



Intramedullary nailing for treatment of pathologic femoral fractures due to metastases



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ABSTRACT

Pathologic fractures of the femur because of bone metastases seriously affect the quality of life of cancer patients. Different surgical options are indicated to achieve a durable and solid fixation, depending on several clinical, prognostic and mechanical factors. Locked intramedullary nailing is currently used to treat pathologic femoral fractures in patients with multiple metastases when the trochanteric region or shaft is mainly involved. This study evaluates intramedullary nailing for treatment of patients with pathologic femoral fractures, focussing on complications, clinical and functional outcomes and survival rates. The series included 80 pathologic fractures treated with a titanium alloy Proximal Nail (Standard or Antirotation) or Lateral Anterograde Femoral Nail (PFN, PFNA or LAFN, Synthes) inserted in a locked static mode. Acrylic cement was used to fill the bone cavity after nail insertion in eight patients; percutaneous cementoplasty was simultaneously performed in 11 cases of severe ipsilateral acetabular osteolysis. Postoperative outcomes focussed on pain relief, postoperative mobility and quality of life and they were analysed retrospectively using QOL-ACD and ECOG. Eleven patients (13.75%) suffered from non-fatal DVT post-surgery, with no pulmonary embolism. Six patients (7.5%) developed superficial wound infections and two patients (2.5%) developed pneumonia. There was no loss of reduction, breakage, screw pull out, or hardware or implant failure that required component substitution or revision. Lung histotype and the contemporary presence of cerebral and visceral metastases appeared to be predisposing factors in reducing survival time. All patients attained satisfactory pain relief, early deambulation and a marked clinical improvement during the first 6–10 postoperative months, with gradual worsening thereafter from deterioration of their general condition due to cancer progression. The patients' survival rate was 40% at 1 year, 25% at 2 years and 15% at 3 years. Results confirm that multiple factors related to patients and primary cancer may affect survival rate after femoral fracture. Intramedullary nailing should be indicated for pathologic fractures at femoral diaphysis and metaphysis when cancer is in an advanced stage. This procedure offers good and durable stability, and enables pain relief, early postoperative mobilisation and weight-bearing, thus improving the quality of life of cancer patients.

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Introduction

The femur is the long bone most commonly affected by bone metastases, one-third of them occurring in the proximal femur, after spinal and pelvic localisations [1–6]. Because of its major load-bearing function [30], pathologic fractures of the femur seriously deteriorate the quality of life of cancer patients: most of

these fractures require surgery with a solid and durable system of fixation to achieve pain control and early restoration of full weight-bearing, regardless of the patient's predicted life span [7–9]. Pathologic fractures at femoral head, neck or distal epiphysis involving the articular surface are commonly treated with arthroplasty; fractures of the inter/sub-trochanteric area or shaft can be stabilised with an intramedullary reconstruction nail, either with or without acrylic (PMMA) cement, tumour debulking or curettage [5,8–12]. Lesions in the region of the calcar and lesser trochanter should also be stabilised surgically because of high stress concentration in those sites [1,5,8]. Besides anatomic

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localisation of the fracture, several further factors influence the surgical decision-making: number of femoral and skeletal lesions, previous radiotherapy, primary tumour and its response to irradiation, visceral metastases and estimated life expectancy [1,4,7,9,12]. The indication for surgical stabilisation of an impending fracture is at least 50% involvement of the cortex on biplanar radiography, with persistent pain after radiation or enlargement of the lesion after radiation [1,5,6,8,9]. Trends in osteosynthesis for femoral metastases shifted over the last three decades towards the use of locking intramedullary devices compared with plate fixation [2,13,14]: open curettage and plate or double-plate fixation, filling the defect with PMMA cement, is indicated for metastatic lesions involving less than half the epiphyseal or metaphyseal area. This procedure is more useful in the distal metadiaphysis than in the proximal femur, but it has an unacceptably high mechanical failure rate when metastatic progression occurs [5,8,13]. Additionally, it is easier to stabilise the entire length of the femur with a nail than with plating techniques to prevent any fractures from further tumour enlargement or non-contiguous site in the same bone [5,6,8,9,14]. Intramedullary nailing is assessed to be a safe and effective treatment option for long bone metastases and non-pathological fractures as it provides a minimally invasive stabilisation, and the procedure is commonly reproducible, which is similar to the nail insertion in traumatic fracture care [11,15,16,31–34]. The aim of this clinical study is to describe a series of pathologic femoral fractures treated with reconstruction and anterograde intramedullary nailing, assessing indications, clinical and functional outcomes, survival rate and complications related to this procedure.

Patients and methods

Records were reviewed from 80 consecutive cancer patients who underwent intramedullary nailing for metastatic femoral fractures from 2000 to 2010 at the authors' institutions in this retrospective study. The series included 42 male and 38 female patients with a mean age of 61.2 years (range 39–81). Preoperative evaluation included cancer staging with total body CT scan, alternatively bone scan or positron emission tomography (PET)-CT was conducted to ascertain the primary tumour and the presence of visceral or multiple bone metastases. Primary lesions were identified in all patients before surgery. Preoperative blood samples, chest XR and biplanar XR of the affected femur and hip were conducted before surgery and operability depended on the patient's general condition according to the Karnofsky general status scale [17]. Exclusion criteria were impending fractures, open fractures, primary bone tumours, non-unions and lesions with uncertain diagnosis. Head, neck or distal epiphyseal fractures and solitary renal cell and thyroid metastases were excluded from the series because resection and prosthetic reconstruction are recommended in these circumstances. According to Capanna and Capanacci's Classification of patients with metastases in the appendicular skeleton [8], all 80 patients belonged to Class 2. They were all able to walk before the fracture occurred. Two patients underwent simultaneous nailing for concomitant impending fractures (one on the other femur and one on the humerus), which were excluded from the series, giving a total of 80 complete femoral fractures. These were categorised according to AO Classification as intertrochanteric, subtrochanteric or mid-diaphyseal. A bone biopsy was always performed to confirm diagnosis. Tumour debulking or curettage was performed after open reduction when tumour extended widely in the soft tissues around the fracture. All patients were treated with a titanium alloy Proximal Nail (Standard or Antirotation) or Lateral Anterograde Femoral Nail (PFN, PFNA or LAFN, respectively, Synthes, USA) inserted in a locked static mode

after a closed or open reduction of the fracture. The diameter of PFN and PFNA was 10 mm, while LAFN changed from 10 to 12 mm. One screw in PFN and PFNA or two distal screws in LAFN were always inserted in a static mode. Acrylic cement was used to fill the bone cavity after PFN insertion to improve mechanical stability of the system; this was not necessary with PFNA or LAFN stabilisation because the proximal diameter of the nail was selected to fill entirely the transverse diameter of the femoral lesion. Ipsilateral acetabular osteolysis was treated simultaneously in the operating room with fluoroscopically-guided percutaneous cementoplasty according to Maccauro's criteria [18]. Antibiotic therapy with third generation cephalosporin was administered from 2 h preoperatively to the third day postoperatively. Low-dose heparin was administered from the day of admittance to 30 days postoperatively. Additional treatment regimens, such as postoperative radiation therapy or preoperative embolisation, were recorded. In addition to demographic and primary tumour data, surgical and postoperative complications, hardware failure and survival rate were investigated. Clinical outcomes focussed on pain relief, postoperative mobility, and quality of life using the Eastern Cooperative Oncology Group (ECOG) and quality of life questionnaire for cancer patients treated with anticancer drugs (QOL-ACD). All patients were evaluated at time of fracture and 1, 3, 6, 12, 24, 36 months after nailing; they were followed up for at least 3 years or until their death. Clinical and radiographic follow-up was an average 22 months (range from 1 to 48 months).

Statistics

Statistical analysis was performed using SPSS software version 16.0 (SPSS Inc.). The results obtained were analysed using the student's *t*-test and χ^2 [2] test; and verified with Fisher's exact test. Significance was accepted at $p < 0.05$. All clinical data were then correlated to histotype, presence of visceral, cerebral and bone dissemination.

Results

Clinical, demographic and surgery-related data are illustrated in Table 1. The most common primary malignancy was carcinoma of the breast (23 patients, 28.75%). Fracture was the first presentation of the primary cancer in 25 patients (31.25%). Of 80 femoral fractures, 52 (65%) occurred in the inter- and subtrochanteric region, and 28 (35%) at mid-shaft. Fifty-five patients (68.75%) had multiple bone metastases; two of them required simultaneous nailing. Visceral and cerebral lesions were present in 60 patients, with a total of 50 patients (62.5%) having concomitant multiple bone and non-osseous metastases. The intramedullary devices used were LAFN in 54 patients (67.5%), and PFN or PFNA in the remaining 26 patients (32.5%) (Fig. 1). PMMA cement was used to fill the bone cavity after nail insertion in 50% of PFN stabilisations (eight cases): five cases of diaphyseal and three of metaphyseal localisation. Ipsilateral acetabuloplasty was performed in 11 patients (13.75%) (Fig. 2a and b). The mean operative time was 102 min (range 70–140 min); the average blood loss was about 270 cc (range 200–350 cc). No patients died intra-operatively. The average length of hospitalisation was 10 days. Eleven patients (13.75%) suffered from non-fatal DVT post-surgery, with no pulmonary embolism. Six patients (7.5%) developed superficial wound infections and two patients (2.5%) developed pneumonia. There was no loss of reduction, breakage, screw pull out, or hardware or implant failure that required component substitution or revision. All patients underwent postoperative radiation therapy. Seventy-six patients had died at the time of review; with a mean survival of 10 months (maximum, 48 months). Forty-eight patients (60%) died within 12 months after surgery because

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