Case report

DOI 10.18019/1028-4427-2021-27-2-265-269

Treatment of a patient with multiple myeloma of the femur

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Introduction Multiple myeloma (MM) is a malignant tumor that causes widespread bone damage. The bone is involved in 90 % of MM patients, and 60% of patients develop pathologic fractures. **Material and methods** We report a case of combined surgical treatment and chemotherapy of a multiple myeloma patient who sustained a pathological diaphyseal fracture of the left femur and later presented with a lytic myeloma lesion in the right femur. Closed reduction and interlocking intramedullary (IM) nailing of the left femur was performed for the patient who was diagnosed with bone destruction in the shaft of the right femur a few months later. The right femur was fixed with interlocking IM nail for prophylaxis. **Results** The left femur consolidated at 6 months. The patient had no pain in the right femur, and enlargement in the bone destruction was not seen in the femur. The patient could ambulate with a cane with signs of deforming arthritis in the adjacent joints of the lower limbs. **Discussion** Three common surgical approaches used for bone tumors being complicated or not complicated by a pathologic fracture include nailing/plating, bone replacement and joint arthroplasty. Bone tumor replacement with oncological endoprostheses can be produced in specialized oncological orthopaedic units and is not available with regular trauma and orthopaedic services for different reasons. The operating orthopedic surgeon is to choose the appropriate implant to address the tumor involvement. **Conclusion** Interlocking IM nailing can be the method of choice for a pathologic fracture or for prophylactic bone fixation with appropriate indications identified with the Mirels's scoring system. Intramedullary nailing offers the advantage of minimally invasive stability for the operated limb and early weight-bearing in contrast to plate fixation treatment for fractures and prophylactic plating.

Keywords: multiple myeloma, pathologic fracture, intramedullary nailing, prophylactic bone fixation

INTRODUCTION

Multiple myeloma (MM) is a malignant tumor characterized by infiltration of the bone marrow by plasma cells that causes widespread bone damage and accompanied by pain and fractures. Multiple myeloma (MM) accounts for 1 % of all cancers and 10–13 % of all haematological malignancies. The incidence of MM in Russia is 1.7/100 000/ year. About 2 000 people get sick from the illness each year and the same number of people die [1, 2]. MM is the most malignant tumor with significant bone involvement. The bone is involved in 90 % of MM patients. Spine (49 %), skull (35 %), pelvis (34 %), ribs (33 %), humeri (22 %), femora (13 %), and mandible (10 %) are the most frequently involved locations. Eighty percent of MM patients experience bone pain. Bone pain tends to get worse with walking and is less pronounced at night. Often MM begins suddenly with sharp pain in some part of the skeleton or a spontaneous bone fracture. 60 % of patients develop pathological fractures over the course of the disease and most of them require surgical treatment. Bone lesions are osteolytic in nature and can result in nonunion after surgical treatment [3–6]. The condition involves significant medical and social components.

The **goal** was to demonstrate the effectiveness of interlocking intramedullary nailing in the treatment of a pathological fracture of the femoral shaft and preventive fixation of the contralateral femur with a lesion identified in the femoral shaft.

MATERIAL AND METHODS

A 66-year-old patient T. was diagnosed with multiple myeloma G lambda, Bence Jones lambda, diffuse focal lesion and destruction of Th1, Th3, Th4 vertebrae in 2017. The patient was treated in the hematology hospital of the Institute and received courses of polychemotherapy (Velkade-Bortezomib 3.5 mg, zometa (zolerix) 4 mg according to the VCD program). Turning in bed at night, the patient experienced a sharp pain and discovered a deformity of the left femur. Prior to this, she had pain in the

Shevyrev K.V., Voloshin V.P., Shavyrin D.A., Mitina T.A., Trifonova E.V., Martynenko D.V., Oshkukov S.A., Stepanov E.V. Treatment of a patient with multiple myeloma of the femur. *Genij Ortopedii*, 2021, vol. 27, no 2, pp. 265-269. DOI 10.18019/1028-4427-2021-27-2-265-269

left femur for several days. Radiological examination revealed a fracture in the upper third of the left femoral shaft through a lytic lesion (Fig. 1).

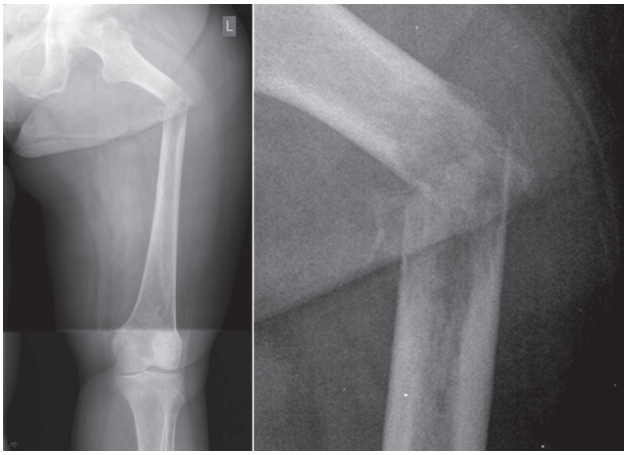

Fig. 1 Radiographs of the left femur showing a pathological fracture

A femoral universal nail was selected for implantation locking the nail in the static mode due to the isthmal location of the tumor and for early axial loading. The nail was planned to be applied without reaming the medullary canal to avoid bone marrow bleeding in a hematological patient. Tissues were not collected at reaming due to the final diagnosis made. There is also no risk of dissemination during internal fixation due to specific development of the lytic lesions. The patient underwent an emergency operation of closed reduction and intelocking nailing of the left femur without reaming the medullary canal (Fig. 2).

The patient continued receiving a course of polychemotherapy and was readmitted to the hematology department for the next course of polychemotherapy five months after the left femur had been nailed. On admission, she complained of severe pain on the anterior surface of the right femur at the gait. She reported similar pain prior to the fracture of the left femur.

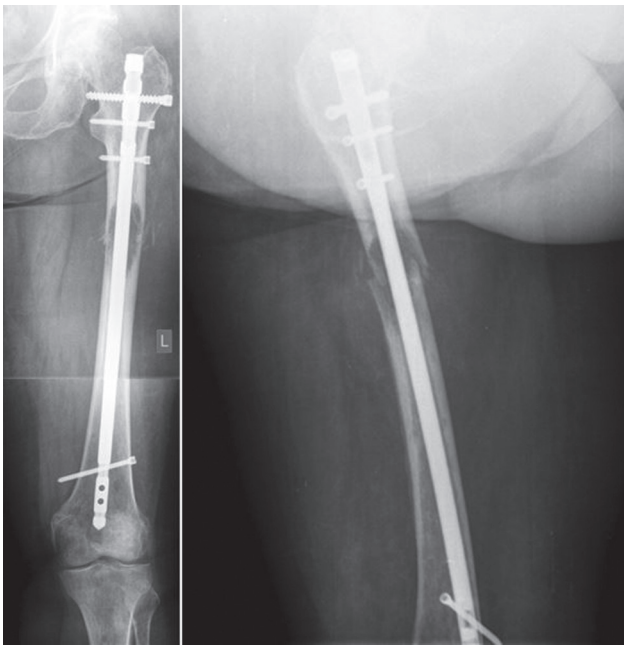

Fig. 2 Radiographs of the left femur of the patient showing the fracture nailed

Conventional radiography and computed tomography of the femur showed a lytic lesion in the middle third of the right femoral shaft and a consolidating fracture in the upper third of the left femoral shaft (Fig. 3).

The clinical scenario scored 10 on the Mirels' scale (2 for lower limb, 3 for severe pain, 3 for lytic lesion tand 2 for the size of the lesion). The pathological fracture risk is 33 % with a Mirels score greater than 9 and suggests prophylactic internal fixation. Again, medullary nailing of the right femur was selected for prophylactic internal fixation because a plate would have been unable to resist varus collapse in constrcut instability or breakage due to growing lesion and the medial bone defect. Prophylactic internal fixation was produced with interlocking nail withot reaming the medullary canal.

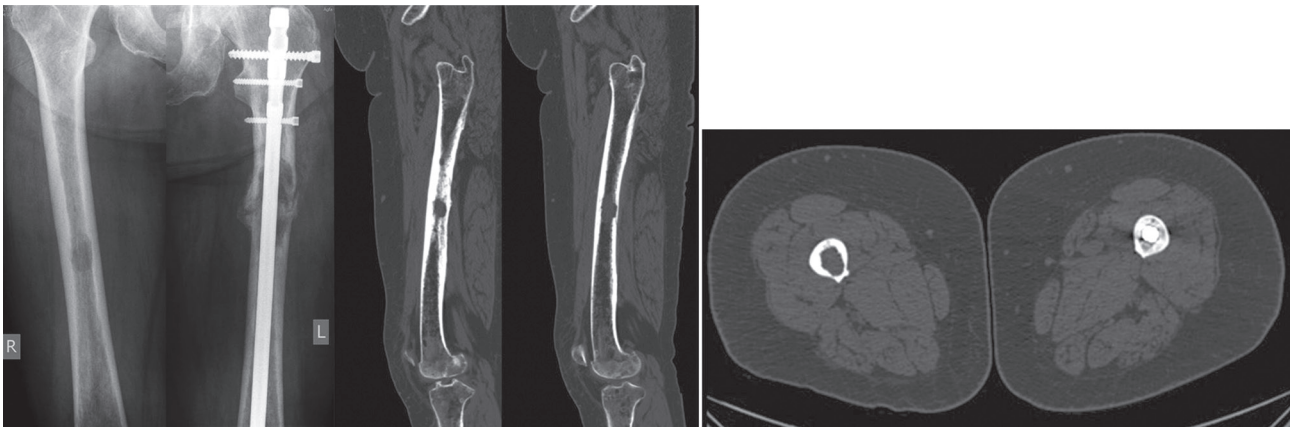

Fig. 3 Radiographs and computed tomography scans of the femurs

RESULTS

Radiographs of the left femur showed consolidation a year following the preventive fixation of the right femur. Radiographs of the right femur demonstrated neither dynamics in the size of lytic lesion of the right femur nor signs of metal construct instability (Fig. 4).

The patient could ambulate unassisted using a cane and had limited motion in the adjacent joints due to deforming arthritis of the knee and hip joints at one-year follow-up (Fig. 5).

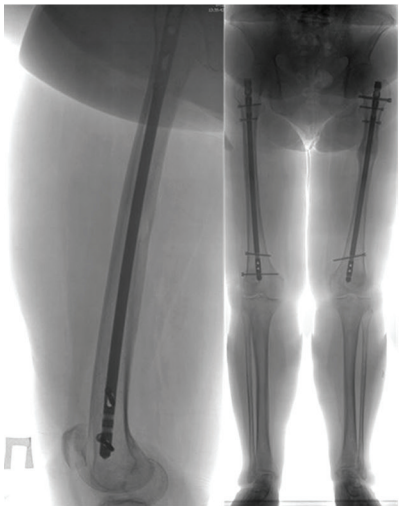

Fig. 4 Radiographs of lower limbs at one year of surgery performed for the right femur

Fig. 5 Appearance and function of joints of lower limbs at one year of the surgery performed for the right femur

DISCUSSION

The presence of a pathological fracture requires accurate identification of indications and contraindications to surgery, preoperative planning with the choice of implants and the performance. The detection of a painful bone tumor necessitates decision making on treatment strategy. Two approaches developed by Harington and Mirels are most commonly used in predicting the possibility of a metastatic fracture of long bones. A scoring system for predicting the risk of a pathological fracture through a metastatic lesion in the femur was originally developed by Harrington in 1986. Harrington criteria can be used to predict which long bone skeletal metastases are at high risk of pathological fracture and should undergo prophylactic internal fixation. He listed four criteria that could be used to predict the fracture risk of metastatic disease primarily in the femur [7]:

- cortical bone destruction > 50 %;
- a lesion > 2.5 cm in the proximal femur;
- pathological avulsion fracture of the lesser trochanter;
- functional pain despite irradiation.

Mirels developed another scoring system in 1989, which is currently widely used to predict the risk of pathological fracture. This scoring system consists of four criteria including the site (upper or lower limb), size of bone lesion, X-ray appearance and pain (Table 1) [8].

Table 1

Mirels' scoring system for pathological fracture prediction

Score	1	2	3
Site	Upper limb	Lower limb	Peritrochanteric
Pain	Mild	Moderate	Severe
X-ray appearance	Blastic	Mixed	Lytic
Size of lesion	< 1/3 Cortex	1/3–1/2 cortex	> 2/3 cortex

The system implies a minimum score of 4 and a maximum score of 12. A score greater than or equal to 9 suggests a prophylactic internal fixation. Treatment should be based on clinical judgment at 8 and conservative treatment and radiation therapy can be suggested at lower scores. Several studies have validated Mirels' scoring system, showing sensitivity and specificity to be 90 % and 35 %, respectively, and prophylactic stabilization can be questionable following initial assessment [9, 10]. Once indications to surgical treatment of bone tumor are identified, the surgeon has to choose the method and surgical treatment modalities.

Several options for surgical treatment of bone tumors and pathological bone fractures include osteosynthesis of a pathological fracture, prophylactic fixation of the bone with a tumor and replacement of a joint or bone after resection. Replacement of tumors, metastatic lesions of the bone and joints with oncological implants can be produced at a specialized oncoorthopedic department and cannot be performed in trauma and orthopedic departments for different reasons. Prophylactic internal fixation of the femur for metastatic disease was first described by Griessman in 1947. Since then, a number of case reports and studies have been published with intramedullary nailing becoming the treatment of choice for impending femoral fractures caused by metastases. Recent studies showed that patients who underwent prophylactic fixation have improved post-operative outcomes than patients who underwent fixation after pathological fracture including longer survival and shorter hospital stay [11–15]. When the distal femur is affected, plating can be used as an option to stabilize the affected part of the femur. Generally, intramedullary nails are the devices of choice for fixation as they offer more extensive stabilization of bone, a reduced risk of future fracture and a lower rate of fixation failure as opposed to plating [16–18].

Ormsby et al. reported plating as being generally reserved for pathological fractures where the use of intramedullary devices are contraindicated, such as the presence of severe medullary involvement or when an unstable metaphyseal fragments that could not be stabilized with intramedullary construct are present [19]. We were unable to find any articles comparing the prophylatic use of intramedullary nailing and plating. Based on the literature studied, there is a reason to assume that the use of intramedullary pins is more effective for the prevention of pathological fractures. However, there is currently no evidence sufficient to suggest that intramedullary nailing has apparent benefits and a greater potential for use in the pathology. Restoration/consolidation or preservation of bone integrity is the criterion for the effectiveness of a metal construct used for pathological fracture fixation or for prophylactic bone fixation.

The case presented has demonstrated the effectiveness of intramedullary nailing in the treatment and prevention of pathological fracture and lytic lesion of the femur. Intramedullary nailing used in the case was practical to restore and maintain the functionality of the patient avoiding continuous non-weight-bearing period required for plating and facilitating continuation of the treatment of the underlying disease.

CONCLUSION

Interlocking IM femoral nailing of diaphyseal myeloma can be the method of choice for a pathologic fracture or for prophylactic bone fixation with appropriate indications identified with the Mirels's scoring system. Intramedullary nailing offers the advantage of minimally invasive stability for the operated limb and early weight-bearing in contrast to plate fixation treatment for fractures and prophylactic plating.

Conflict of interests *No competing interests were disclosed.*

Funding *The authors received no specific funding for this work.*

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Received: 02.12.2020

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