

Surgical Management of Pathological Fractures of Extremities in Patients with Myeloma Using Custom Prosthesis

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Abstract

The major clinical manifestations of Multiple Myeloma result from bone destruction. We analysed nine patients of Multiple Myeloma with pathological fractures of extremities who were surgically treated by custom prosthetic replacement in a single institution during a 14 year period (1990 – 2004). The mean age was 47.7 years and females predominated the series. Femur was the most common location. Prosthetic joint replacements were done in five patients, total bone (femur) replacement in one and intercalary prosthesis for shaft of long bones was done in 3 patients. All patients received preoperative chemotherapy. With an average follow up of 88.2 months, three patients died due to progression of the disease. Late deep infection, aseptic loosening and periprosthetic fracture occurred in one patient each. The functional outcome was excellent in three, and good in three patients. Five year Kaplan Meier survival rate of the patients was 66.7%.

Level of evidence: level IV (clinical case series)

Keywords: multiple myeloma, custom prosthesis, functional outcome

Introduction:

Multiple Myeloma is a primary and systemic neoplasm which represents a malignant proliferation of plasma cells and their precursors (1). The pelvis and proximal femur are the common sites of lesions produced by solitary plasmacytoma and multiple Myeloma (2). These lesions tend to be diffuse and more extensive than those from metastatic carcinomas. Massive Osteolytic lesions, diffuse osteoporosis and pathological fractures are common in the hip region because of the myelomatous infiltration of the acetabulum and proximal femur (3). Most of these lesions are not amenable to internal fixation techniques.

Because of recent advances in chemotherapy patients with Myeloma are surviving for long periods (2, 4). Their actuarial survival rate is far better than for patients with bone metastasis (5). This has presented to the orthopedic surgeon the challenge of maintaining the activity and ambulatory status of patients with myeloma.

Though the principles of internal fixation for these pathological fractures are similar to those of metastatic bone disease, there is high incidence of implant failure even when reinforced with methyl methacrylate (6, 7). This could be attributed to diffuse myelomatous infiltration, associated bone destruction with loss of bone stock and altered biomechanics. The probability of implant failure increases markedly with

prolonged survival of patient after fracture (7). Aggressive surgical management of these pathological fractures using custom prosthesis can provide better functional outcome and improve their quality of life in these patients with limited life expectancy (8). We present the functional and oncological outcome of nine patients who underwent custom mega prosthetic replacement for pathological fractures in multiple myeloma.

Material And Methods**Patient data**

Between July 1990 and September 2004 nine patients with multiple myeloma who had pathological fractures of the extremities underwent surgical reconstruction with custom mega prosthesis. There were 4 males and 5 females with the age ranging from 35 to 60 (average 47.7) years. Femur was the most common location: 3 patients had proximal femoral lesions and 3 patients had femoral shaft lesions of which one patient had extensive myelogenous involvement of shaft of femur. One patient each had involvement of proximal humerus and humeral shaft (Table 1). Preoperative planning was done in all patients to determine the extent of tumor involvement and the appropriate reconstruction and implant type. All patients had skeletal survey to detect multifocal involvement. The entire limb was surveyed with AP and lateral radiographs to exclude concomitant

Table 1

Demographic data of 9 patients of multiple myeloma treated with resection and reconstruction with custom mega prosthesis

S.No.	Age	Sex	Site	Biopsy	Type of Prosthesis	Margins of Resection
1	60	Male	PF	Open	PFP	Marginal
2	58	Female	PF	Open	PFP	Wide
3	50	Female	PF	Closed	PFP	Wide
4	48	Female	DF	-	TKP	Marginal
5	35	Female	SF	Open	ICP	Marginal
6	49	Male	SF	Closed	ICP	Marginal
7	45	Male	SF	Open	TFP	Marginal
8	49	Male	SH	Closed	ICP	Marginal
9	36	Female	PH	-	PHP	Marginal

Abbreviations: PF-Proximal Femur; DF-Distal Femur; SF-Shaft of Femur; SH-Shaft of Humerus; PH-Proximal Humerus; PFP-Proximal Femoral Prosthesis; TKP-Total Knee Prosthesis; ICP-Intercalary Prosthesis; TFP-Total Femoral Prosthesis; PHP-Proximal Humeral Prosthesis.

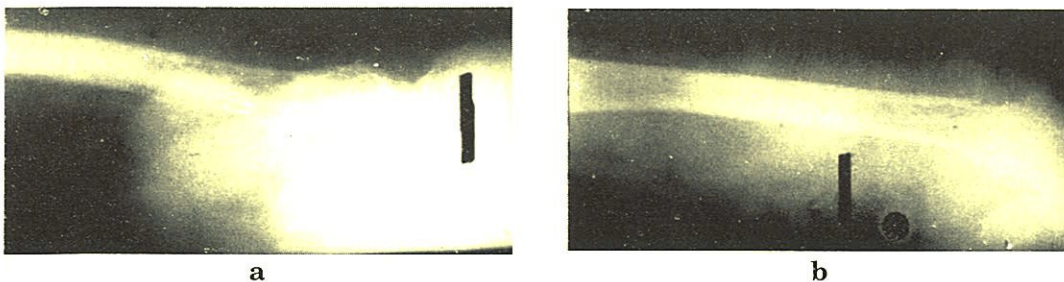


Figure 1 Preoperative x ray of a patient (No 3) with Myelomatous lesion of proximal femur with Pathological Fracture

lesions that would place a large lytic lesion near the stem of the planned prosthesis. Four patients each had Computerised Tomogram and Magnetic

Resonance Imaging to find the extent of involvement. The diagnosis was confirmed by open biopsy in four and closed biopsy in 3. The remaining two

patients were tertiary referrals with surgery done elsewhere and hence diagnostic biopsy was not required.

Resection and reconstruction

Resection and reconstruction was done using custom made prosthesis with cementation. The material used was 316L Stainless steel in 8 patients and Titanium in one patient. Wide margins of resection were achieved in 2 patients and marginal in 6 patients. Proximal femoral prosthetic joint was used to reconstruct defects for patients with proximal femoral lesion. Of the three patients with lesion involving the femoral shaft, two patients had intercalary prosthesis. The other patient had extensive involvement of the diaphysis and hence total femoral prosthesis was used. Total knee prosthesis, proximal humeral prosthesis and intercalary prosthesis were used for distal femoral, proximal humeral and humeral shaft lesions respectively. All patients received general supportive care, chemotherapy and/or radiotherapy along with biphosphonates.

Results

All patients were followed-up monthly for the first six months and 6-monthly thereafter. Long term follow-up was done annually. The average follow-up period was 88.2 months (range 60-166). Clinical examination and

radiography was performed to detect any complications. Also, functional assessment was done during each visit and the progress recorded.



Figure 2 Five years follow up X ray after wide resection and Custom mega prosthetic replacement (AP view)

Complications

There were 1 intra operative, 1 early and 2 late complication. One patient with femoral shaft lesion planned for intercalary prosthesis had extensive intra-operative bleeding requiring 6 units of blood transfusion. Superficial skin necrosis occurred as an early complication in other patient who had proximal femoral prosthesis which required antibiotics and skin cover. Late complications included delayed infection and prosthesis failure each in one patient. The patient who had total knee prosthesis developed deep infection 2 years after surgery requiring removal of

prosthesis. The patient who had intercalary prosthesis had fracture of the femoral stem which was treated conservatively with a brace.

Functional outcome

The functional outcome was assessed using Enneking modified system of functional evaluation of surgical management of musculoskeletal tumours (9). This system rates combined active range of movement, pain, stability,

deformity, strength, functional activity and emotional acceptance. As three patients died of disease during follow-up, the functional outcome reported was that on their last follow-up visit. According to this system, 3 patients had excellent outcome, 3 good, 2 fair and one poor outcome (Table 2). All patients in our series had improved functional outcome with no surgery related mortality.

Table 2

Follow-up and clinical outcome of 9 patients of multiple myeloma treated with resection and reconstruction with custom mega prosthesis

S.No.	Follow-up (Months)	Complications	Functional Result	Oncological Result
1	60		Excellent	DOD
2	166	Skin necrosis	Good	CDF
3	165		Excellent	CDF
4	52	Deep Infection-prosthesis removal	poor	DOD
5	45		Good	DOD
6	92	Intraoperative bleeding, Fracture of femoral stem	Fair	CDF
7	83		poor	CDF
8	71	Implant loosening	Good	CDF
9	60		Excellent	CDF

Abbreviations: DOD-Died of disease; CDF-Continuously disease free

Oncological outcome

Three patients died of disease at 45, 52, and 60 months of follow-up. None of these patients required amputation. The Kaplan-Meier survival analysis (10) done with death as the end point showed a 5 year survival rate of 66.7% (Fig. 3). The oncological outcome was related to the disease response to chemotherapy with no local recurrence.

Discussion

Myeloma is the most common primary malignant tumour of the skeleton and accounts for approximately

50% of malignant bone tumours. It occurs as a result of unregulated, progressive proliferation of neoplastic monoclonal plasma cells (11). Bone destruction is due to increased osteoclastic bone resorption and inhibition of osteoblastic bone formation resulting in osteolytic lesions predisposing to pathological fractures (12).

Myeloma is common in elderly patients and rare in patients below 40 years of age. There is a slight male preponderance and commonly occurs in the sixth or seventh decade of life (12).

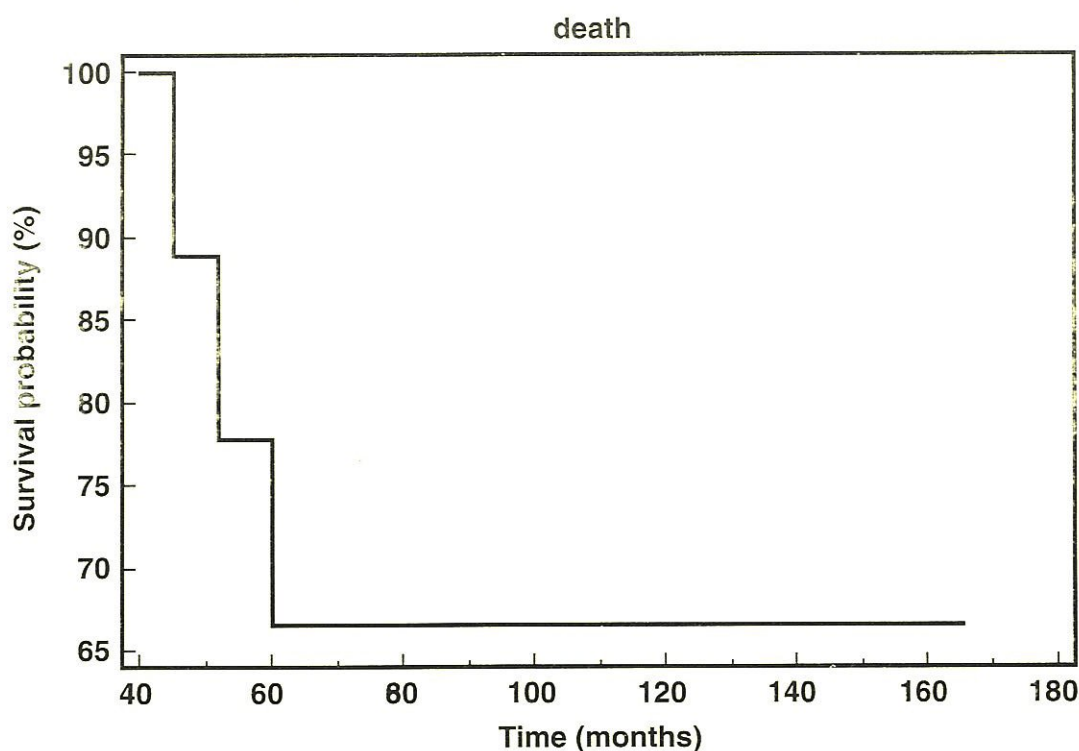


Figure 3 Five year Patient survival rate as shown by Kaplan Meier estimator.

In our series, the average age was 47 years which is much less when compared to that reported in the literature. There was also a female preponderance in our series with 6 patients below the age of 50 years.

Treatment of multiple myeloma could be difficult and challenging. Alexanian et al have reported that the extent of disease involvement, clinical behavior and prognosis, complications and sensitivity to various therapeutic agents dramatically vary between patients (1). The natural course of disease in the absence of treatment is progressive bone destruction; anemia and renal failure with infection being the most common cause of death (12). Owing to the recent advances in chemotherapy, a considerable improvement in overall survival rate could be achieved for patients with newly diagnosed Myeloma (13). Though chemotherapy is successful in many patients, the risk of osteopenia and subsequent pathologic fracture persists and radiation therapy does not address pathological fracture or associated instability which requires additional surgical stabilisation. All the patients in our series were on chemotherapy and had pathological fractures warranting surgical stabilisation to enable early mobilisation and reduce pain.

The principle purpose of orthopaedic surgical management in these patients

is to restore skeletal function and maintain the ambulatory status of the patient. As the disease progression is slow and the long term survival of these patients is better when compared to pathological fracture due to metastasis from other tumours, surgery should pursue a long term stable reconstruction of the affected bone (13,14). Failure of standard internal fixation even with the use of methyl methacrylate due to extensive cortical bone destruction associated with diffuse osteopenia justify a more aggressive treatment with endoprosthesis (8,11,15). In our series surgical treatment was aimed at achieving adequate margin of resection and stable reconstruction using cemented custom endoprosthetic replacements in all patients.

Though surgical stabilisation has been described for spinal compression fractures in myeloma (16,17), the literature is scarce regarding endoprosthetic replacement for pathological limb fractures (11). In our experience with 9 patients there were few unique therapeutic challenges. Recurrent infection which is a major cause of morbidity in these patients (1) could potentially result in an increased risk of prosthesis related infection. One patient in our series with total knee prosthesis had delayed deep infection of the prosthesis two years after surgery due to recurrent episodes of chest

infection which was the obvious focus of infection..

Also as these patients are on chemotherapeutic agents and/or radiotherapy this may affect the timing of surgery and healing of the tissues. A delay in the institution of chemotherapy may be required in situations where emergency surgery is needed for pathologic fracture and prior radiation to the surgical area can result in poor wound healing. A patient with proximal femoral lesion who received pre-operative radiotherapy had skin necrosis following proximal femoral reconstruction necessitating skin cover. Continued osteolysis and bone destruction around the prosthesis can result in loosening of prosthesis and symptoms of instability. One patient with intercalary prosthesis of humerus had radiological evidence of loosening at 18 months follow-up. He was asymptomatic and not keen on revision surgery. He provided with a hinged elbow brace for support.

In addition dehydration, renal impairment, anemia, chest infection and hypercalcemia can have a profound effect on anesthesia with increased morbidity in these patients and may require a prolonged intensive care support post-operatively. Also, a dedicated rehabilitation team consisting of physiotherapist, occupational therapist is

required to enhance early mobilisation, prevent chest infection and help in successful recovery of the patient.

The median length of survival after diagnosis is reported to be 3 years (17). Durr *et al* (18) in a series of 27 patients who underwent spinal surgery for multiple myeloma have reported 59% 5-year survival rate and opined that these patients have a superior survival rate than metastatic disease. There are few reports showing long term survival. Wegener *et al* have reported 16 year follow-up of one patient with cervical spine metastasis (19)

Treatment of pathological fractures in multiple myeloma with custom mega prosthesis is a feasible option as more than 65% of our patients had satisfactory functional outcome and were emotionally satisfied. They were able to mobilise early with good pain relief and had a useful functional limb.

Conclusion

Multiple myeloma is a systemic malignancy. Given the improved life expectancy of patients with multiple myeloma the aim of surgical management of pathological fractures should be a fit and stable reconstruction of the affected bone. Custom prosthesis can provide pain relief, early mobilisation and provide good functional result with improved Quality of life.

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