Modular Megaprostesis in Metastatic Bone Disease of the Femur

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Abstract

The treatment of bone metastases is frequently palliative, aiming to achieve satisfactory pain control and to prevent or treat pathological fractures. For lesions involving the femur, internal fixation frequently fails; therefore, prosthetic reconstruction may be the optimal choice for treatment. This article retrospectively reviews our experience with femoral bone metastases between 1999 and 2008.

A series of 22 patients (14 men and 8 women; mean age, 61.8 years) with femoral bone metastases were treated with resection and modular megaprosthetic reconstruction. Bipolar hip prostheses were used in 19 patients, intercalary prostheses were used in 2 patients, and total knee replacement was used in 1 patient. Oncologic outcome was evaluated, and functional outcomes were obtained by the Musculoskeletal Tumor Society (MSTS) score, which assigns numerical values (0-5) for each of 5 parameters, excluding emotional status. A numerical score (maximum 25 points) and percent rating was calculated. Six-month survival was 86.4%, 1-year survival was 54.2%, and 2-year survival was 37.1%. Three patients were unable to ambulate due to acute paraplegia with spinal metastases at the perioperative period. Excluding these 3 patients, average MSTS score was 62.3%. The MSTS score in patients surviving >12 months was 70.8% compared with a score of 46.4% in those living <12 months (P<.05). Complications included 2 dislocations.

Megaprosthetic reconstruction provides for optimal treatment of femoral metastatic disease in patients with a prognosis of >12 months with satisfactory functional outcomes based on lower complications.

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Bone metastasis is a major problem in patients with cancer. The increased longevity of patients with metastatic disease has made the pathologic fracture an increasingly common problem. The treatment of bone metastases is usually palliative, and the aim is to achieve adequate control of pain. Another goal is to anticipate or stabilize pathologic fractures in the appendicular skeleton because patients with metastatic bone disease usually have a poor survival. Chemotherapy and radiation therapy are appropriate treatment options for sensitive tumors.1 Bisphosphonates have been shown to be useful in decreasing skeletal complications from breast carcinoma, prostate carcinoma, and multiple myeloma.2 Surgery is indicated for intractable pain from impending or established pathological fracture. The management of patients with a pathologic fracture presents a challenge to orthopedic surgeons and necessitates a multidisciplinary approach.

The conventional surgical treatment of metastatic bone lesions of the femur is internal fixation with or without bone cement. This is an inexpensive procedure that allows for immediate weight bearing and function.3,7 However, management of pathologic fractures of the femur can be difficult, especially when fracture stabilization is hindered by extensive bone loss. This is particularly true for lesions involving the proximal femur region because of the high compressive stress passing through this area. Therefore, some surgeons prefer prothetic reconstruction with resection of the tumor.8-13 Prosthetic reconstruction is more invasive and more expensive and associated with longer operating time and hospital stay and greater blood loss.3,6,7 Over the past 20 years, the availability and improvement of the modular megaprosthesis have improved the treatment of metastatic bone disease, particularly the treatment of isolated bone metastases, failed conventional reconstructions, and lesions with extensive bone loss.8,13

The question is whether an aggressive surgical treatment, such as megaprothetic reconstruction with resection of the tumor, performed on patients with limited life expectancy will succeed in improving quality of life. The purpose of this study is to retrospectively review our experience with patients with metastatic bone disease in the femur from carcinoma after resection and modular megaprothetic reconstruction at our hospitals over a 10-year period.

**Materials and Methods**

We reviewed the medical records and imaging studies of all patients with metastatic disease treated with megaprothetic reconstruction of the femur from January 1999 to December 2008. Twenty-two patients with metastatic disease in the femur were treated. Fourteen men and 8 women had an average age of 61.8 years (range, 37-78 years). Histologic types of primary tumors included breast carcinoma in 8 patients, renal cell carcinoma in 4 patients, prostatic carcinoma in 4 patients, thyroid carcinoma in 2 patients, and lung, liver, adrenal gland, and unknown carcinoma in 1 patient each. Five of 22 patients (23%) had a solitary skeletal metastasis, 10 patients had multiple skeletal metastases, and 7 patients had metastases to other organs. Lesions were in the proximal femur in 19 patients and in the shaft in 3 patients. All patients were able to walk prior to their fracture.

The indications for megaprothetic reconstruction were established in 15 patients. Impending pathologic fractures were discovered in 4 patients, along with failed internal fixation in 3 patients. We were unable to achieve the goals of long-standing stability and good function by other methods. Anticipated survival was >6 months. The decision to operate was determined in cooperation with the medical specialist–predicted prognosis on the basis of the progress of the disease and the age and general condition of the patient. Moreover, from 2005 onward, to evaluate the anticipated survival we used the scoring system proposed by Katagiri et al,14 based on the primary lesion (rapid, slow, moderate growth), visceral or cerebral metastases, performance status (Eastern Cooperative Oncology Group performance scale 3 or 4), previous chemotherapy, and multiple skeletal metastases. Megaprothetic reconstruction was considered with a score <5 points (range, 0-8 points).

These metastatic lesions were excised in a manner similar to primary bone tumors. Where possible, wide soft tissue margins without exposure of the focus were obtained, and the shaft of the femur was transected at least 2 cm away from the extent of the disease. Because this was palliative surgery, important neurovascular structures, muscles, and tendons were usually preserved at the expense of wide margins to maximize functional outcome. Cementless modular bipolar hip prostheses (Howmedica Modular Reconstruction System [HMRS]; Stryker, Tokyo, Japan) were used in 19 patients (Figure 1); cemented intramedullary nails with intercalary prostheses (Protesi per Grandi Resezioni [PGR]; Lima Lto, Pordenone, Italy) were used in 2 patients (Figure 2); and a cementless HMRS total knee replacement was performed in 1 patient (Figure 3). In patients requiring proximal femoral replacement, the remaining fragment of the greater trochanter with both glutus medius and vastus lateralis was fixed to the prosthesis with the plate-screw system.

Functional results were determined using the Musculoskeletal Tumor Society (MSTS) scoring system.15 All living patients were asked to return for periodic control examination, and their MSTS scores were recorded. The last examination records obtained were used to calculate MSTS scores for dead patients. Five parameters were scored from 0 to 5, excluding emotional status. Final results were divided by the maximum of 25 points, and the percentage of MSTS scores were calculated.

Postoperative survival rates were estimated using Kaplan-Meier analysis. Statistical
analysis was performed with Student’s t test. Significance was set at $P < .05$.

**RESULTS**

Average operating time was 181 minutes (range, 120-320 minutes), and average perioperative blood loss was 840 g (range, 350-2000 g). The patients were mobilized at an average of 13.3 days (range, 3-21 days), and active and passive weight-bearing activities were allowed at an average of 22 days (range, 3-35 days). Average hospital stay was 6.4 weeks (range, 3-11 weeks) (Table).

**Survival**

The Kaplan-Meier survival rate of 22 patients was 0.864 at 6 months, 0.542 at 12 months, and 0.371 at 24 months (Figure 4). Average Katagiri score was 2.2 (range, 0-5). The survival rate of 14 patients with a score of 0 to 2 was 0.929 at 6 months, 0.637 at 12 months, and 0.340 at 24 months. The survival rate of 8 patients with a score of 3 to 5 was 0.750 at 6 months, 0.469 at 12 months, and 0.234 at 24 months. There was no significant difference in the survival rate between the 2 groups (long-rank test; $P = .586$).

**Functional Outcome**

Three patients were nonambulatory due to acute paraplegia with spinal metastases in the first 3 weeks postoperatively. The remaining 19 patients were functionally evaluated. Three patients were able to walk without crutches, whereas 14 patients needed 1 crutch and 2 patients needed double crutches. Average MSTS score was 62.3% ± 18.3% (range, 28%-100%). Pain relief was obtained in all patients (average pain score, 5); however, scores of function and the use of walking aids were lower (average function score, 2.4; use of walking aid, 1.9). Average MSTS score of 10 patients surviving >12 months was 70.8% ± 17.5%, compared with 46.4% ± 11.2% in 5 patients surviving <12 months ($P < .05$).

**Complications**

Two dislocations occurred in the bipolar hip prostheses group (10.5%). One patient was reduced closed, and the other required an open reduction with capsular reconstruction using an artificial ligament. There were no postoperative infections or aseptic loosening. No patient had local recurrence or required revision surgery.

**Discussion**

In our series, femoral modular megaprosthetic reconstruction with metastatic disease provided for long-standing stabili-
Failure requiring revision surgery also occurs at a lower rate. Although some authors reported that osteosynthesis surgery for metastatic disease of the femur had a low rate of complications and implant failure, these studies had short follow-up periods.3-6

The most important risk factor for failure of treatment is the length of survival.
after surgery. In their large series of patients with a long follow-up period, Wedin and Bauer\(^\text{16}\) suggested that prosthetic reconstruction surgeries had a lower rate of failure than osteosynthesis. For patients with a limited life expectancy, an important factor in the selection method is a low rate of complication. These patients may be unable to undergo revision surgery due to poor general health with progressive disease. With fewer complications and failures, prosthetic reconstruction surgery for metastatic bone disease may be preferable.

Authors have reported good functional outcomes after megaprosthetic reconstruction surgery for bone metastases\(^\text{8-13}\); however, some studies are of selected patients who survived >1 or 2 years.\(^\text{11,12}\) Moreover, Rompe et al\(^\text{17}\) proposed that functional outcome was better in patients with metastatic bone disease of the femur by compound osteosynthesis than by megaprostheses. However, the functional outcome was obtained 3 months postoperatively. We found that the functional outcomes of patients who survived a longer period were better than those who did not. In a study of both prosthetic reconstruction and internal fixation surgery, Talbot et al\(^\text{17}\) also suggested that improvements in functional scores occurred as early as 6 weeks postoperatively; thereafter, the functional scores increased at 3 months postoperatively.

The load-bearing characteristics of prosthetic reconstruction surgery offer immediate postoperative stability and facilitate rapid rehabilitation. However, we believe that some period of rehabilitation is necessary to acquire a good functional outcome from prosthetic surgery. Patients should be selected based on a definitive prediction of prognosis. However, patients with a shorter life expectancy should have the option of aggressive surgical treatment, such as megaprosthetic reconstruction with tumor removal. It is the only method used to stabilize metastatic bone disease in extensive bone destruction or epiphyseal/metaphseal regions of long bone.

Life expectancy is the most important factor in deciding for aggressive surgical treatment. The time of postoperative recovery and improvement in patients with metastatic disease is critically important.\(^\text{17}\) We evaluated the prognosis of patients by Katagiri score, and life expectancy in our patients mostly matched these data. Patients who died during the perioperative period or were lost to follow-up were excluded in the functional evaluations of these previous studies.\(^\text{8-13}\) Three of our patients had acute paraplegia with spinal metastases in the perioperative period. They were also excluded in the functional evaluations in our series. These patients were part of a sicker subgroup of patients with metastatic bone disease who underwent aggressive surgery. Functional outcomes are unknown variables in this subgroup; however, the clinical outcome in this subgroup is unsatisfactory.

The justification for wide resection and megaprosthetic replacement for metastatic bone disease with a 2-year mortality of 63% is debatable. We should avoid overtreatment for patients with limited life expectancy. For most patients with bone metastatic disease, intralesional procedures may be appropriate because the goal is palliation, not cure. In metastatic lesions limited to the head and neck or extended the trochanteric regions of the femur without large bone destruction, we prefer intralesional curettage with a cemented standard prosthetic reconstruction. However, in most of our patients, the bone destruction was so great that no simpler form of bone reconstruction could be expected to provide a biomechanically satisfactory reconstruction.

Capanna and Campanacci\(^\text{1}\) proposed that an intralesional procedure involving wide exposure, curettage, and filling with cement has no significant advantage in terms of surgical invasion and rate of complications compared with a more aggressive wide resection. In our opinion, the technique of intralesional curettage in malignant lesions should be undertaken with caution due to the possibility of an unexpectedly large amount of bleeding. For these reasons, wide resection and megaprosthetic reconstruction for femoral bone metastases is our preferred method of treatment.

No one surgical technique can be applied to all patients with metastatic disease affecting the femur because of the diversity of patients and of the lesions affecting the femur. The variety of procedures used reflects the necessity of individualizing treatment for each patient. In agreement with previous studies, we believe that the megaprostheses is a suitable treatment of bone metastases located in the femur for patients with a long life expectancy. If the postoperative survival of patients is unexpectedly poor, functional outcome will be similarly poor. Patients should be carefully selected for megaprosthetic reconstruction surgery for metastatic bone disease based on definitive prediction of prognosis.

References


