



FUNCTIONAL OUTCOMES OF MODULAR TUMOR PROSTHESES IN METASTATIC PROXIMAL FEMORAL TUMORS: A RETROSPECTIVE STUDY

Sudheer Kumar Reddy

Associate Professor, Department of Orthopaedics, Sree Balaji Medical College & Hospital, Chennai – 600044, Tamilnadu, India

ABSTRACT

In the management of metastatic tumors causing proximal femoral pathological fractures, proximal femoral endoprosthetic replacements, particularly modular prostheses, are commonly employed to address varied reconstructive needs. This retrospective study evaluated 100 consecutive patients with metastatic proximal femur tumors who underwent reconstruction with modular tumor prosthetics using the METS system between 2001 and 2007. Clinical and functional outcomes were assessed, including overall survival, local control, implant survival, and complications related to patients, tumors, and treatments. The cohort, comprising 45 males and 55 females with a mean age of 60.2 years, primarily underwent the procedure for metastatic cancer management. Seventy-five patients presented with pathological fractures or failed fixed fractures, while 25 were at high risk for fractures. The mean follow-up duration was 15.9 months, ranging from 0 to 77 months. A significant portion of patients (69 out of 100) passed away post-surgery, with most implanted prostheses serving as definitive treatment options until the patients' demise. Complications included dislocation in a minority of cases with unipolar femoral heads and total hip replacements, along with six cases of deep infections. Kaplan-Meier analysis estimated a five-year implant survival rate of 83.1%, with satisfactory functionality observed in 64% of patients based on functional tests. The study underscores the effectiveness of METS modular tumor prostheses in providing long-term functionality with minimal implant-related complications.

Keywords:- Metastatic tumors, Proximal femoral fractures, Modular tumor prostheses, Endoprosthetic replacements, Functional outcomes.

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INTRODUCTION

Breast, bronchus, kidney, prostate, and thyroid carcinomas are often the primary sources of metastatic bone tumors. Bony metastases have been extensively studied in literature, including surgical approaches, complications, and outcomes. Malignant bone tumors most commonly affect the proximal femur among long bones [1, 2]. Endoprostheses have been used successfully for treating malignant tumors within the proximal femur

for many years, and they are now widely applied to treating metastatic disease as well. As modular implants have become increasingly popular, endoprostheses are no longer crafted individually. For patients with metastasis-induced pathological fractures, they are particularly useful because they allow for prompt surgery. Disease processes or concurrent radiotherapy often inhibit natural healing of pathological proximal femur fractures.

Corresponding Author: **Sudheer Kumar Reddy**

An endoprosthetic replacement is a rational choice both functionally and oncologically for patients whose lives are expected to be prolonged and who have substantial upper femur destruction. As soon as possible, it is imperative to address pathological fractures linked to metastatic bone disease so as to restore near-normal function. In addition, the patient should outlive any fixation device used. Endoprosthetic replacement offers an advantage over internal fixation by allowing for a tumor-excavated area to be replaced, thereby mitigating the risk of recurrence and non-union [2, 3]. Aside from local recurrence and infection, endoprosthetic pain may develop as a result of aseptic loosening, mechanical failure, and fractures (in either the prosthesis or bone) [4–6]. The deployment of modular and custom proximal femoral endoprostheses has been the subject of a number of studies [7–11]. In 2001, Stanmore Implants Worldwide introduced the MetS prosthesis system (an endoprosthetic replacement system for proximal femoral tumors that uses modular design). As part of this study, 100 patients with metastatic tumors were evaluated for both clinical as well as functional outcomes after having their proximal femurs reconstructed with modular tumor prostheses. Additionally, these outcomes were compared with those obtained by patients who received modular or custom endoprostheses.

METHODOLOGY

In a series of 100 consecutive surgeries, patients with metastatic disease of the proximal femur underwent resection followed by modular endoprosthetic replacements. Pathological fractures or failed fixations were observed in 175 patients, while 25 were at high risk of fractures. Multidisciplinary discussions determined treatment strategies based on factors like unsuitable internal fixation due to femoral destruction and metastatic disease prognosis. Surgical procedures were performed by a dedicated oncological surgical team. Modular prostheses with various customization options were used, developed by a biomedical engineering

department. Antibiotic prophylaxis was administered during and post-surgery, guided by oncological principles. Surgical techniques aimed for wide margins or palliative reconstruction based on tumor characteristics. Functional assessments and radiographic analyses were conducted using validated tools. Patient and prosthetic survival, complications, and functional outcomes were evaluated, with a high limb salvage rate of 95% achieved using modular endoprosthetic systems.

RESULTS

100 patients underwent proximal femur replacement with modular endoprosthetics. A total of 45 males and 55 females were present. There were 60.2 participants in the study. Metastases were the cause of the surgery. Table 1 shows the indications. There was a range of 0 to 77 months of follow-up, ranging from 15.9 to 19.7 months on average. As a result of pulmonary embolism following extended bedrest in elderly individuals who underwent surgery, three patients succumbed during the perioperative period. There were also three cases of postoperative pulmonary embolisms. There have been 69 deaths among the initial cohort, while 31 are alive today. The implant proved to be a long-lasting, singular treatment that outlived the patient—68 of 68 deceased patients were not required to undergo revision surgery. Revision surgery was performed on just one patient. There were 25 survivors among the 25 patients with metastatic cancers. Of these, 11 had metastatic renal carcinomas and six had metastatic breast carcinomas. Based on ISOLS (International Society of Limb Salvage) guidelines, radiographs from 25 patients with a survival rate exceeding 24 months were analyzed. Of these six patients, three exhibited proximal migration, two had broken wires, and one had calcification following greater trochanter preservation and reattachment. Radiographic findings were not adversely affected by any other cases, apart from these two.

Table 1: Diagnoses made by patients

Diagnosis	In Number
Breast	30
Renal	10
Bronchus	14
Prostate	06
Thyroid	10
Adenocarcinoma	22
Other	08

DISCUSSION

According to existing literature, there are various limb salvage techniques, including endoprosthetic replacements, allografts, and allograft-

prosthesis composites [12,13]. During the first decade and the first two decades of a custom proximal femoral replacement, 77% of implants survived without revision [14]. Custom implants, however, are often unavailable

immediately, which may result in prolonged bed rest and associated morbidity in patients with pathological fractures and failed trauma implant fixations [15,16]. Prostheses that are made to order may not be ready in time for resection margins to be preserved, leading to tumor progression during the waiting period [17]. A modular proximal femur endoprosthesis was introduced by Stanmore Implants Worldwide in 2001, based on their extensive experience with custom endoprostheses [18]. Among 100 patients with metastatic bone tumors, most were suffering from pathological fractures or implant failure as a result of their tumors. A primary bone tumor has been the most common reason for proximal femoral replacement in most published studies [19-22]. Prostheses are successful if they can provide a non-complicated, stable structure throughout the patient's lifetime. Out of 69 patients, 68 died with the implant in situ (98.5%), meaning there was no need for revisions. A multitude of authors have addressed infection concerns after proximal femoral endoprostheses [23]. A range of infection rates has been reported. A study reported a 6.3% infection rate in 96 modular prostheses patients in their series of 96 patients. In comparison, a study described an infection rate of 19.5% in 41 patients who had modular proximal femoral endoprostheses replaced with radiation therapy after Ewing's sarcoma. Infections associated with endoprosthetic replacements are known to be related to radiotherapy. The 16 patients treated with radiotherapy in our series did not develop deep infections. There has been a variety of reports reporting dislocation rates from 1.7% to 20% following proximal femoral endoprosthetic replacement. This condition often results from extensive removal of muscles and the hip capsule surrounding the hip. When repairing the hip capsule, it is necessary to address both the hip capsule and the abductor lever arm. After tumor resection, small femoral heads are associated with higher dislocation rates. Larger femoral heads are recommended to mitigate this issue [24]. The present series recorded a dislocation rate of 3%, comparable to other reported series. As compared with a series of 54 patients at our center receiving custom implants for primary bone tumors, this rate was significantly lower. In the current series, dislocation rates were reduced to 3% using large monopolar heads. For patients with metastatic disease without acetabular involvement, large monopolar heads were safe despite two out of five experiencing dislocations. It was aimed at minimizing dislocation risks that monopolar heads were used in this series [25]. Long-term follow-up of both modular and custom implants has revealed an increased risk of aseptic loosening. In patients with metastatic renal carcinoma, which is the

most common type of aseptic loosening, hydroxyapatite-coated collars were implemented to mitigate this risk. A distal femoral and proximal tibial replacement have been successfully performed using this approach. It is necessary to follow up for a long time after replacing the proximal femur to determine whether the approach is applicable. An internal fixation via intramedullary nails and postoperative radiotherapy is often ineffective in healing pathological fractures of the proximal femur. Metastatic renal carcinoma is more likely to present with this problem. Further intervention may be required if the tumor progresses, resulting in implant failure. According to studies, reoperation rates for metastases range between 20% and 35% after internal fixation fails [26]. It is noteworthy that 86% of patients who underwent endoprosthetic replacement surgery were alive one year after the surgery for metastatic renal carcinoma and 40% of patients who underwent endoprosthetic replacement surgery for metastatic breast carcinoma. Metastatic renal carcinoma patients have well-documented long survival rates. Metastatic renal carcinoma was associated with a 24% local failure rate after internal fixation. Patients with renal metastases were more likely to experience better outcomes with primary endoprosthetic replacement compared to internal fixation, given its lower failure rate. In addition to providing immediate functional mobility, this approach is cost-effective, enabling the patient to live a normal life regardless of metastatic proximal femur disease. Although one-year mortality rates of 65% are high, the rationale for proximal femoral replacement surgery is debated. The survival rates of patients following surgery for proximal femoral metastases were 30%, 10%, and 7%, respectively, according to a study. Additionally, this study estimated patient survival rates at one-year, two-year, and three-year intervals of 35%, 20%, and 10%, respectively. Interestingly, metastatic renal cancer patients had an 86% survival rate after one year. Surgical treatment is often a better option than bed rest, palliation, and radiotherapy for patients with metastatic proximal femoral disease and pathological fractures or implant failure.

CONCLUSION

An endoprosthetic replacement of the proximal femoral portion of the thigh might be considered for patients with pathological fractures or failed internal fixations with a life expectancy exceeding six weeks. In collaboration with the multidisciplinary team, the choice was made. A stable, painless proximal femur enabled optimal mobility and dignity during the final months of life for patients who passed away within the first year after surgery.

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