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Reconstruction of the iliac bone using the homolateral femur after resection for pelvic tumor☆

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ABSTRACT

The authors have treated three patients with extensive involvement of the acetabular and peri-acetabular bone by a malignant tumour. One had a metastasis from a carcinoma of the thyroid, one from a carcinoma of the breast and one a plasmacytoma. In all three cases, the upper part of the femur was unaffected. It was used to replace the resected pelvic bone and fixed to the remaining bone by screws and plates. An acetabular cup was cemented into the transplanted bone, which itself was replaced by a massive femoral prosthesis. This technique allowed the patients to resume weight bearing rapidly. Two patients were alive and walked satisfactorily after two and four years respectively. The third died five months after the surgical procedure.

1. Introduction

En-bloc resection of bone tumours with tumour-free margins is currently the treatment of choice, not only for radio-resistant tumours with limited aggressive potential, but also, in combination with chemotherapy, for certain malignant tumours or even metastases, to improve function or lessen pain. Tumour-free resection is facilitated by the good pre-operative evaluation of tumour spread and vascularisation afforded by modern imaging techniques, as well as by appropriate pre-operative biopsy studies. On the other hand, the reconstruction challenges raised by extensive resections can seem insurmountable. At the pelvis, in particular, the difficulties are so great that some authors simply forgo all attempts at reconstruction [1] and rely instead on the patient's potential for adaptation, which often produces acceptable results. Others have resorted to the manufacture of costly prostheses [2,3]. Finally, as early as 1954, Merle D'Aubigné successfully used an allogeneic bone-bank graft [4] (after resection of a chondrosarcoma, use of an allogeneic femur for reconstruction, and deepening of the acetabular cavity to accept an interposition cup). Since then, the risk of necrosis and resorption of allogeneic bone grafts has decreased [5].

Ideally, an autologous bone graft would be used. The main challenge is the large amount of bone needed. We reasoned that the proximal femur, when intact, can provide, within the same operative field, not only the *amount* of bone needed, but also a bone piece of appropriate *quality* and *shape*: the head, neck, and trochanters constitute a strong cortical-cancellous graft that is curved and whose middle trochanteric-epiphyseal portion is sufficiently large to allow the fashioning of an acetabular cavity. The site requiring reconstruction is then moved from the pelvis to the hip, where a total hip prosthesis with a large femoral component can be implanted.

The advantages of this method seemed obvious: in the short term, the construct should be sufficiently strong to allow early weight-bearing and ambulation and, in the long term, autologous bone grafts are more likely to heal and have longer survival times than do pelvic prostheses or allogeneic grafts.

We have used our method in 3 patients and believe the favourable results obtained deserve to be reported.

2. Technique

2.1. Approach

An extensive approach is needed to expose the iliac bone from the anterior pillar to the posterior pillar and down to the attachment of the ischium and proximal femur.

The incision follows the linea alba starting just below the false ribs then curves down to the iliac crest three finger-breadths behind the antero-superior iliac spine, bends to a nearly horizontal direction posteriorly at the buttock and, finally, becomes vertical again, extending behind the greater trochanter to the middle of the lateral aspect of the thigh. Thus, the incision delineates two triangles: a superior triangle over the abdomen and buttock with a

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para-median tip, and an inferior triangle over the groin and buttock with a lateral tip.

After incision of the abdominal muscles, a feasible and useful step consists in identifying the common iliac vessels below the peritoneum and looping sutures under them.

2.2. Dissection

The dissection is performed around the tumour, in healthy tissue. Beyond the tumour, the healthy bone areas that are to be cut are exposed, at a reasonable distance from the tumour.

Anteriorly, the sartorius and tensor facia lata muscles, protecting the lateral cutaneous nerve of the thigh, are detached and retracted to expose the anterior portion of the external iliac fossa. Posteriorly, the posterior pillar of the sciatic notch can be reached and the gluteal artery identified and ligated if needed. Medially, the internal iliac fossa is exposed to the pelvic inlet and, if needed, to the sacro-iliac joint. Inferiorly, the anterior aspect of the capsule is exposed by displacing the femoral vessels, which are protected by the muscle masses; posteriorly, the pelvic muscles attached to the trochanters are divided, and the trochanter is detached with the attachments of the gluteus medius and vastus lateralis muscles, which thus constitute a digastric muscle. The sciatic nerve and ischium are easily identified.

2.3. Bone cuts

The pelvis is cut using an oscillating saw and the tumour is removed. The length of the grafts can then be determined and the femoral shaft cut at the appropriate level. For our patients, the length needed was 9 to 11 cm.

2.4. Reconstruction

After removal of the cartilage from the femoral head, the graft is fit into the iliac stumps. Any additional cuts are performed as needed. In our patients, nearly complete resection of the ilium was required and we therefore split the femoral graft into two segments, one extending from the sacrum to the ischium and the other from the pubis to the anterior part of the iliac bone.

The best orientation is chosen based on the pelvic cut, but it is important to orient the graft in such a way that the trochanteric region, where the acetabulum will be fashioned, is in the desired position. The two ends of the graft are screwed to the iliac bone or, if needed, to the sacrum and pubis. The fixation is strengthened by a Müller-type reinforcement ring whose screws are oriented so that they connect the various components of the assembly.

A prosthesis of appropriate size is selected. The degree of tension of the digastric muscle (gluteus medium and vastus lateralis) provides useful guidance. Finally, the various prosthetic components are cemented in the correct position. We believe that exaggerated anteversion (20°) is useful to decrease the risk of posterior luxation. The various overlying planes are reconstituted by reattaching the muscles as best as possible with slowly resorbable suture. Drains are inserted.

Immobilisation on an abduction pad is used for 2 days, after which gradual mobilisation is started. Weight bearing and walking can be started after about 15 days. One of our patients (case #2) was able to walk on the day after surgery with no adverse effects.

3. Case-reports

3.1. Case #1 (Figs. 1–4): Ms. B. . . 47 years of age

This patient had a history of total thyroidectomy in 1981 for medullary thyroid cancer. At the time, she had reported low back pain and the radionuclide bone scan had shown increased uptake at the left hip. In 1982, her pelvic pain worsened and her laboratory tumour markers remained elevated (CEA, 1200 g/mL; calcitonin, 2500 mg/mL). Imaging studies showed a tumour in the acetabular region.

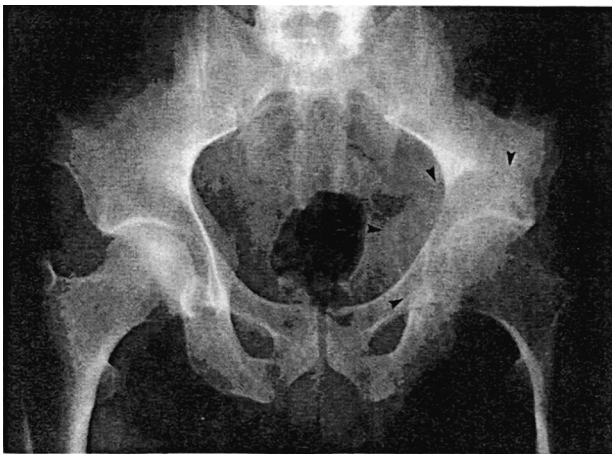

Fig. 1. Metastasis from thyroid cancer (case #1).

February 1982: very extensive resection followed by reconstruction. Ambulation on the next day with a walker and after 15 days with two crutches. Self-sufficient after 2 months. The patient died 6 months later after an acute confusional state (brain metastasis?).

3.2. Case #2 (Figs. 5–9): Ms. L. . . 45 years of age

Plasmacytoma of the pelvis with sciatic pain as the presenting symptom in 1979. The radionuclide bone scan found no other foci. The bone marrow smear contained 60% of plasma cells. A bone marrow biopsy at a distant site was normal. However, monoclonal IgG-kappa gammopathy and Bence-Jones proteinuria were found. Radiation therapy (50 Gy) failed to alleviate the severe pain.

August 1981: resection followed by reconstruction using an autologous femoral graft and total hip prosthesis. She resumed walking 3 weeks later. At follow-up in February 1985, she had no signs of recurrence and was able to walk with no aids.

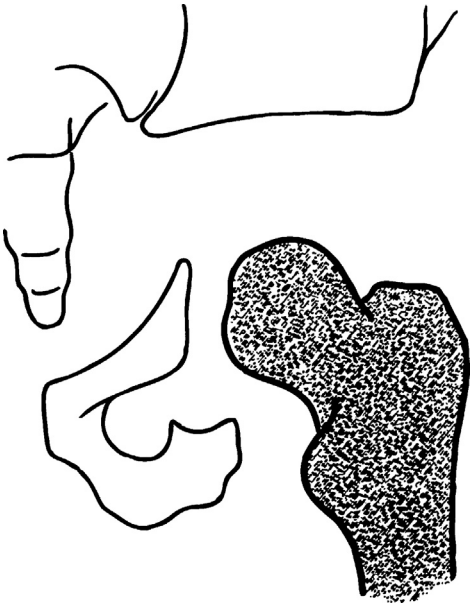

Fig. 2. Diagram showing the extent of the resection (case #1).

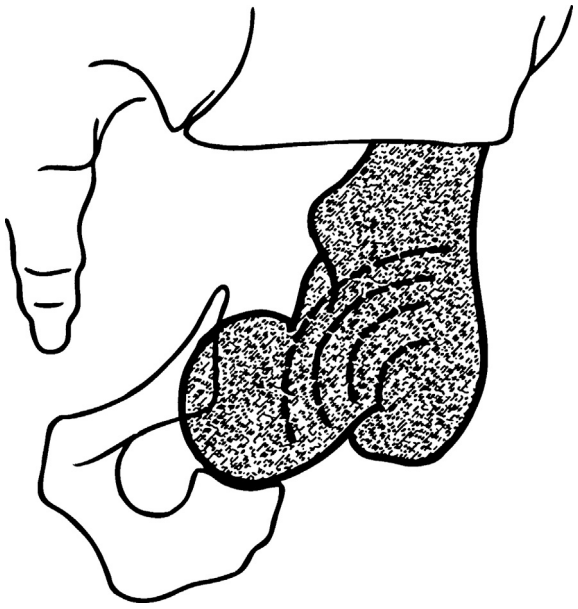

Fig. 3. Diagram showing the femoral graft in position (case #1).

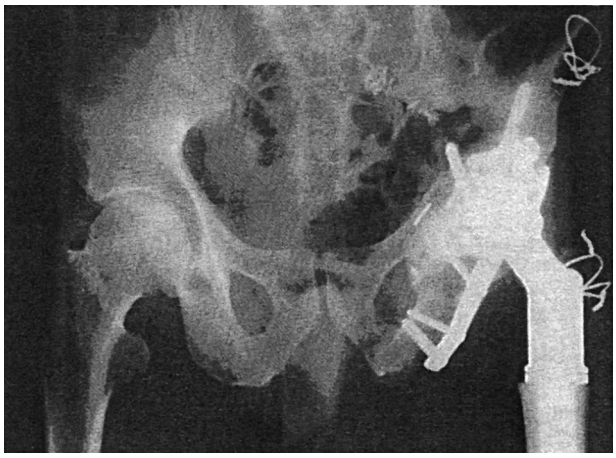

Fig. 4. Reconstruction (case #1).

Fig. 5. Solitary plasmacytoma (case #2).

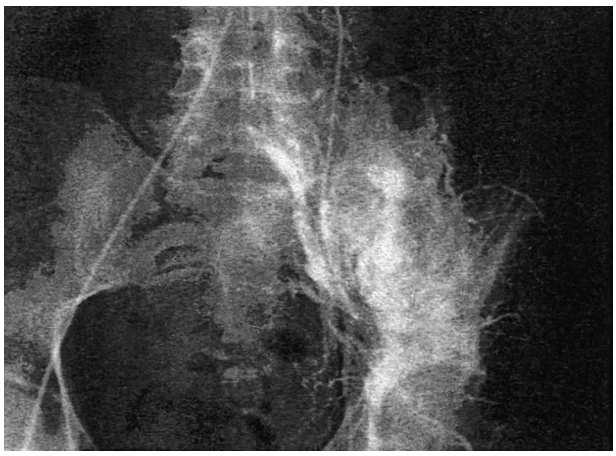

Fig. 6. Angiography (case #2).

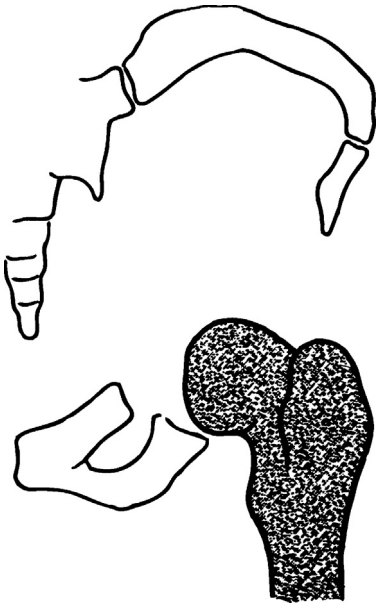

Fig. 7. Diagram of tumour resection (case #2).

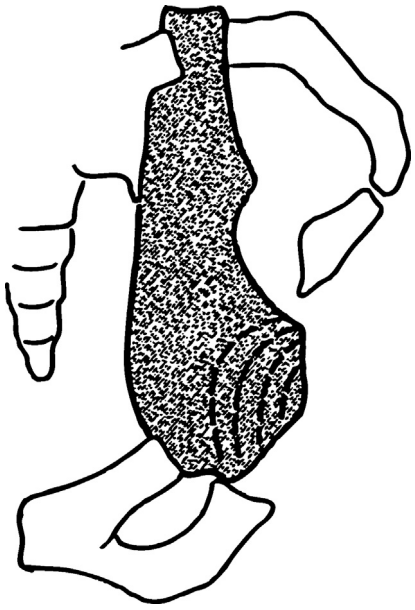

Fig. 8. Diagram of the reconstruction assembly (case #2).

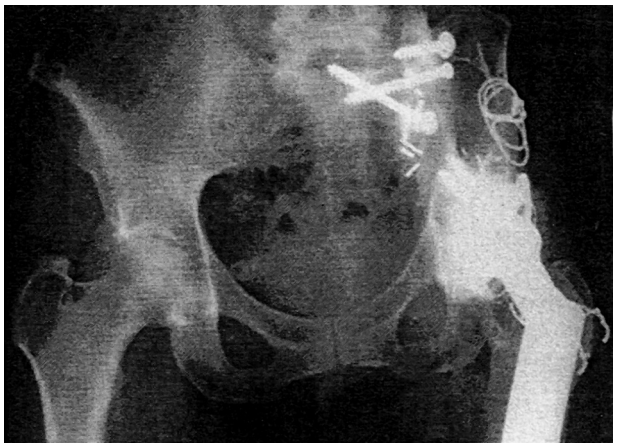

Fig. 9. Reconstruction 3 years after the surgical procedure (case #2).

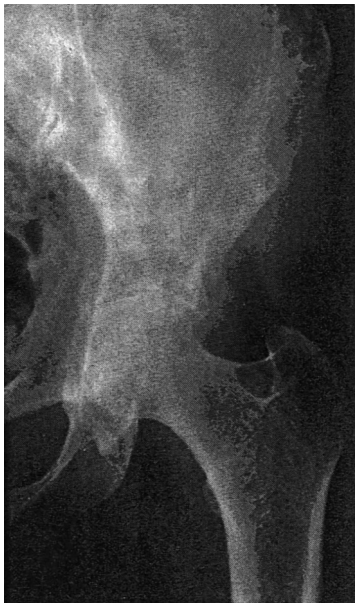

Fig. 10. Metastasis from breast cancer (case #3).

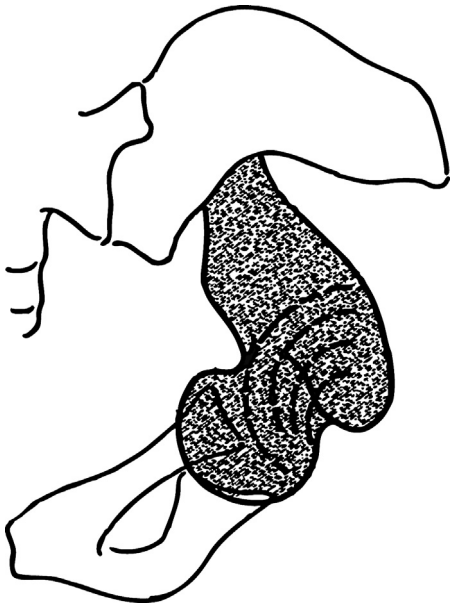

Fig. 11. Diagram of the reconstruction assembly (case #3).

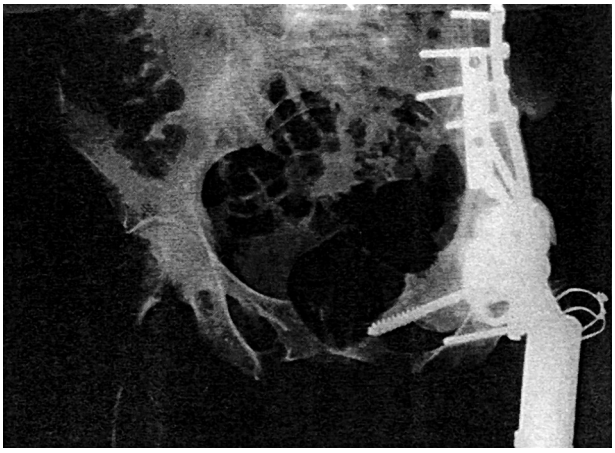

Fig. 12. Reconstruction after 1 year (case #3).

3.3. *Case #3 (Figs. 10–12): Ms. C. . . 52 years of age*

This patient had a history of breast cancer with a hip metastasis treated in 1981 with oophorectomy and radiation therapy to the breast and hemi-pelvis (3000 Rad). She presented in June 1983 with excruciating hip pain and complete functional impairment.

June 1983: very extensive pelvic resection followed by reconstruction. In February 1985, despite a new metastasis in the mandible, disease progression was slow. The patient was self-sufficient and was able to walk with a cane after a 2-month recovery period.

4. Comments

This article focuses chiefly on technical issues. We will not discuss the *indications*, which are obviously rare and consist mainly in well demarcated tumours for which complete resection seems feasible. Of our 3 patients, 2 had metastases, but these were relatively stable. Furthermore, in such patients, the very severe pain and functional impairment warrant surgical treatment provided an early functional recovery is achieved. This early return to function is among the main advantages of our technique. However, with slowly progressive tumours (chondroma or chondrosarcoma) or stabilised malignancies, if resection is indicated, the patient is best referred to the orthopaedic surgeon sufficiently early before the lesions become so extensive as to jeopardise the feasibility of the resection.

Regarding the technique, we hope we have sufficiently emphasised the following two points:

- tumour spread should be assessed as accurately as possible, both at the pelvis and at the femur, which can be used for grafting only if it is completely intact;
- tumour vascularisation can result in huge difficulties and must be evaluated before the procedure. We believe that embolisation of the feeding artery can be very useful. This method was used in our case #2 and considerably diminished the blood transfusion requirements. Embolisation is most effective when performed on the day before surgery.

Disclosure of interest

Authors' disclosure of conflict of interest was not requested when the article was originally published.

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