

# Case series of patients with pathological dyaphyseal fractures from metastatic bone disease

Dinu Vermesan<sup>1</sup> · Radu Prejbeanu<sup>1</sup> · Horia Haragus<sup>1</sup> · Alis Dema<sup>2</sup> · Manuel D. Oprea<sup>1</sup> · Diana Andrei<sup>3</sup> · Dan V. Poenaru<sup>1</sup> · Marius Niculescu<sup>4</sup>

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## Abstract

**Introduction** Fractures on pathologic bone have major impact on life quality. The appropriate treatment is not standardized, but the current literature delineates that surgery must provide adequate stabilization for the life expectancy. We aimed to review the epidemiology, treatment outcomes and survival in our department.

**Material and methods** The electronic database from a major referral centre was searched for patients treated for tumours and fractures by the corresponding ICM-10 codes over five years. Eighty-nine patients were identified. Eleven females and nine males, with an average age of 64 years underwent 23 operations during the selected timeframe. Six fractures were subtrochanteric, five at the femoral neck and five at the femoral diaphysis. Seventeen cases were metastatic carcinomas, out of which five mammary, three pulmonary and seven carcinomas of undetermined origin without immunohistochemistry.

**Results** Fourteen types of surgical intervention were osteosynthesis with intramedullary nails and six were partial hip replacements of which one had proximal femur resection and revision stem hemiarthroplasty. Four patients had single metastatic lesions which underwent resection and defect filling using PMMA cement (polymethylmethacrylate). The follow-up period ranged between two and seven years or until death. Only five patients (25%) were alive at the last follow-up. Local recurrence appeared in one patient. There was one immediate post-operative complication (dehiscent wound) and one implant failure after five years and was replaced with a larger diameter (exchange nailing).

**Conclusion** Both hip arthroplasty and femoral nailing are safe and routine procedures that are performed with relatively technical ease and low surgical stress and few peri-operative complications for the patient. They allow for immediate mobilization and weight-bearing with moderate and rapidly decreasing pain and discomfort.

**Keywords** Hip · Femur · Pathologic fracture · Bone tumor · Metastasis · Nailing · Arthroplasty

✉ Dan V. Poenaru  
danvpoenaru@gmail.com

<sup>1</sup> Department of Orthopaedics and Trauma, University of Medicine and Pharmacy ‘Victor Babes’ Timisoara, Eftimie Murgu Square No. 2, 300041 Timisoara Timis, Romania

<sup>2</sup> Department of Anatomopathology, University of Medicine and Pharmacy ‘Victor Babes’ Timisoara, Eftimie Murgu Square No. 2, 300041 Timisoara Timis, Romania

<sup>3</sup> Rehabilitation and Physical Medicine Department, University of Medicine and Pharmacy ‘Victor Babes’ Timisoara, Eftimie Murgu Square No. 2, 300041 Timisoara Timis, Romania

<sup>4</sup> Department of Orthopaedics and Trauma, Faculty of Medicine, University ‘Titu Maiorescu’ Bucharest, 22 Dâmbovcului, 040441, Sector 4, Bucharest, Romania

## Introduction

Improvements in oncology have increased the life expectancy of patients with malignancy. Pathologic fracture occurs at presentation in 8–30% of patients with metastatic disease and almost half of all patients with malignancy will exhibit some form of bone involvement at some point in evolution [1, 2]. Therefore, more patients require treatment for fractures on pathologic bone. The occurrence of these types of fractures has a great impact on the patients’ life quality in the final stages of the malignant disease, limiting the mobility and producing severe social and physical dependence [3–5]. The

attempts in comparing different surgical techniques were scarce [3, 4], and it remains unclear whether some types of implants offer better patient outcomes. Choosing the most adequate technique is rather difficult, as the surgeon must consider the local biomechanical requirements as well as the patients' comorbidities. Recent studies have shown that the failure rates in managing these fractures may vary from 3.1 to 42% [4–6]. The failure risk increased mainly with increase in life expectancy for metastatic cancer with modern treatments [1, 2]. We aimed to review the epidemiology, treatment outcomes and survival in our department.

## Materials and methods

We conducted a retrospective study on patients operated in the 1st Clinic of Orthopaedics and Trauma, Emergency Clinical County Hospital Timisoara for fractures on pathologic bone over a five-year period between 2010 and 2015. The electronic databases were searched for patients discharged with all C (malignant tumours) and D (benign tumours) and M84.4 (pathologic fractures) ICM-10 codes. After exclusion of

duplicates, 89 patients with confirmation by biopsy were included for analysis. All files were individually reviewed and those with surgically treated pathologic fractures and histopathologic confirmation were selected. Information on the age, gender, implant type, anatomic location, tumor histology, imagistic diagnosis, follow-up period, and recurrence is presented in Table 1. The surgical management included hip arthroplasties and femoral nailings performed in a standard fashion, under combined spinal epidural anaesthesia and dorsal decubitus.

## Results

Eleven females and nine males, with an average age of 64 years underwent 23 operations during the selected timeframe. Six fractures were subtrochanteric, five at the femoral neck and five at the femoral diaphysis (Table 1). Seventeen cases were metastatic carcinomas, out of which five mammary, three pulmonary and seven carcinomas of undetermined origin without immunohistochemistry.

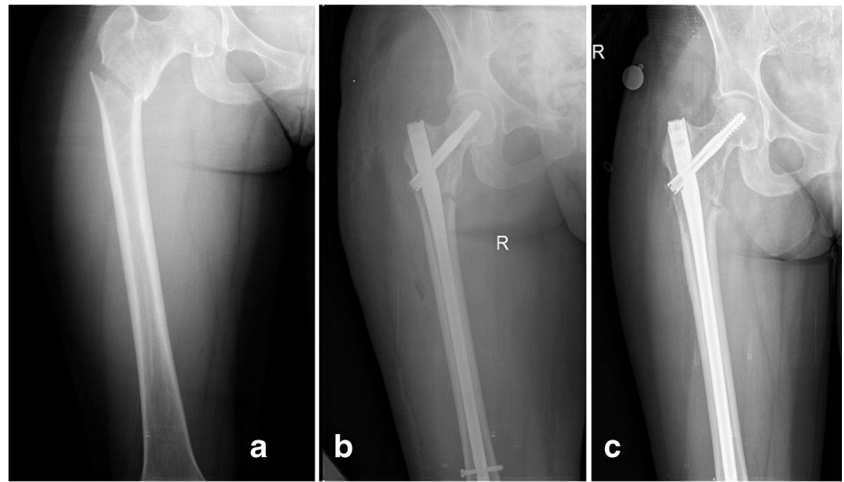
Fourteen types of surgical intervention were represented by osteosynthesis with intramedullary nails (Fig. 1) and six were

**Table 1** Synthetic representation of pathologic fracture cases

Patient number	Age (years)	Gender	Fracture location	Implant type	Histopathology	Status in 2017
1.	57	F	Subtrochanteric	Long Gamma Nail	Mammary gland - ductal	Alive
2.	60	M	Subtrochanteric	Revitan stem/ bipolar head	Adenocarcinoma	Deceased
3.	85	M	Subtrochanteric	Long Gamma Nail	Undetermined	Deceased
4.	65	F	Femoral diaphysis	S2 Nail exchanged S2 Nail	Pulmonary carcinoma	Deceased
5.	90	F	Femoral neck	Moore hemiarthroplasty	Mammary carcinoma	Deceased
6.	74	M	Subtrochanteric	Long Gamma Nail	Carcinoma, unclear origin	Deceased
7.	81	M	Femoral diaphysis Periprosthetic R Femoral neck	S2 Nail Surgery aborted Cemented hemiarthroplasty	Prostate carcinoma	Deceased
8.	65	F	Femoral neck	Bipolar hemiarthroplasty	Mammary carcinoma	Alive
9.	60	F	Femoral neck	Moore hemiarthroplasty	Carcinoma, unclear origin	Deceased
10.	67	M	Femoral diaphysis	S2 Nail	Carcinoma, unclear origin	Deceased
11.	57	M	Femoral diaphysis	S2 Nail	Pulmonary carcinoma	Deceased
12.	47	M	Femoral diaphysis	S2 Nail	Pulmonary carcinoma	Deceased
13.	58	F	Subtrochanteric	Kuntscher nail	Mammary carcinoma	Alive
14.	66	M	Trochanteric	DHS – dynamic hip screw	Carcinoma, unclear origin	Deceased
15.	51	F	Femoral diaphysis	S2 Nail	Myeloma	Deceased
16.	64	F	Tibia	S2 Nail	Carcinoma, unclear origin	Alive
17.	63	F	Femoral neck	Moore hemiarthroplasty	Highly malignant, unclear origin	Deceased
18.	64	F	Humerus	Kuntscher nail	Renal carcinoma	Alive
19.	36	F	Subtrochanteric	Long Gamma Nail	Mammary carcinoma	Deceased
20.	71	M	Supracondylar	Plate	Carcinoma, unclear origin	Deceased

Synthetic representation of pathologic fracture cases; Gamma Nail and S2 are trademark implants of Stryker (Michigan, USA); Revitan femoral stem – Zimmer (Indiana, USA)

**Fig. 1** Secondary bone tumor, fracture and stabilization. A 57-year-old female with mammary ductal carcinoma. **a** Presented in 2015 in the emergency department for right subtrochanteric fracture. **b** Underwent internal fixation with long gamma-nail. **c** At the 2017 follow-up



partial hip replacements of which one had proximal femur resection and revision stem hemiarthroplasty (Table 1). Four patients had single metastatic lesions which underwent resection and defect filling using PMMA cement (polymethylmethacrylate) as previously described [7].

The follow-up period ranged between two and seven years or until death occurred (Table 1). Only five patients were alive at the last follow-up. Local recurrence appeared in one patient. There was one immediate postoperative complication (dehiscent wound) and one implant failure after five months (Table 1). The initial intramedullary nail fixation broke at the fracture level and was replaced with a larger diameter (exchange nailing). There were three consecutive fractures: one treated conservatively (bed rest), one by intramedullary osteosynthesis (Fig. 2) and one by hemiarthroplasty (Fig. 3).

According to the Dindo et al. [8] criteria, the recorded complications in our series were: (I): 1 – nausea, (II): 8 – blood transfusions, (III): 0, (IV): 0, (V): 0.

## Discussion

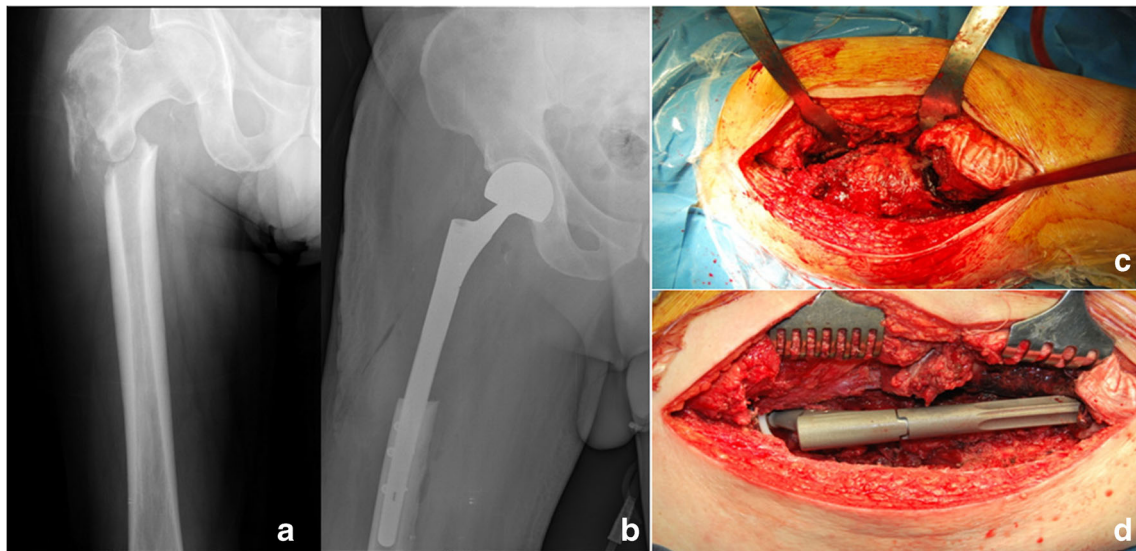
In our review, the vast majority of pathologic bone fractures from metastatic disease that received surgical treatment was

located in the femur. This underlines both the predilection for this location (the second most common localization of bone metastases after spine [9]) as well as the importance of surgery in restoration of function. Treatment type should take into consideration the level of fracture, tumor subtype, associated conditions as well as patient's life expectancy. Median survival in patients with metastatic bone disease is generally between six and 48 months [10, 11]. In our series, only five patients (25%) were alive at the final follow-up (range 2–7 years). This shows that while most interventions are short-term palliations some can still have extended survival.

When encountering a pathologic fracture in a patient, one of the key points in conducting a well-designed therapy is finding out whether the fracture is caused by a primary or metastatic bone tumor. As Soldatos et al. (2013) stated, there are differences between these two types of lesions. They conducted a study on a series of 69 patients (16 primary bone tumours and 53 metastatic bone tumours). Primary bone tumours have a higher incidence of lytic bone cortex and mineralization on conventional X-rays. The CT reveals a soft-tissue mass and the MRI shows periosteal abnormalities [12]. Augmentation of the implant with PMMA cement allows early postoperative mobilization in most cases, thus improving the rehabilitation process. These spacers can represent an inexpensive

**Fig. 2** Complicated case with recurrent fracture. A 65-year-old female with pulmonary carcinoma presented in 2014 in the emergency department for pain at the left thigh. **a** X-ray exam showed metastatic lesions in the middle of the femoral diaphysis. **b** The patient suffered a spontaneous fracture two weeks later. **c** Underwent surgery with locked intramedullary nailing. **d** She suffered iterative fracture and nail exchange five months later





**Fig. 3** Atraumatic trochanteric fracture of the right hip in a 60-year-old male; preoperative AP X-ray (a) as well as intra-operative image (c) show extensive tumor involvement into the surrounding soft tissues, apart from

the lytic bone lesion; AP X-ray (b) and intra-operative image after proximal femur resection and revision stem arthroplasty (d)

and solid procedure that offers additional fixation to the implants, while having limited complications and favourable outcomes [7]. Another option would be to use intercalary endoprosthetic reconstruction [13]. Deschamps et al. stated that percutaneous cementoplasty can be a useful technique in preventing proximal femur fractures in patients with bone metastases under certain conditions (less than 30 mm of cortical involvement and no history of previous trochanteric fractures) [14]. This is due to the fact that a history of proximal femur fracture is an expression of a structurally weakened bone which may predispose to further complications [15]. One must take into account that a pathologic bone fracture occurs on a local tissuer environment that does not provide the optimal condition for healing, thus the construct must be rigid, and it should allow early weight bearing and mobility [16]. This is usually obtained by intramedullary implants that can be augmented with cement spacers and/or vascularized bone grafts [17]. Scolaro et al. (2014) described that the morbidity associated with bone metastatic lesions can be further reduced by prophylactic stabilization of impending pathologic fractures [16]. A very important aspect that must be taken into account in the evolution is the fracture healing. This should be addressed from both a surgical point of view as well as a pharmacological one. Adjuvant chemotherapy and radiation therapy may also affect bone healing and increases the risk of malunion. Another possible factor that may delay fracture healing is non-steroidal anti-inflammatory medication, a commonly prescribed drug in this subtype of patients, although their influence on bone formation is contradictory. Positive signals are coming from a pharmaceutical research point of view, as more and more studies regarding osteoinductive proteins have shown their efficiency during animal testing [18]. The medical team should take into

consideration the patient's overall condition together with the pharmacologic treatment he is receiving. Both of these factors can and will influence the healing process of the fracture. Even for regular, non-neoplastic elderly patients, hip fractures and especially extracapsular location has increased peri-operative complications [19]. Provided they avoid immediate aggravation, the one-year mortality of frailty hip fractures is around 20% [15]. For the diaphyseal location, the only way to increase the mechanical strength and delay material fatigue is to grossly increase the diameter of the nail [20]. Even with the new, anatomically preshaped rods, this requires extensive reaming of the intramedullary canal, especially around the isthmus. From an oncologic perspective, a pathologic fracture is considered to have already disseminated through the blood stream. There is no clear consensus of the effect of reaming in pathologic fractures [2, 6, 11, 16, 17]. A pitfall we have seen in our review was the potential for collecting insufficient relevant tumoral biopsy tissue in the setting of percutaneous closed reduction and internal fixation. The surgical operative technique allows for the diaphyseal fracture to be indirectly reduced on the traction table under radioscopic control. The intramedullary nail is then inserted anterograde through the tip of the greater trochanter, at considerable distance from the tumor location. If no reaming is performed, the available tumoral tissue obtained through the incision and from the instruments can be insufficient for correct histopathologic diagnosis. If the fracture is the initial presentation of the neoplastic disease, it is also the first and most important opportunity to determine the nature, origin, histologic grading and profile of the tumor. There are several additional weaknesses of our study. First, it is retrospective and has no control group; also, it does not describe the cases that did not have surgery and does not record radiation therapy.



## Conclusions

Both hip arthroplasty and femoral nailing are safe and routine procedures that are performed with relatively technical ease and low surgical stress and little perioperative complications for the patient. They allow for immediate partial or full mobilization and weight-bearing with moderate and rapidly decreasing pain and discomfort.

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