# Megaprosthetic replacement of the pelvis

## Function in 17 cases

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Between 1980 and 1997, we treated 39 patients (mean age 39 (16–66) years, 24 men) with megaprosthetic replacement of a large bone defect (> 10 cm) of the pelvis. The bone resection was necessary in 38 cases due to malignant bone and soft tissue tumors and in 1 case due to hydatid disease. Polyacetal hemipelvic replacement was performed in 29 cases, CAD hemipelvic replacement in 8 cases, and a saddle prosthesis was inserted in 2 cases.

All patients were followed clinically and radiographically. The mean follow-up was 58 (15–110) months. 20 patients have died of their tumor. 10 local infections occurred, in 2 cases necessitating hemipelvectomy. Hip dislocation occurred in 6 cases. 13 of the remaining 17 survivors had good or excellent clinical results according to the Enneking evaluation (MSTS). In 6 of the 17 survivors, radiographs revealed implant loosening.

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Most studies on the treatment of pelvic sarcomas focus on the oncological outcome; few studies present the long-term function, especially after pelvic megaprosthetic replacement (Enneking et al. 1993, Campanacci and Capanna 1987, Mutschler et al. 1987, O'Connor and Sim 1989, Harrington 1992, Gradinger et al. 1993, Shin et al. 1994, Wirbel et al. 1996, Abudu et al. 1997).

We report our experience of megaprosthetic replacement for large pelvic bone defects, with special regard to the long-term function.

## Patients and methods

From January 1980 through April 1997, we treated large (> 10 cm) bone defects of the pelvis with megaprosthetic replacement in 39 patients (15 women). The median age was 39 (16–66) years. Clinical data were retrieved from the clinical charts, radiographs and outpatient interviews. Patients suffering from metastatic bone disease were not included, because our aim was to study the long-term function.

The diagnoses included primary malignant bone tumors (n 30), primary soft tissue sarcomas (n 8) and hydatid disease (n 1). The tumors were classified as 2 stage IA, 8 stage IB, 27 stage IIB and 1 stage III sarcomas.

### *Treatment*

29 patients were treated with partial or total hemipelvic replacement, using a polyacetal resin prosthesis (Figure 1). CAD (computer-aided designed) pelvic replacement was performed in 8 cases, using vitallium prostheses (Howmedica, Kiel, Germany or ESKA, Lübeck, Germany) (Figure 2). A saddle prosthesis was used in 2 patients (Link, Hamburg, Germany). In 21/38 sarcomas, histology confirmed a resection with a wide margin, and 17 cases as marginal margins. The technique of internal hemipelvectomy has been reported previously (Mutschler et al. 1987).

*Functional assessment* was made with the Musculoskeletal Tumor Society's criteria, described by Enneking et al. (1993). 6 parameters were analyzed—namely, functional activity, pain, need of supports, limitation of walking, gait and the patient's emotional acceptance of the reconstruction. Overall function was classified as excellent, if all 6 parameters were recorded as excellent, function was good, when 5 of the 6 parameters were good

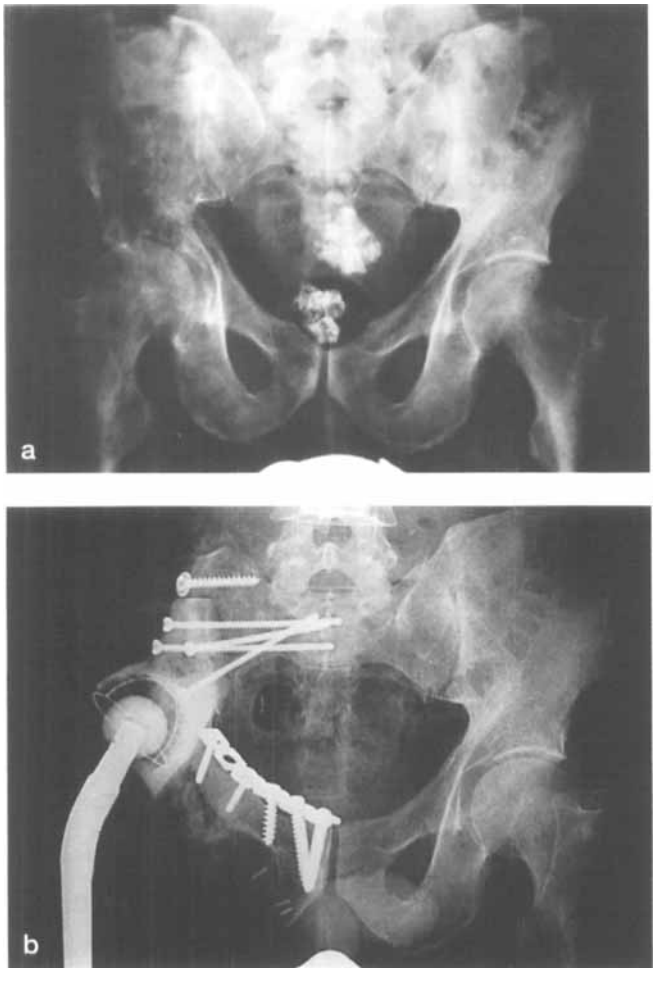

Figure 1. Polyacetal pelvic replacement in a 54-year-old man with leiomyosarcoma of the right hemipelvis involving the hip joint. Pre- (a) and postoperative (b) radiographs.

or excellent; a fair result required at least 5 parameters to be scored as fair or better, and a poor result was obtained when at least 2 parameters were scored as poor.

The outpatient interview at the last follow-up also included questions about leisure activities, continuation of occupation or invalidity.

*Radiographic assessment* followed the guidelines proposed by the International Symposium of Limb Salvage in 1991 (Glasser and Langlais 1991). Four parameters were used—namely, interface, anchorage, implant body problem and implant articulation.

### *Follow-up*

Follow-up was calculated from the time of surgery to the last date of outpatient review or death. At the last follow-up, 16 of the sarcoma patients were disease-free, 2 were alive with disease and 20 had died of their disease. The median follow-up for survivors was 58 (15–110) months.

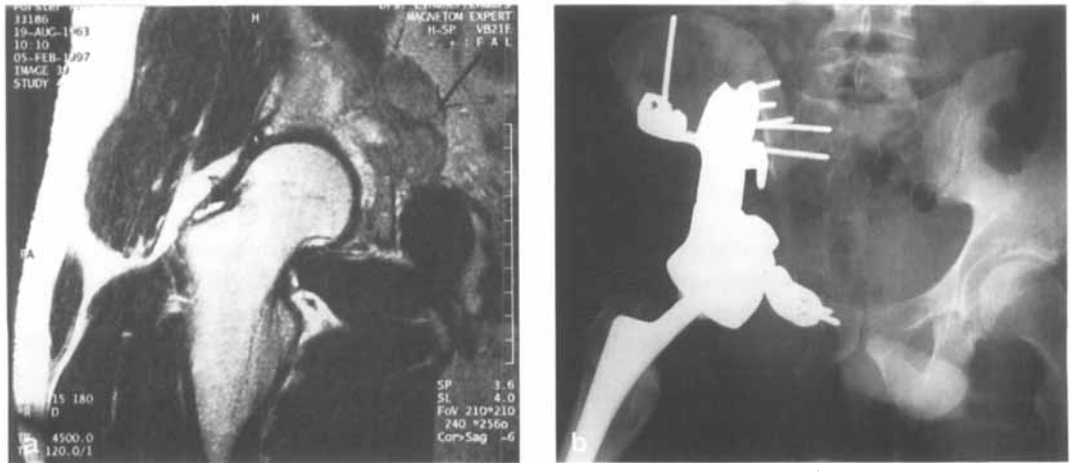

Figure 2. Ewing's sarcoma involving the right acetabulum in a 31-year-old man. CAD-vitallium endoprosthetic replacement was performed after internal hemipelvectomy. Preoperative MRI (a) and postoperative radiograph (b).

Table 1. Function in 17 patients with megaprosthetic pelvic replacement

| | Reconstruction | | | |
|---|---|---|---|---|
| | P-PR (n 10) | CAD-PR (n 6) | Saddle (n 1) | Total (n 17) |
| Overall Enneking score | | | | |
| excellent | 2 | | | 2 |
| good | 7 | 3 | 1 | 11 |
| fair | 1 | 2 | | 3 |
| poor | | 1 | | 1 |
| Mean MSTS score (range) in percent | 61 (27–100) | 63 (17–86) | 74 | 62 (17–100) |
| Number of patients with good or excellent results in the categories | | | | |
| pain | 10 | 6 | 1 | 17 |
| function | 6 | 3 | 0 | 9 |
| emotional acceptance | 9 | 5 | 1 | 15 |
| support, stability | 5 | 4 | 1 | 10 |
| walking ability | 5 | 3 | 1 | 9 |
| gait | 5 | 3 | 1 | 9 |

P-PR polyacetal pelvic replacement,
CAD-PR computer-aided design-pelvic replacement

## Results

### *Oncological outcome*

20 patients had died of their tumor. The median survival time for these patients was 30 (2–86) months. 2 patients died due to multiple organ failure, 2 and 4 months postoperatively, respectively. 13 patients developed pulmonary metastases (12 died), 6 patients developed a local recurrence (4 died, 2 were cured by hemipelvectomy), and 3 patients developed a local recurrence and metastases (2 died).

Thus, at the latest follow-up, 2 patients were alive with metastatic disease and 16 patients showed no evidence of disease.

### *Function*

Since 2 patients required a secondary amputation, 17 patients—16 tumor patients and the patient who suffered from hydatid disease—were available for functional evaluation of their hemipelvic replacement.

We found excellent or good outcome in 13 of the 17 patients, but 9 patients needed one or two crutches for walking outdoors. All 17 patients had good or excellent outcome, as regards pain, 15 as regards emotional acceptance, 10 as regards stability and support, but only 9 patients as regards the other three categories (Table 1).

8 patients are premature pensioners, whereas 8 patients regained their previous working ability, 4 of them in full-time employment. 1 patient is still hospitalized in a rehabilitation center.

### *Complications*

10 local infections were cured by local debridement and antibiotics in 8 cases. In 2 cases, hemipelvectomy was necessary. 6 cases of total hip dislocation required open or closed reduction and treatment with a brace for 3 months. 2 patients developed heterotopic periarticular hip ossifications with limitation of motion as a late complication.

We observed 6 patients with implant loosening and anchorage problems (Figure 3). 3 of them were revised, in 1 case with refixation of the polyacetal resin by plates, in 1 case with change of the polyacetal resin by CAD vitallium pelvic replacement and in 1 case by removal of the polyacetal implant without filling the defect. In the latter case, the head of the total hip was replaced with a bipolar head.

The parameters anchorage, interface and implant body of the radiographic assessment were good or excellent in 11 cases. In 6 cases, the outcome was poor because of implant loosening. Articulation, i.e., angulation problems, mostly caused by malposition of the acetabular component, were seen in 8 of the 17 cases (Table 2).

## Discussion

Megaprosthetic reconstruction of large pelvic bone defects can give a restricted, but acceptable limb function. The function mainly depends on the necessary bone and particularly soft tissue resection. In our series, good or excellent function was achieved in about three quarters of the surviving patients and half of the patients could resume their previous occupation. Comparable results have been reported by other authors (Campanacci

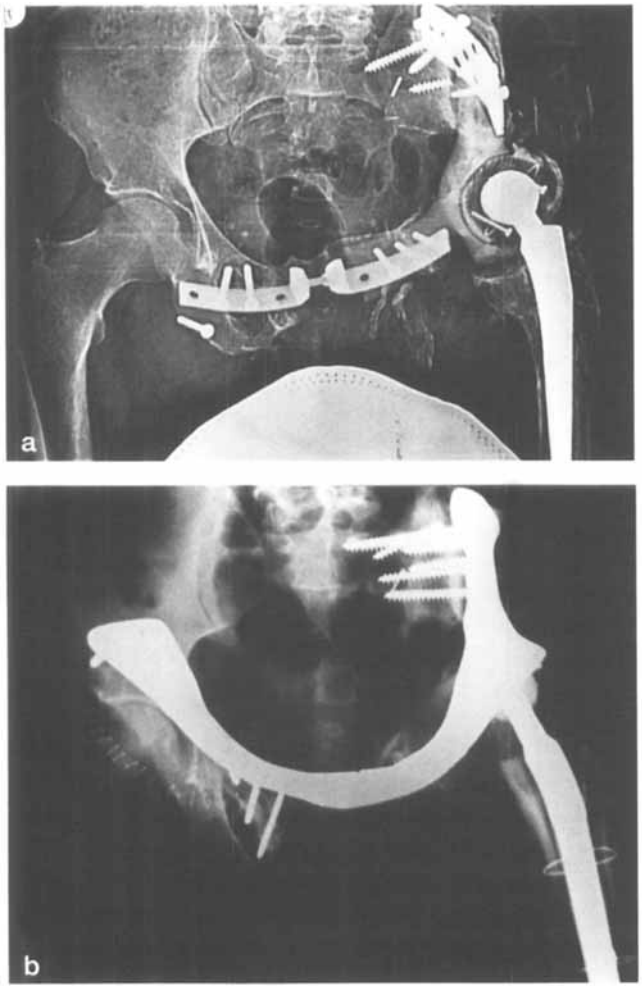


Figure 3. Left-sided polyacetal hemipelvic replacement due to hydatid disease in a 54-year-old man. 4 years after primary surgery, radiograph shows loosening of the implant (a). Removal of the implant and renewed reconstruction with a CAD pelvic replacement (b).

Table 2. Radiographic outcome

| Parameters | | P-PR (n 10) | CAD-PR (n 6) | Saddle (n 1) | Total (N 17) |
|---|---|---|---|---|---|
| Anchorage | A | 5 | 5 | 1 | 11 |
| | B | 5 | 1 | | 6 |
| Interface | A | 5 | 5 | 1 | 11 |
| | B | 5 | 1 | | 6 |
| Implant body | A | 5 | 5 | 1 | 11 |
| | B | 5 | 1 | | 6 |
| Articulation | A | 5 | 4 | | 9 |
| | B | 5 | 2 | 1 | 8 |

A good or excellent, B fair or poor

and Capanna 1987, O'Connor and Sim 1989, Gradinger et al. 1993, Shin et al. 1994, Abudu et al. 1997).

A further improvement in function can only be reached by changes in prosthetic designs. Some problems can be solved by the use of CT-controlled CAD-pelvic replacements (Campanacci and Capanna 1987, Gradinger et al. 1993). When major parts of the ileum can be preserved cranially, new megaprosthetic devices with an intramedullar stem fixation may allow bony ingrowth for long-term stability (Gradinger et al. 1993).

The complication rate after prosthetic reconstruction of the pelvis is high, infection and implant loosening being the most serious complications (Campanacci and Capanna 1987, O'Connor and Sim 1989, Rechl et al. 1991, Harrington 1992, Shin et al. 1994) as also found in our study.

The use of allografts for reconstruction can lead to function similar to that achieved by megaprostheses. But long-term outcome of massive allografts is uncertain and the complication rate, especially the infection rate, is high (Rechl et al. 1991, Harrington 1992, Ozaki et al. 1996). The advantage of allografts consists in the possibility of soft tissue reattachment and therefore in a reduced complication rate of dislocation of a replaced hip joint. However, we believe that the reported good function favor the use of megaprostheses for reconstruction of large bone defects of the pelvis.

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