

## **Limb-Salvage and Reconstruction with MUTARS Modular Endoprosthesis for Proximal Femoral Chondrosarcoma: A Case Report**

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**Abstract-Background:** Chondrosarcoma is a malignant cartilage-producing bone tumor that most commonly affects the pelvis and proximal long bones in adults. Owing to its relative resistance to chemotherapy and radiotherapy, wide surgical resection remains the treatment of choice. Reconstruction following proximal femoral resection presents a significant challenge, and modular tumor endoprostheses have become an important limb-salvage option.

**Case presentation:** A 52-year-old male presented with a 3-month history of progressive swelling in the proximal right thigh associated with discomfort and intermittent numbness exacerbated by prolonged sitting. The patient had no significant medical comorbidities. Physical examination revealed a palpable soft-tissue mass in the proximal femoral region that was soft on palpation, without overlying skin changes. Imaging studies demonstrated a large osteolytic lesion in the proximal femur with an extraosseous extension into the surrounding soft tissues. A diagnosis of chondrosarcoma was established after biopsy and histological evaluation. The patient underwent wide en bloc resection of the proximal femur and involved soft tissues followed by limb-salvage reconstruction using a modular MUTARS proximal femoral endoprosthesis and total hip arthroplasty. Postoperatively, the patient achieved satisfactory functional recovery without early complications.

**Conclusion:** Proximal femoral chondrosarcoma remains a challenging condition requiring adequate wide resection to achieve local tumor control. Limb-salvage surgery with wide resection and reconstruction using a modular MUTARS proximal femoral endoprosthesis represents an effective treatment option, providing satisfactory early functional outcomes while preserving the affected limb.

**Keywords—** Chondrosarcoma; proximal femur; limb-salvage surgery; wide resection; modular tumor prosthesis;

### **1. INTRODUCTION**

Chondrosarcoma is a malignant cartilage-producing neoplasm and the second most common primary malignant bone tumor after osteosarcoma, accounting for approximately 20–30% of all malignant bone neoplasms<sup>1</sup>. It is a heterogeneous group of tumors characterized by the production of hyaline cartilage matrix and most commonly affects

adults between the fourth and seventh decades of life, with a slight male predominance. Based on its origin, chondrosarcoma may arise *de novo* as a primary tumor or develop from pre-existing benign cartilaginous lesions such as enchondromas or osteochondromas. According to anatomical location, it is classified as central (intramedullary), peripheral, or juxtacortical. Conventional central chondrosarcoma is the most common subtype, representing approximately 85% of all cases. Histological grade is one of the most important prognostic factors, influencing the risk of local recurrence, metastatic spread, and overall survival. The tumor most frequently occurs in bones formed through endochondral ossification, particularly the pelvis, proximal femur, proximal humerus, distal femur, and ribs. The proximal femur is among the most commonly involved sites and presents unique therapeutic challenges because of its weight-bearing function and its close relationship to the hip joint and surrounding neurovascular structures. Patients typically present with nonspecific symptoms such as localized pain, swelling, restricted joint motion, or a palpable mass. The onset of symptoms is often insidious, progressing over several months before diagnosis. In more advanced cases, cortical destruction, soft-tissue extension, neurological symptoms caused by local compression, or pathological fractures may occur. Imaging plays a fundamental role in the diagnosis, staging, and surgical planning of chondrosarcoma.<sup>2</sup> Conventional radiography is usually the initial imaging modality and may reveal an intramedullary osteolytic lesion with characteristic chondroid matrix mineralization, commonly described as punctate, ring-and-arc, or “popcorn” calcifications. Additional findings suggestive of malignancy include endosteal scalloping, expansion of the medullary cavity, cortical thinning or destruction, and extension into adjacent soft tissues. Endosteal scalloping involving more than two-thirds of the cortical thickness is considered particularly suspicious for chondrosarcoma. Computer tomography provides superior assessment of cortical involvement, matrix mineralization, and extraosseous tumor extension, making it valuable for defining local tumor extent. Magnetic resonance imaging is indispensable for local staging and operative planning, allowing accurate evaluation of intramedullary tumor spread, soft-tissue invasion, and the relationship of the lesion to adjacent neurovascular structures. Conventional chondrosarcoma typically demonstrates low-to-intermediate signal intensity on T1-weighted sequences and high signal intensity on T2-weighted images due to the high water content of the cartilaginous matrix. Following contrast administration, septal or diffuse enhancement patterns may be observed depending on tumor grade. Accurate staging is essential for treatment planning and prognostic assessment. The Musculoskeletal Tumor Society (MSTS/Enneking) classification remains one of the most widely used staging systems in orthopedic oncology. It categorizes malignant bone tumors according to histological grade, local extent, and metastatic status. Stage I tumors are low-grade malignancies and are subdivided into intracompartmental (IA) and extracompartmental (IB) lesions. Stage II tumors are high-grade malignancies and are similarly divided into intracompartmental (IIA) and extracompartmental (IIB) lesions. Stage III includes tumors of any grade that have developed regional or distant metastases. In addition, the AJCC TNM classification is frequently used for prognostic stratification. MRI is essential for evaluating local tumor extent and soft-tissue involvement, while chest computed tomography is routinely performed to exclude pulmonary metastases, the most common site of distant spread. Unlike osteosarcoma and Ewing sarcoma, conventional chondrosarcoma

demonstrates relative resistance to chemotherapy and radiotherapy, which makes surgical treatment the method of choice in most cases.

We present a case of a 52-year-old male patient with proximal femur chondrosarcoma who we diagnosed and treated with wide surgical resection and reconstruction with a modular tumor endoprosthesis.

## 2. Clinical case

### Clinical presentation

A 52-year-old male presented with a 3-month history of progressive swelling in the proximal right thigh accompanied by discomfort and intermittent numbness, which was aggravated by prolonged sitting. The patient denied previous trauma, constitutional symptoms, or significant medical comorbidities.

Physical examination revealed a palpable mass in the proximal femoral region. The lesion was soft in consistency, mildly tender on deep palpation, and showed no overlying skin changes, erythema, or signs of local inflammation. Neurovascular examination of the affected extremity was unremarkable, apart from subjective intermittent paresthesia reported by the patient.

### Management and outcome

An incisional biopsy was initially performed through a lateral approach to the proximal femur. Histopathological examination confirmed a periosteal grade I chondrosarcoma. Following multidisciplinary evaluation, the patient was scheduled for definitive surgical treatment.

Wide surgical resection was performed under spinal anesthesia through a lateral approach to the proximal femur<sup>3</sup>. After mobilization of the surrounding musculature and hip joint exposure, a proximal femoral osteotomy was carried out. Intraoperatively, the tumor was identified posteromedially, extending into the region of the iliopsoas and adductor musculature. En bloc excision of the lesion, together with the involved soft tissues, was achieved with tumor-free margins.

Reconstruction was subsequently performed using a modular MUTARS-type proximal femoral endoprosthesis. Following implantation, a polyethylene attachment tube was applied to facilitate soft-tissue reconstruction, and the detached abductor, adductor, and vastus lateralis muscles were reattached using nonabsorbable sutures.

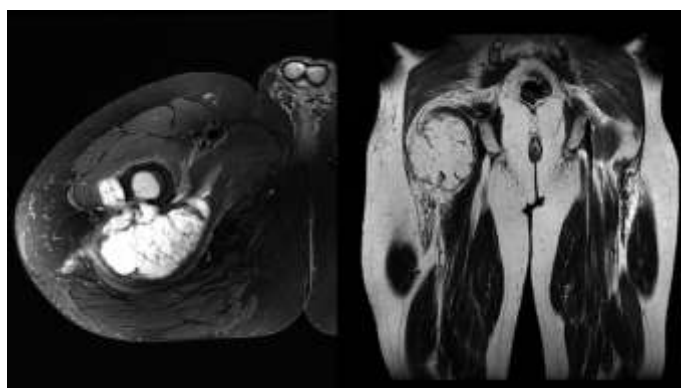
Histopathological analysis of the resected specimen confirmed complete excision with negative surgical margins. The postoperative course was uneventful, and the patient underwent an early intensive rehabilitation program. At the first follow-up 1 month postsurgery, there were no signs of local recurrence and no complications were noted. Limb functionality was assessed with the MSTS (Musculoskeletal tumor society) scoring system. Our patient had a MSTS score of 16 or 53% indicating satisfactory results at the 1 month follow-up.

## 3. DISCUSSION

Wide surgical excision/resection with negative margins remains the golden standard of treatment in patients with chondrosarcoma and the most important determinant of local disease control. Advances in orthopedic oncology have enabled limb-salvage



**Figure 1.** Plain radiographs of the right hip joint(anteroposterior and lateral views) demonstrated a large osteolytic lesion involving the intertrochanteric and subtrochanteric regions.



**Figure 2.** Magnetic resonance imaging demonstrated a large proximal femoral lesion with extensive extraosseous soft-tissue extension. On coronal images, the tumor occupied the proximal femur, involving the intertrochanteric region and extending into the adjacent medial soft tissues. The lesion exhibited a lobulated appearance, characteristic of a cartilaginous neoplasm, with cortical disruption and a substantial extraosseous component.



**Figure 3.** Intraoperative picture of the en bloc resected specimen.



**Figure 4.** Intraoperative resected segment with the tumor and involved tissues and post-operative radiograph of the modular prosthesis

procedures to replace amputation in the majority of patients. Modular tumor endoprostheses have become the most popular option for reconstruction in these patients as they provide good functionality, preservation of limb length and early mobilization.

In our case reconstruction was carried out with a proximal femur MUTARS endoprosthesis (WITTENSTEIN intens GmbH, Igersheim, Germany). This type of implant is individually planned for every case and has seen increased usage in Bulgaria. Reported functional results with the MUTARS endoprosthesis are generally positive. Yordan Ivanov et al. report for good functional results in their series of 6 pediatric patients with Ewing's sarcoma that underwent reconstruction with a MUTARS endoprosthesis. Functionality was assessed with the MSTS (Musculoskeletal tumor society) scoring system. Reported average MSTS score was 62% 1 month postsurgery and 72% at 12 months postsurgery (Ivanov, Y.; Patrikov, K.; Slavchev, S.; Andreev, A. **Our Experience With the Modular Universal Tumour and Revision System in Pediatric Patients With Ewing's Sarcoma – Report of Six Cases. C. R. Acad. Bulg. Sci. 2023, 76, 302-308.**)<sup>4</sup>. Similar results were reported in another recent study of 14 patients with different primary malignant bone tumors, that had reconstruction with MUTARS type endoprosthesis, where the mean MSTS score was 70% (Ivanov YS, Tsenkov T. **Functional results after reconstruction with modular tumor endoprostheses in patients with malignant bone tumors. Folia Med (Plovdiv). 2023;65(1):80-86.**)<sup>5</sup>.

Complications after reconstruction with modular tumor endoprosthesis are usually severe and often require additional surgical treatment for their management. A large case series from Ivanov et al. report an overall complication rate of 72% after limb salvage surgery for musculoskeletal malignancies (Ivanov YS, Patrikov K. **Complications after limb salvage surgeries for musculoskeletal malignancies: 10-year experience of the main sarcoma center in Bulgaria. Folia Med (Plovdiv). 2024;66(1):35-40**)<sup>6</sup>. In their series a total of 32 patients had endoprosthetic reconstruction, as 25 of them had 1 or more complications during the follow-up period. Encountered complications are usually split into two groups – mechanical and non-mechanical. The former are usually more common and consist of wound complications, aseptic

loosening and implant failure. Wound complications have a literature reported incidence of up to 43% and depend on several factors like preoperative radiotherapy, tumor size and location, and present comorbidities. Aseptic loosening is reported as a late complications with an incidence of 2 to 48%. Its most commonly connected with the type of implant fixation and stem diameter. Structural failure which consists of implant fracture or wear and tear, has a reported literature incidence between 5 and 16% in MUTARS type endoprosthesis. An interesting complication from this type was reported by Ivanov et al., which was a failure of the expanding mechanism in a pediatric patient with a MUTARS expanding endoprosthesis. Local recurrence is a devastating non-mechanical complication with an incidence of 2 to 10%, which is highly dependent on the surgical margin status especially in patients with chondrosarcoma. The other type of non-mechanical complication is infection. Occurrence rates vary in different series and are generally between 5 to 20%. Both of these non-mechanical complications usually require one or more revision surgeries for their management and in some cases would require radical treatment.

A delay in the diagnosis often decreases the chances for patients to be eligible for limb salvage surgery. The problem with delayed diagnosis in Bulgaria was recently highlighted by Ivanov et al. who report a mean diagnostic delay of 182 days in patients with Ewing's sarcoma (Ivanov YS, Ivanov IV, Atanasova-Ivanova KA. **Assessing diagnostic delay in Ewing sarcoma: A single tertiary center analysis. *Folia Med (Plovdiv)*. 2025;67(4):10.3897/folmed.67.e153324**)<sup>7</sup>. Chondrosarcoma is reported to have the longest diagnostic delay among primary bone tumors (Ciechanowicz D, Kotrych D, Starszak K, et al. **Delay in Diagnosis and Treatment of Bone Sarcoma-Systematic Review. *Cancers (Basel)*. 2025;17(6):981. Published 2025 Mar 14. doi:10.3390/cancers17060981**)<sup>8</sup>. Currently there are no available studies about the epidemiology or diagnostic delay of this entity in Bulgaria. Research in this area will no doubt lead to better results in the treatment of these patients.

#### 4. Conclusion

Proximal femoral chondrosarcoma presents a significant therapeutic challenge due to its local aggressiveness and the complex anatomy of the hip region. This case demonstrates that limb-salvage surgery can achieve effective oncological control when combined with meticulous preoperative planning and wide tumor resection with negative surgical margins. Reconstruction using a modular MUTARS proximal femoral endoprosthesis and total hip arthroplasty allowed preservation of the affected limb while restoring stability and facilitating early rehabilitation. Modern endoprosthetic reconstruction therefore represents a reliable treatment option for selected patients with proximal femoral chondrosarcoma, offering satisfactory functional outcomes without compromising oncological principles.

## 5. REFERENCES

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