

Pathological Femoral Shaft Fracture from Follicular Thyroid Carcinoma Managed with Cemented Spacer and Nailing: A Rare Case with 2-Year Follow-Up

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Abstract

Differentiated thyroid carcinoma (DTC) accounts for a small proportion of all malignancies but is among the cancers most frequently associated with bone metastasis, especially in the axial skeleton. Metastatic involvement of the appendicular skeleton is rare, and pathological fractures of the femoral shaft are even more uncommon. Follicular thyroid carcinoma (FTC), due to its angioinvasive nature, shows a markedly higher propensity for hematogenous spread to bone than papillary thyroid carcinoma. These lesions significantly impair mobility and quality of life, often necessitating surgical intervention when life expectancy is reasonable. We describe a rare case of a 45-year-old male with metastatic FTC who presented with a pathological fracture of the femoral shaft. After multidisciplinary evaluation, the patient underwent wide segmental resection of the diseased femur, followed by intramedullary interlocking nailing with polymethylmethacrylate (PMMA) cement augmentation. This strategy provided immediate structural stability, allowed early weight-bearing, and offered potential cytoreductive benefit from PMMA-induced thermal effects. Postoperative recovery was uneventful, with significant pain relief and restoration of full function within 6 weeks. At 2-year follow-up, the patient remained ambulatory without limitations, with stable local control and ongoing oncological management. This case highlights that aggressive surgical management with stable reconstruction can yield excellent functional outcomes in selected patients with metastatic FTC, particularly when presenting with pathological fractures of weight-bearing bones. Durable fixation, early mobilization, and individualized multidisciplinary planning are crucial in optimizing quality of life in advanced thyroid carcinoma with skeletal metastases.

Keywords: Follicular Thyroid Carcinoma, Bone Metastasis, Pathological Fracture, Intramedullary Nailing, Cement Augmentation

Introduction

Differentiated thyroid carcinoma (DTC) represents about 3% of all malignancies, yet it is among the five cancers most frequently associated with bone metastases. Following pulmonary spread, the skeleton is the second most common site of distant disease in DTC. Both papillary and follicular variants may metastasize to bone, though the incidence is considerably higher in follicular thyroid carcinoma (FTC), reported in 7–28% cases, compared with 1–7% in papillary thyroid

carcinoma (PTC). This difference is attributed to the greater angioinvasive tendency of FTC, facilitating hematogenous dissemination [1].

The axial skeleton, particularly the spine and pelvis, is the most frequent site of involvement, due to the rich red marrow and high vascular supply. In contrast, metastases to the appendicular skeleton are uncommon, occurring in approximately 17% of cases [2]. Many of these lesions are managed using external beam radiotherapy or radioactive iodine; however, 0.5% cases of

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thyroid carcinoma may need surgical intervention for metastatic lesions in the appendicular skeleton. Surgical options include curettage, partial or complete resection, endoprostheses, and limb sacrifice. Endoprostheses may not be suitable in all patients, considering the nature of the surgery and the lower survival rate of patients. It may be more suitable for lesions close to the joint than the diaphysis. Complete resection has shown better outcomes compared with curettage or partial resection. In aggressive lesions, the resected portion could be substantially large, requiring stabilization and fixation [3]. Management becomes especially challenging when presenting with a fracture, as the resulting disability usually necessitates surgery, unless risks outweigh benefits.

Herein, we report a rare case of femur shaft metastasis presenting as a pathological fracture in a patient with advanced follicular carcinoma. The case was managed successfully with segmental resection, intramedullary interlocking nail fixation with cement augmentation, allowing immediate weight-bearing and excellent 2-year follow-up.

Case Report

A 45-year-old male presented to the casualty with complaints of pain in the left thigh and inability to walk following a trivial trauma. He also reported a long-standing history of progressive neck swelling that was overlooked for the past 8 years. Eight months prior, the swelling was diagnosed as follicular carcinoma of the thyroid on histopathological examination, and the patient was started on lenvatinib.

On examination, there was a firm, non-tender, irregular swelling over the neck measuring approximately $15 \times 10 \times 10$ cm, with poorly defined margins. Examination of the left thigh revealed diffuse swelling, marked tenderness, and loss of transmitted movements, raising suspicion of an underlying fracture. The limb was temporarily immobilized in a splint, and plain radiographs confirmed a pathological fracture of the femoral shaft, showing irregular margins (Fig. 1).



Figure 1: X-ray on presentation.

As part of his thyroid carcinoma workup, a whole-body positron emission tomography-computed tomography (PET-CT) performed 1 month before presentation showed pulmonary metastases but no avid uptake in the femoral lesion; consequently, targeted bone scan/CT staging of the limb was not performed as PET did not demonstrate skeletal uptake. This was discussed in the multidisciplinary team and deemed reasonable given the negative PET findings. Magnetic resonance imaging of the left thigh showed no abnormalities beyond the fracture site, while CT of the head and neck revealed the thyroid mass compressing the trachea and left brachiocephalic vein (Fig. 2).

Given the airway compromise and functional disability, a multidisciplinary team approach was adopted. With an anticipated 5-year survival exceeding 90%, the objective was to achieve durable stability, early mobilization, and minimal morbidity. A single-stage procedure was planned.

Under general anesthesia, with the patient in the lateral position, an intraoperative frozen section biopsy from the fracture margins confirmed invasive follicular carcinoma. Wide resection of the diseased femoral segment and surrounding tissue was performed until tumor-free margins were obtained. The excised specimen measured approximately $14 \times 7 \times 5$ cm, creating a defect in the shaft (Fig. 3).

A proximal femoral nail of appropriate length, measured against the contralateral side, was selected, inserted across the defect, and locked distally. Traction was applied to the distal fragment to restore limb length, and the nail was locked proximally (Fig. 4). The defect was then filled with polymethylmethacrylate (PMMA), providing structural stability and a local cytotoxic effect (Fig. 5). The resected specimen was sent for histopathological confirmation.

The procedure was uneventful. Postoperatively, radiograph was done and physiotherapy was initiated based on pain tolerance (Fig. 6). The VAS which was 8/10 preoperatively had reduced



Figure 2: Pre-operative magnetic resonance imaging.



Figure 3: Intraoperative image of resected mass.



Figure 4: Defect after proximal femoral nail insertion with restoration of length.

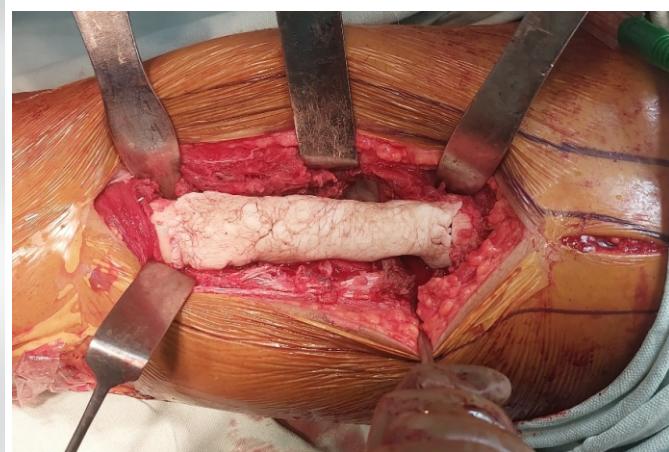


Figure 5: Defect filled with polymethylmethacrylate.



Figure 6: Post-operative radiograph.

to 2/10. He was allowed immediate weight-bearing, achieved full range of motion within 6 weeks, and resumed independent activities of daily living. The resected specimen showed metastatic FTC composed predominantly of microfollicular and trabecular architecture with colloid-deficient follicles. There was clear evidence of vascular invasion. Tumor cells were positive for thyroglobulin and thyroid transcription factor-1 on immunohistochemistry. Resection margins were reported as free of tumor on final histology. At 2-year follow-up, he remains ambulatory without functional limitations in the operated limb. He demonstrated objective size control under lenvatinib and is currently undergoing adjuvant external beam radiotherapy to the neck as part of local control. Systemic oncological follow-up is ongoing under the treating oncology unit.

Discussion

Bone metastases from DTC are relatively rare but significantly impact morbidity and survival. FTC demonstrates a greater tendency for skeletal spread than PTC due to its angioinvasive nature. The axial skeleton is the commonest site, while

appendicular metastases are infrequent, and pathological fractures of the femoral shaft are particularly uncommon. These lesions are challenging to treat, as they impair mobility and are often resistant to conservative measures.

Non-operative management carries substantial morbidity including prolonged immobilization, persistent pain, loss of independence, and very limited functional recovery in displaced pathological femoral fractures; thus, in patients with reasonable life expectancy, operative stabilization remains the cornerstone [4, 5]. Various options include curettage, endoprostheses, and segmental resection with fixation. Curettage carries high recurrence rates, while endoprostheses, though durable, is less suitable for diaphyseal involvement. Endoprosthetic reconstruction is generally reserved for periaricular or metaphyseal lesions where joint replacement is required. For mid-diaphyseal femoral shaft lesions, segmental endoprostheses would necessitate complex, morbid surgery with significant bone resection and soft-tissue sacrifice, and is therefore not considered a suitable option in most midshaft pathological fractures. Segmental resection with intramedullary

fixation and cement augmentation provides stability, allows immediate weight-bearing, and offers good functional outcomes. Filling the diaphyseal defect with PMMA provides immediate structural fill and increases construct stiffness by converting a segmental defect into a continuous load-bearing column. PMMA interlocks with the remaining trabeculae and distributes load around the nail, reducing bending and shear stresses on the implant. Cement also improves the purchase of the interlocking device in osteolytic bone and allows earlier weight-bearing compared with fixation without augmentation. In addition, PMMA generates local hyperthermia during polymerization which may contribute to local tumor cytoreduction.

In the present case, complete resection with intramedullary nailing and cement reconstruction resulted in excellent pain relief, early mobilization, and durable long-term outcome. Possible complications such as wound infection, deep infection/osteomyelitis, cement-related thermal injury to surrounding tissues, cement leakage or embolization (pulmonary cement embolus), peri-implant fracture, implant failure or loosening, non-union at bone–cement interfaces, thromboembolic events, and need for future revision surgery were monitored for and not observed during the 2-year follow-up in this patient.

The success highlights the role of aggressive surgical intervention in select patients with advanced thyroid carcinoma and bone metastasis.

Conclusion

Pathological femoral fractures due to metastatic FTC are rare and demand individualized management. Resection with intramedullary nail fixation and cement augmentation provides durable stability, facilitates immediate weight-bearing, and ensures a satisfactory functional outcome. A multidisciplinary approach is crucial in tailoring treatment according to survival expectancy and disease burden. Our case emphasizes that in selected patients, aggressive local control with stable reconstruction can significantly improve quality of life, even in advanced thyroid carcinoma with bone metastases.

Limitations

We acknowledge that a single-case design limits generalizability and that longer oncological follow-up is valuable to determine recurrence and systemic progression. However, the rarity of femoral shaft pathological fractures from FTC justifies reporting individual cases to inform clinical practice. While a longer follow-up is desirable, 2 years is a relevant duration for reporting durable orthopedic outcomes, early implant performance, and functional recovery.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

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