in which the limb is salvaged is an alternative treatment to external hemipelvectomy for the treatment of malignant

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pelvic tumours. In recent years, through the development of imaging and surgical techniques, adequate surgical margins have been achieved with preservation of a limb (11, 13). Moreover, current preoperative chemotherapy protocols often decrease tumour bulk, thereby allowing a non-ablative procedure to be performed in a patient who otherwise might have needed an amputation (18). In general, the function is better after a limb-sparing procedure than after external hemipelvectomy (19, 20, 24). Good function may have a positive influence on the patient's quality of life and avoid some of the social and psychological consequences. Limb-sparing surgery should also be considered for sarcomas which extends into the sacrum and along the lumbosacral plexus, because amputation may not provide a better surgical margin in these patients (18).

Limb-sparing surgery for malignant tumours of the pelvis is a difficult surgical undertaking, with respect to both surgical resection and reconstruction. Following wide resections with preservation of the limb, the surgeon's next challenge is reconstruction to restore as much pelvic stability and hip joint function as possible (20). The surgeon's primary goal is local control of the tumour by complete resection and the secondary goal is to preserve a functional limb.

An optimal method of reconstruction is not clearly established for many types of skeletal defects. The techniques include flail hip or pseudoarthrosis, arthrodesis, the use of pelvic osteochondral allografts, autoclaved grafts for anatomic reconstruction, vascularised autogenous grafts, and prosthetic replacement (5, 8, 12, 16, 17). Selection of the reconstructive technique is influenced by the patient's age, medical status, functional demands, location and extent of the resection (15, 18).

The aim of this paper is to present our results in 16 cases of primary malignant pelvic tumours following resection only or following reconstruction with autogenous or allogeneous bone grafts without using megaprotheses, and to assess the possibility to restore acceptable function with autogenous or allogeneous bone grafts while avoiding the high risks of massive endoprotheses.

Table I. — Resected area according to Enneking's classification (9). P1 : iliac bone, P2 : periacetabular region, P3 : pubic bone or ischium, P4 : hemisacrum

Resection site	Number of patients
P 1	7
P 2	1
P 1, 2	1
P 2, 3	1
P 4	4
P 1, 4	2

(P stands for "part").

PATIENTS AND METHODS

From 1996 to 2002, 16 patients (7 male, 9 female) with a primary malignant pelvic tumour were treated surgically. Their ages at the time of surgery ranged from 37 to 59 years (mean : 46 years). All of the tumours were classified as stage II B (10).

Preoperative evaluation included routine blood work, radiographs and computed tomography and magnetic resonance imaging studies of the lesion. A technetium bone scan was done to exclude distant skeletal metastases or multiple lesions, as well as radiographs and CT-scan of the chest to exclude pulmonary metastases. Preoperative angiography was performed in all patients and embolisation was done in 4 of them.

The diagnosis was made by open biopsy in 9 and thru-cut needle biopsy in 7 patients, taking into account the surgical approach planned for the definitive operation. The diagnosis was malignant fibrous histiocytoma (MFH) in 5, chondrosarcoma in 4, chordoma in 4 and osteosarcoma in 3 patients.

The area of resection was classified according to the Enneking classification (9) (fig 1, table I).

All of the patients with the diagnosis of osteosarcoma received neo-adjuvant chemotherapy according to protocols being used at that time. Adjuvant chemotherapy and radiotherapy were used in all patients except four with a diagnosis of chordoma.

The surgical approach was often customised for the patient, depending upon the presentation of the tumour and the location of pre-existing biopsy scars. The basic surgical principle that we followed included excision of previous biopsy tracts aiming for wide resection margins by limiting all dissection to normal tissue outside the reactive zone.

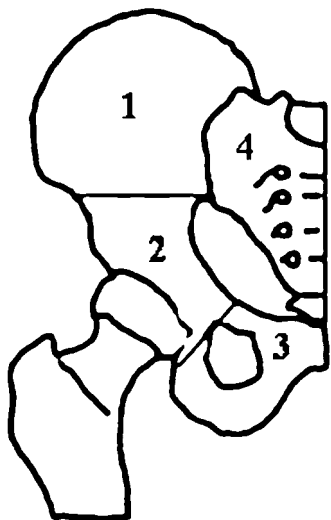


Fig. 1. — Parts of the pelvis according to the Enneking classification (9) : 1 : iliac bone ; 2 : periacetabular region ; 3 : pubis or ischium ; 4 : hemisacrum.

In 8 patients, reconstruction surgery was not necessary because the tumour was located in the peripheral site of the innominate bone, in the pubic or ischial bone or in the sacrum and because the pelvic stability was maintained.

Five patients had autogenic fibula implantation after iliac resection (fig 2). All fibulae were free and non-vascularised. Two patients underwent reconstruction with an allograft. A titanium mesh cage was used in one patient whose tumour involved the lumbar spine.

Operation time and blood loss during the procedure were recorded. The complications associated with the reconstruction were registered as well as the additional surgical procedures after reconstruction.

RESULTS

The mean time to diagnosis was 7.5 months ; for chordomas, the mean time to diagnosis was 16.5 months. The mean operation time was 6 hours 35 minutes and the mean blood loss was 1600 cc.

Wound complication was the most common complication, with 10 patients requiring additional treatment in the form of local surgical debridement, appropriate multi-drug anti-microbial therapy and wound care. All ten patients went on to uneventful healing without the need for flap procedures ; none

of the fibular strut autografts had to be removed owing to chronic osteomyelitis.

Secondary pelvic reconstruction was performed in two patients with chondrosarcoma, owing to local recurrence. External hemipelvectomy was not required in any patient. Morbidity also included the sacrifice of nerve roots in 4 patients.

The mean follow-up was 42.4 months (range, 24 to 60). One patient is alive with disease, five patients have died of metastatic disease (2 of them had evidence of local recurrence), and the remaining ten patients are alive with no evidence of disease.

DISCUSSION

Internal hemipelvectomy is the application of the principles of limb-sparing surgery to pelvic tumours. With an increased demand for limb salvage, it is being performed more often and for more advanced tumours than previously. The critical area in this procedure remains the proximal margin, and local control is a measure of successful surgical resection (3, 9, 14, 17).

Adequate reconstruction following surgery can be difficult, particularly with peri-acetabular resections. The choices are arthrodesis, arthroplasty, or allograft reconstruction (20). Arthrodesis involves coaptation of the resected bone ends to achieve either a sound fusion or a pseudoarthrosis (9, 17, 23).

If the tumour is located in the pubic area, peripheral iliac wing or sacrum, no skeletal reconstruction is needed. In patients without reconstruction, the rate of complication is lowest (13). If the continuity of the pelvic ring is interrupted after iliac resection, iliosacral arthrodesis with bone graft interposition between the sacrum and ilium is recommended (9). In the current study, autograft was mainly used for such type of reconstruction owing to its lower reported rate of complications (13). With the development of preoperative adjuvant treatment, imaging systems, implementation of the concept of surgical margin, and improvement in surgical technique, limb salvage is now possible even in patients with pelvic tumours. However, complications have been reported in 50-60% after surgery (6, 19, 21). One of the most important keys to

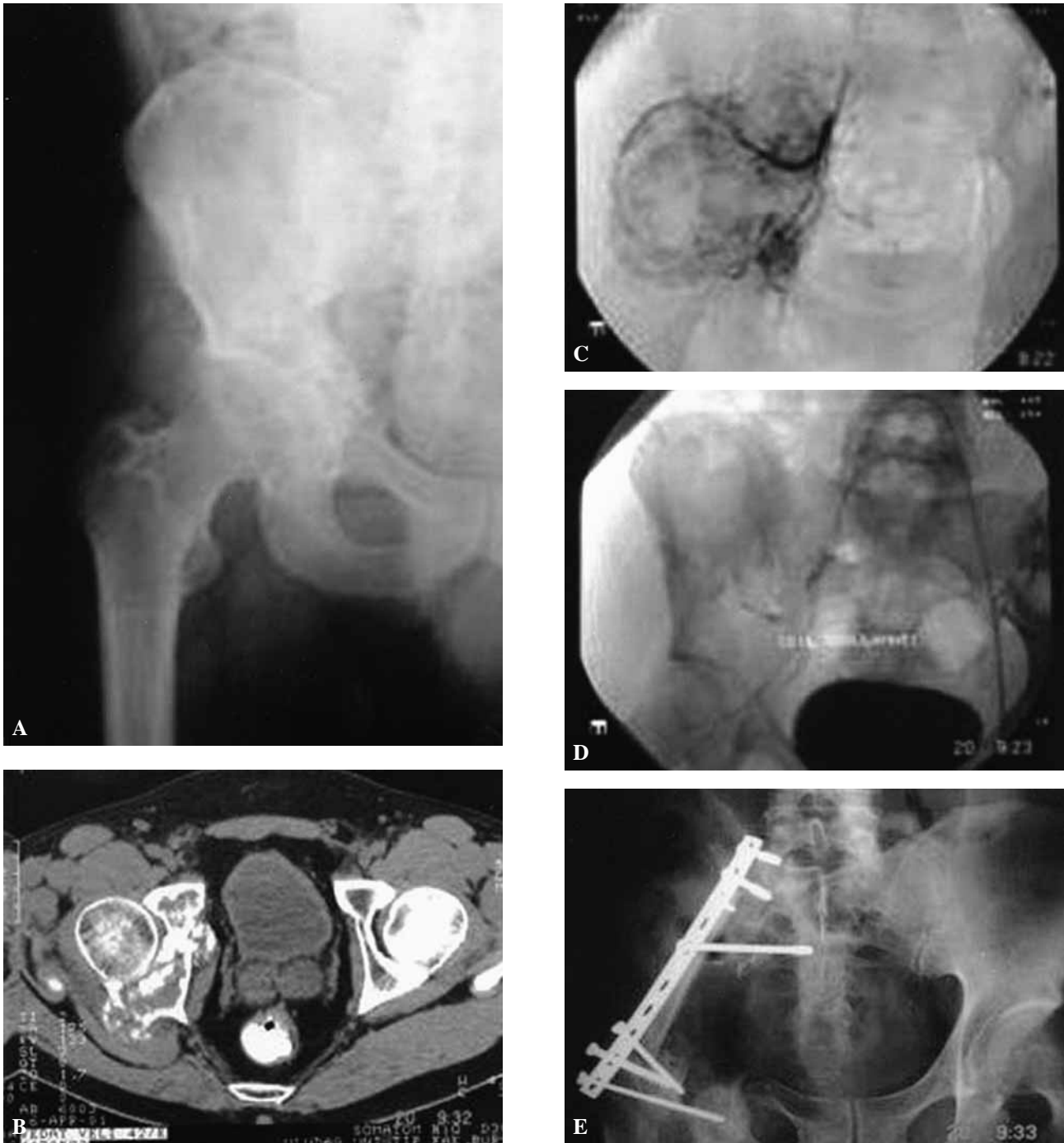


Fig. 2. — A 44-year-old man with chondrosarcoma of the pelvis (A, B). After angiography (C) and embolisation (D), Enneking zones 1 and 2 together with the hip joint were resected and the defect was reconstructed with a non-vascularised fibular autograft and titanium plate and screws (E).

success in limb sparing surgery with pelvic tumours is to select an adequate reconstruction with the lowest complication rate.

While we favored the technique of iliosacral arthrodesis by direct bone apposition, large defects may not be amenable to this method of arthrodesis. Alternative techniques have been described using both vascularised and non-vascularised fibular grafts (7, 22). Cannon *et al* (7) reported on 34 patients treated with non-vascularised fibular iliosacral arthrodesis. Three patients required re-exploration for graft repositioning ; all grafts incorporated and hypertrophied. Takeda *et al* (22) reported successful fusion in four patients, using a vascularised fibula with pedicle screw fixation to the sacrum combined with ISOLA rods.

Although beneficial results have been reported after prosthetic replacement (11, 13, 17), there is a high risk of infection, loosening, and difficulty of prosthetic fixation. Also, reconstruction with prosthetic replacement is not suitable for children before skeletal maturity. In the study of Hillmann *et al* (13), of the 16 patients who underwent implantation of a pelvic prosthesis, 10 (62.5%) had complications whereas only 4 (33%) of 12 patients who had implantation of auto or allograft developed complications after surgery. Owing to the high risks of complications, reconstruction with an endoprosthesis was not elected in our patients.

In the surgical treatment of such tumours, local recurrence continues to be problematic. While our overall local recurrence rate was 12.5%, failure was most frequent in the difficult iliosacral lesion. O'Connor (18) and Cannon *et al* (7) have reported local recurrence rates of 17% and 24% respectively in treatment of sarcomas of the ilium by en bloc resection and fibular strut reconstruction.

With such major surgical procedures, problems with wound healing and infection are anticipated : we had such complications in 62 % of cases, which is comparable to the 50-60% (6, 19, 21) reported in other studies. However, we did not have any major flap necroses. Four patients had neurological complications with a resultant permanent foot drop for which they required an orthosis. Injury to nerve roots (intentional or inadvertent) in an effort to gain

clearance at the proximal resection margin has been well documented and is not a contraindication to limb salvage (3, 9, 17).

The justification for an internal hemipelvectomy depends upon both achieving at least as good a survival rate as with hindquarter amputations and at the same time leaving the patient with a functional level greater than could be achieved by a prosthesis fitting after amputation. Apffelstaedt *et al* (3) and Huth *et al* (14) have shown in their studies that local recurrence rates and mortality after internal hemipelvectomy were lower than those obtained in patients undergoing a standard hemipelvectomy (hindquarter amputation), while offering better functional results.

Pelvic limb salvage for malignant tumours is a formidable procedure with a high potential for complications. Although more difficult than a formal hemipelvectomy, the survival and recurrence rates are similar. Patients prefer it to formal hemipelvectomy, both for appearance and function. We preferred resection alone or biologic reconstruction using autogenous bone grafts in the majority of our patients.

In conclusion, increased blood loss and operation time, major radical surgery requirement due to the delay in the diagnosis and wound complications after surgery are the important points that should be considered in the treatment of primary malignant pelvic tumours. Therefore, the management needs meticulous preoperative investigation, multidisciplinary approach and experienced surgeons.

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