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Rare primary intraosseous neurofibroma of the distal femur: a case report and comprehensive literature review

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Case Report

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Rare primary intraosseous neurofibroma of the distal femur: a case report and comprehensive literature review

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Abstract

Background Neurofibromas are common benign nerve sheath tumors, presenting either as sporadic solitary neoplasms or as multifocal lesions closely linked to pathogenic variants of the NF1 gene. Primary intraosseous involvement is exceedingly rare, particularly in long bones, due to the paucity of myelinated nerves within the medullary cavity.

Case report We report a rare primary intraosseous neurofibroma located in the distal femur of a 29-year-old woman. Magnetic resonance imaging (MRI) depicted a well-demarcated 17 × 12 × 25 mm lesion in the medial femoral condyle. Histopathological analysis identified a spindle cell proliferation that was diffusely positive for S-100 and SOX-10, but negative for epithelial membrane antigen (EMA). Concurrent peripheral blood genetic testing detected no pathogenic or likely

pathogenic variants in *NF1*, *NF2*, or *SPRED1*. Combined morphological, immunohistochemical, and molecular analyses confirmed the diagnosis of a sporadic, solitary intraosseous neurofibroma. Owing to its clear oncological margins, the tumor underwent en bloc excision, with subsequent osseous reconstruction using a synthetic bone substitute. This report details the diagnostic evaluation, surgical management, and postoperative clinical course, noting an absence of complications or tumor recurrence over a nine-month follow-up period. Along with detailing the surgical intervention and favorable postoperative trajectory, we conducted a comprehensive, non-systematic literature review. By incorporating 17 historical cases with our present report, we establish a comprehensive cohort of 18 patients to elucidate the characteristics of this uncommon osseous tumor. The observed distribution of these cases is predominantly concentrated within the craniofacial (77%) and spinal (11%) regions, implying a potential pathophysiological link to the distinct neural anatomy. To the best of our knowledge, our case is the first documented case of neurofibroma located in the distal femur.

Conclusions This report enriches the clinical literature by expanding the known anatomical spectrum of skeletal neurofibromas to the appendicular skeleton and offering a successful surgical treatment strategy**.** By highlighting this atypical presentation, we emphasize the inclusion of neurofibroma in the differential diagnosis of solitary osteolytic femoral lesions and advocate for a multidisciplinary diagnostic approach.

Keywords Intraosseous neurofibroma; Distal femur; Bone tumor; Case report; Immunohistochemistry;

Background

Neurofibromas are histologically complex, benign neoplasms of the peripheral nerve sheath. While Schwann cells are widely recognized as the primary tumorigenic driver, the tumor microenvironment is inherently heterogeneous. In accordance with current World Health Organization (WHO) classifications, these lesions comprise a dense admixture of Schwann cells, perineurial hybrid cells, and intraneural fibroblasts**[1]**. Clinically, neurofibromas may develop as isolated sporadic masses or as multifocal lesions. The latter represents a hallmark of neurofibromatosis type 1 (NF1), an inherited tumor predisposition syndrome caused by loss-of-function mutations in the NF1 tumor suppressor gene (17q11.2). The resulting deficiency in

neurofibromin, a critical RAS GTPase-activating protein that deregulates neuronal signal transduction and facilitates aberrant cellular proliferation**[2-4]**. Because neurofibromas exhibit a near-exclusive tropism for soft tissue compartments, their denovo development within the skeletal microenvironment is an exceptional anatomical anomaly**[5]**. The emergence of primary intraosseous neurofibromas disrupts standard diagnostic algorithms and significantly complicates therapeutic decision-making. Highlighting this rare pathological deviation, we report an atypical presentation of a primary intraosseous neurofibroma localized to the distal femur. To contextualize this unusual clinical entity, we integrate our findings with a comprehensive literature review and comparative analysis. By defining the radiologic and histopathologic hallmarks of skeletal neurofibromas, this study establishes these tumors as a critical consideration in the differential diagnosis of solitary osteolytic femoral lesions. Furthermore, we outline an evidence-based, multidisciplinary framework required for the definitive diagnosis and optimal clinical management of such cases.

Case presentation

Patient information and clinical findings

In October 2025, a 29-year-old female presented to Zhanjiang Central Hospital of Guangdong Medical University with pain in the distal left femur. Physical examination showed no features of neurofibromatosis (café-au-lait macules). Given the equivocal findings from initial radiography and magnetic resonance imaging, a core needle biopsy was conducted for histological diagnosis, incorporating immunohistochemical evaluation for S-100 and SOX-10. Concurrently, targeted next-generation sequencing (Illumina NovaSeq 6000, USA) of peripheral blood was utilized to screen for pathogenic or likely pathogenic variants in the *NF1*, *NF2*, and *SPRED1* genes (**Figure S1**). Following definitive surgical resection, the excised tissues were further assessed immunohistochemically for S100 protein (Kit-0007, 1:100), epithelial membrane antigen (EMA; Kit-0011, 1:70), and SRY-box transcription factor 10 (SOX-10; RMA-0726, 1:50). All primary antibodies were purchased from Fuzhou Maixin Biotechnology Development Co., Ltd. (Fuzhou, China). The patient's postoperative course was monitored via serial radiographic evaluations at 1, 3, and 9 months. The patient was informed that relevant clinical data of this case would be submitted for publication, and written informed consent was obtained from the patient.

Diagnostic assessment, therapeutic intervention and follow-up

Preoperative MRI images revealed a well-demarcated 17 × 12 × 25 mm lesion within the medial condyle, abutting the anterior cortex. Axial fat-suppressed proton density-weighted imaging (FS-PDWI; **Figure 1a**) showed a markedly hyperintense lesion abutting the anterior cortex, which was thinned and focally interrupted, together with a small joint effusion, and coronal FS-PDWI (**Figure 1b**) confirmed its confinement to the medial condyle. On the contrast-enhanced sagittal fat-saturated post-contrast T1WI, (**Figure 1c**) the lesion enhanced markedly and heterogeneously, with non-enhancing internal septa. Sagittal FS-PDWI (**Figure 1d**) delineated the multilocular architecture and the anteroposterior dimension of the lesion, and the unenhanced sagittal T1WI (**Figure 1e**) showed homogeneous hypointensity throughout, with no high-signal focus to suggest intralesional fat or hemorrhage. No perilesional bone marrow edema, cortical sclerosis, periosteal reaction or discrete extraosseous soft-tissue mass was identified. These features indicated a benign, slow-growing fibromatous lesion, and percutaneous core needle biopsy was therefore performed for histological confirmation (**Figure 3a–c**).

Initial histopathological evaluation of the biopsy core revealed a fascicular proliferation of spindle cells harboring eosinophilic cytoplasm and elongated nuclei (**Figure 3d-e**). Immunohistochemically, these neoplastic cells exhibited diffuse positivity for S-100 (**Figure 3f-g**) and SOX-10 (**Figure 3h-i**), corroborating a Schwannian/neurogenic lineage. Following surgical excision, the resected tumor tissues were subjected to comprehensive morphological and immunohistochemical profiling. H&E staining of the whole specimen validated the initial spindle cell morphology and notably lacked any distinct plexiform architecture (**Figure 4a-b**). Furthermore, the surgically excised tissue demonstrated strong and diffuse S-100 expression (**Figure 4c-d**), whereas epithelial membrane antigen (EMA) reactivity was absent (**Figure 4e-f**). Collectively, these findings effectively exclude a perineurial origin.

To evaluate potential syndromic associations, peripheral blood sequencing was conducted. No pathogenic or likely pathogenic variants (SNVs, indels, or CNVs) capable of explaining the phenotype were detected in the *NF1*, *NF2*, or *SPRED1* genes (**Table 2 and Figure S1**), making neurofibromatosis type 1 and Legius syndrome unlikely. Integrating the congruent molecular-pathological data with the absence of clinical stigmata (e.g., café-au-lait macules) and a negative family history, these findings support the classification of the lesion as a sporadic, solitary

intraosseous neurofibroma.

The tumor was resected en bloc, and the resulting osseous defect was reconstructed with a synthetic bone substitute. Postoperative radiography verified complete tumor removal (**Figure 2c-d**). Following an unremarkable recovery, the patient was discharged. Serial follow-ups at one (**Figure 2e-f**), three (**Figure 2g-h**), and nine (**Figure 2i-j**) months revealed robust osseous healing and preserved articular integrity, alongside progressive biodegradation of the synthetic graft indicative of active physiological remodeling. From the patient's perspective, she expressed high satisfaction with the diagnostic clarity and the surgical intervention, noting significant pain relief and a smooth functional recovery over the post-treatment period.

Timeline. The clinical course spanned approximately 12 months: the patient first presented in October 2025; plain radiography, magnetic resonance imaging, CT-guided core needle biopsy and peripheral blood molecular testing were completed during the following weeks; surgical resection with reconstruction of the osseous defect was then performed; and structured follow-up visits were held at 1, 3 and 9 months after surgery (**Figure 2c-j**).

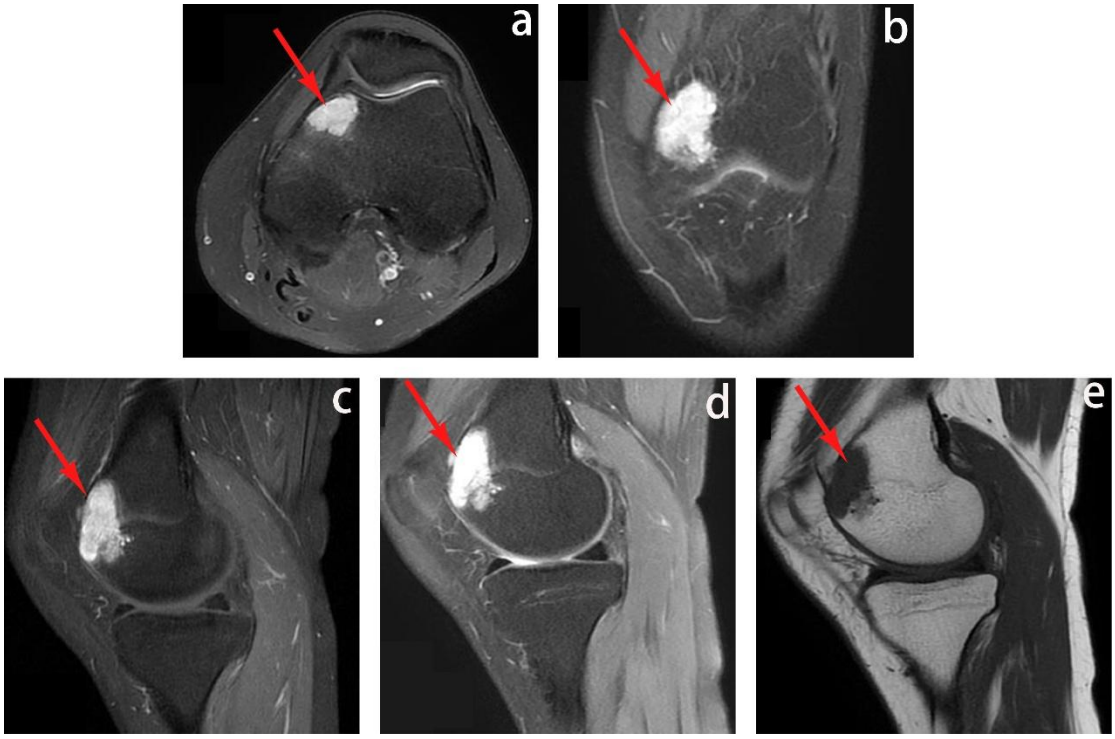


Fig. 1 Preoperative MRI images. **(a)** fat-suppressed proton density-weighted imaging (FS-PDWI); **(b)** oblique coronal FS-PDWI; **(c)** oblique sagittal contrast-enhanced fat-suppressed T1-weighted image; **(d)** sagittal FS-PDWI ; **(e)** sagittal unenhanced T1-weighted image. Red arrows indicate the lesion.

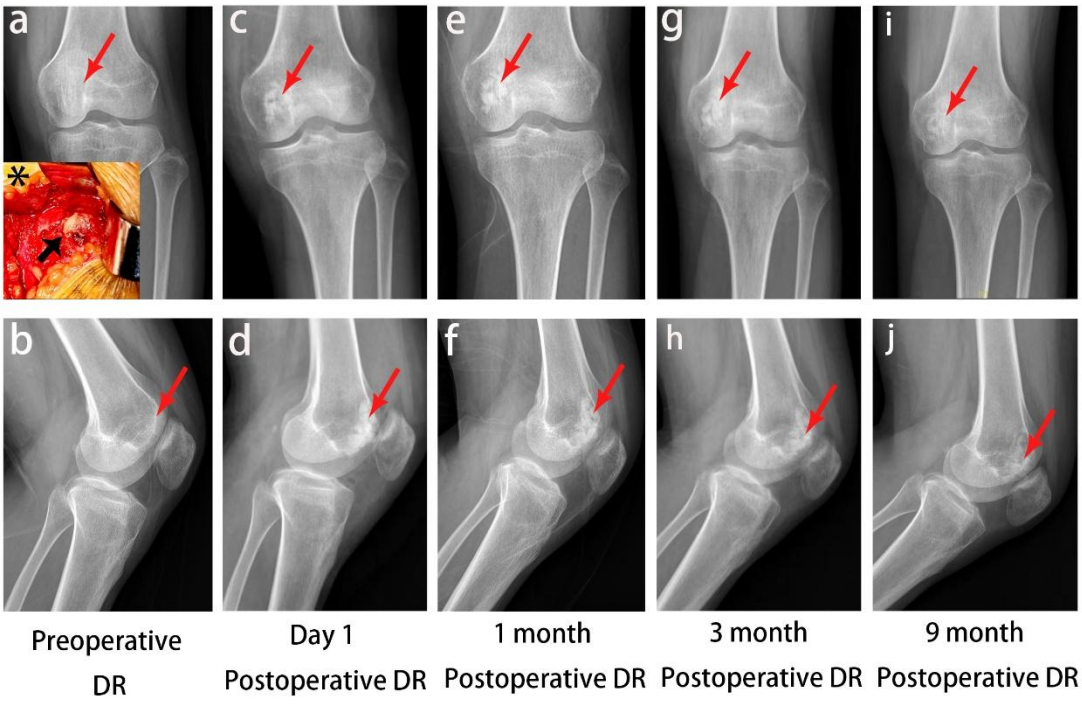


Fig. 2 Intraoperative photographs and comparative preoperative and postoperative follow-up X-ray imaging data **(*)** Intraoperative view of the knee surgical area. Intraoperatively, the tumor was located in the medial femoral condyle with well-defined boundaries, presenting a soft, grayish-white. **(a)** Anteroposterior preoperative and (red arrows indicate the preoperative lesion area of the knee joint). **(b)** Lateral preoperative and (red arrows mark the postoperative therapeutic area of the knee lesion). **(c-d)** DR radiograph of the knee at postoperative day 1, **(e-f)** DR radiograph of the knee at 1 month postoperatively, **(g-h)** DR radiograph of the knee at 3 months postoperatively,and **(i-j)** DR radiograph of the knee at 9 months postoperatively. (red arrows indicate the postoperative lesion site of the knee joint)

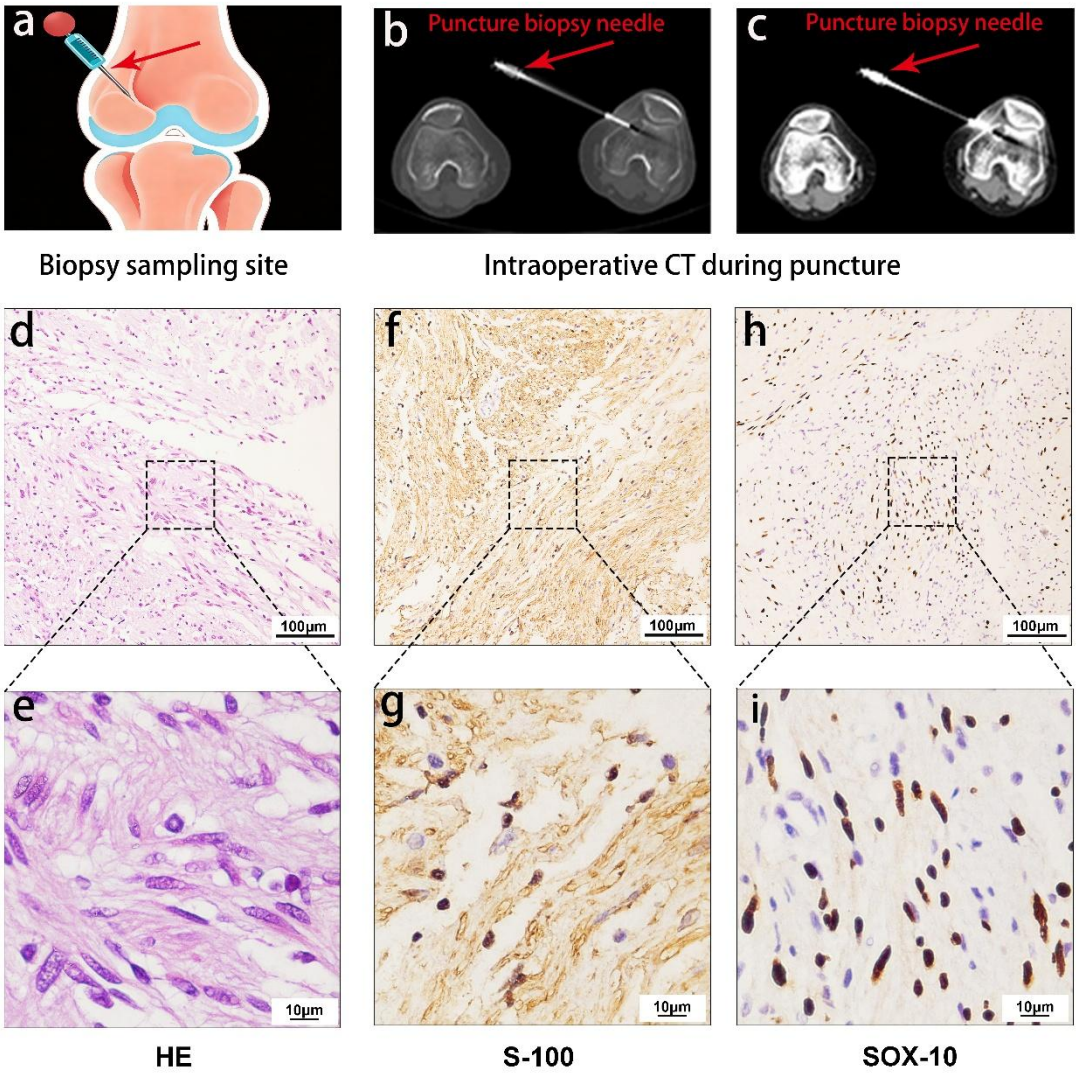


Fig. 3 Intraprocedural CT images during puncture biopsy and histopathological and immunohistochemical images. **(a-c)** Intraoperative CT images acquired during puncture biopsy, with red arrows indicating the position of the biopsy needle. **(d-e)** Hematoxylin and eosin (HE) staining shows proliferative spindle-shaped tumor cells.**(f-i)** Immunohistochemical staining demonstrates diffuse positive expression of S-100 protein and positive SOX-10 immunoreactivity.

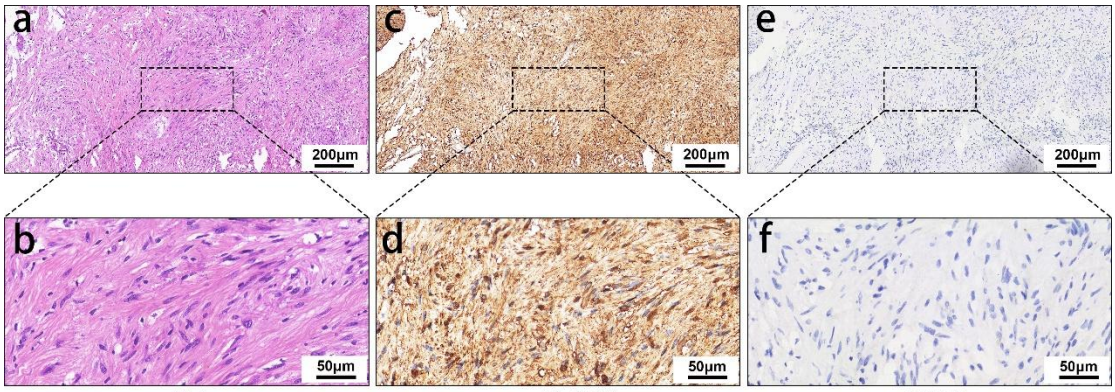


Fig. 4 Histopathological and immunohistochemical images of surgically-collected specimens. (a) H&E staining showing spindle cells with eosinophilic cytoplasm and slender nuclei without prominent clustering, consistent with neurofibroma. (c) Immunohistochemical staining displaying strong S100 positive staining, confirming neurogenic origin. (e) EMA negative staining, excluding epithelial-derived tumors.(Panels b, d, and f represent high-magnification views of a, c, and e, respectively).

Discussion

Neurofibroma is a benign neoplasm originating from Schwann cells and peripheral fibroblasts, as well as mesenchymal cells that constitute the nerve sheath. Owing to the abundant nerve innervation in the head and neck region, this anatomical site is most frequently involved, commonly affecting the trigeminal nerve and upper cervical nerves. These tumors predominantly arise in superficial soft tissues, such as the tongue, buccal mucosa, gingiva, salivary glands, and palatal soft tissues. Given the relative paucity of myelinated nerve fibers and of well-defined nerve sheaths within the medullary cavity, primary intraosseous neurofibromas are exceedingly rare **[5]**. To the best of our knowledge, this represents the first reported case of a neurofibroma involving the distal femur. To confirm this rare diagnosis, we utilized a comprehensive approach combining multimodal imaging, genetic testing, and immunohistochemical staining.

To date, scarcely more than a dozen cases of intraosseous neurofibroma have been documented globally **(Table 1)**. The vast majority of these lesions localize to the maxillofacial and craniofacial skeleton, a spatial predilection driven by the dense peripheral innervation of adjacent anatomical niches, including the tongue, salivary glands, and oral mucosa. In stark contrast, primary neurofibromas originating within the appendicular skeleton are exceptionally rare.

Clinically, intraosseous neurofibromas often follow an initially indolent course. However, progressive osteolytic expansion and subsequent mass effects can eventually induce localized pain,

edema, or functional impairment **[3, 5]**. In the present case, a 29-year-old woman presented with isolated focal pain in the distal left femur. Crucially, the absence of an *NF1* family history and syndromic cutaneous stigmata, coupled with negative next-generation sequencing (NGS) profiling for *NF1*, *NF2*, and *SPRED1* variants, definitively confirmed the sporadic nature of this lesion. Diagnostically, while plain radiographs are standard for initial evaluation, their utility is limited by non-specific features that overlap with diverse benign osseous or cystic pathologies. Accordingly, initial radiography in this patient localized the defect to the medial femoral condyle but lacked pathognomonic details. In contrast, magnetic resonance imaging (MRI) serves as the optimal modality for characterizing these tumors, offering superior delineation of anatomic boundaries and soft-tissue interfaces**[5, 6]**. Our MRI analysis demonstrated a well-circumscribed mass exhibiting T1-weighted hypointensity, fat-suppressed T2-weighted hyperintensity, and marked heterogeneous contrast enhancement without extraosseous invasion. This multiparametric imaging signature is highly consistent with the established radiological profile of benign intraosseous neurofibromas**[3]**.

Primary intraosseous neurofibromas typically present with non-specific clinico-radiological manifestations, frequently resulting in diagnostic ambiguity during initial evaluations. Consequently, establishing a definitive diagnosis relies entirely on integrated histopathological and immunophenotypic analyses. In the present case, morphological assessment revealed an interlacing proliferation of bland spindle cells characterized by elongated, wavy nuclei. Crucially, the structural absence of a plexiform architecture effectively excluded an NF1-associated plexiform neurofibroma. Immunohistochemically, the neoplastic cells exhibited diffuse reactivity for S-100 and SOX-10, substantiating Schwannian differentiation and confirming a neurogenic lineage. Furthermore, the lack of epithelial membrane antigen (EMA) expression specifically precluded perineurial differentiation and epithelial-derived neoplasms, thereby refining the differential diagnosis among osseous spindle-cell lesions.

Complete surgical extirpation with negative margins remains the cornerstone of therapeutic management for resectable skeletal neurofibromas, with the definitive operative approach dictated by tumor volume, localized expansion, and proximity to neighboring neurovascular or articular structures **[5]**. Structurally, these neoplasms are characterized by their unencapsulated nature; the absence of a true fibrous capsule presents an intrinsic surgical hazard, driving local recurrence rates as high as 30% if marginal clearance is compromised **[3]**. In the present case, the lesion was

localized within the medial condyle of the distal femur, measuring 17 mm × 12 mm × 25 mm. Preoperative mapping verified well-demarcated boundaries without structural infiltration into the adjacent knee joint architecture or the nearby neurovascular bundles. This favorable anatomical compartmentalization permitted a meticulous, complete local excision, with postoperative imaging confirming total resection of the mass.

Solitary, non-syndromic intraosseous neurofibromas carry an excellent overall prognosis and a minimal baseline risk of malignant transformation (2%-5%). This clinical trajectory stands in stark contrast to NF1-associated variants, which exhibit a pronounced propensity for transformation into highly aggressive malignant peripheral nerve sheath tumors (MPNSTs) **[3, 5]**. The present lesion was pathologically classified as a solitary entity, lacking any atypical mitotic features, necrosis, or cellular pleomorphism suggestive of malignancy. Although the postoperative course (1-9 month) remains entirely disease-free, the biological unpredictability of unencapsulated nerve sheath tumors mandates continuous, long-term clinical and radiological surveillance.

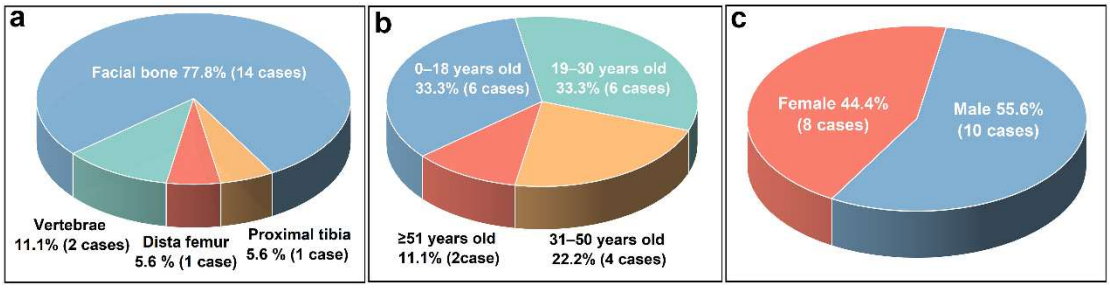


Fig. 5 Clinical characteristics of patients with intraosseous neurofibroma. **(a)** Anatomical distribution. The maxillofacial region (zygomatic bone, maxilla, and mandible) accounted for the majority of cases (14 cases, 77.8%). The vertebrae (2 cases, 11.1%), proximal tibia (1 case, 5.6%), and dista femur (1 case, 5.6%) were rare sites. **(b)** Age distribution. The largest proportion was patients aged 0–18 years (children and adolescents; 6 cases, 33.3%), followed by those aged 19–30 years (young adults; 6 cases, 33.3%), 31–50 years (middle-aged adults; 4 cases, 22.2%), and ≥51 years (elderly patients; 2 cases, 11.1%). **(c)** Gender distribution. Male patients accounted for 55.6% (10 cases), and female patients for 44.4% (8 cases).

The present case report summarizes and analyzes the previous cases that clinical distribution characteristics of primary intraosseous neurofibromas (**Table 1**). In terms of anatomical site, the facial zygomatic bone, maxilla, and mandible account for 77.8% of cases (**Figure 5a**), representing the predominant affected sites. This finding indicates a striking predilection for maxillofacial bones. To our knowledge, the current report describes the only identified case of primary intraosseous

neurofibroma arising in the distal femur in a young female, presenting unique features in both patient age and anatomical location. This case further enriches the clinical data regarding this rare entity in the long bones of the extremities.

Regarding age distribution(**Figure 5b**), intraosseous neurofibroma showed a wide age range, with a predominance in adolescents and young to middle-aged adults. The highest proportion was observed in patients aged 0–18 years (33.3%) and 19–30 years (33.3%), followed by those aged 31–50 years (22.2%), and patients aged 51 years and older (11.1%). These findings indicate that the tumor mostly occurs during the growth, development, and young adult periods, although it can also arise in elderly patients.In terms of gender distribution (**Figure 5c**), the male-to-female ratio was nearly equal, with male patients accounting for 55.6% and female patients for 44.4%. This result differs from some previous viewpoints and suggests that intraosseous neurofibroma has no significant gender predilection.

Limitations of this study warrant consideration. First, the nine-month follow-up is relatively short, requiring longer surveillance to confirm long-term outcomes and recurrence rates. Second, despite negative genetic testing, the precise cellular origin and embryonic mechanisms of long-bone intraosseous neurofibroma remain unclear.

Conclusion

To date, the clinical and biological landscape of appendicular intraosseous neurofibromas remains poorly defined. This report details the first documented instance of a primary neurofibroma localizing to the distal femur in a young adult. This presentation diverges from the only previously recorded tibia case, thereby expanding the known demographic and anatomical heterogeneity of these skeletal neoplasms. Given this phenotypic variability, clinicians must maintain a high index of suspicion for atypical nerve sheath tumors, extending beyond classic maxillofacial loci to include appendicular osteolytic lesions. Because unusual anatomical sites and non-specific radiological signatures frequently confound early detection, definitive diagnosis and optimal intervention rely implicitly on a multidisciplinary paradigm that integrates orthopedic oncology, musculoskeletal radiology, and molecular pathology. While margin-negative surgical excision remains the therapeutic cornerstone for local control, establishing multi-institutional registries and pursuing comprehensive genomic profiling will be crucial to deciphering the underlying pathogenesis of these rare bone tumors and standardizing their long-term management.

Table 1 Summary of Reported Intraosseous Neurofibroma Cases

No.	Reference	Age/Sex	Lesion Site	Core Imaging Feature	Treatment	Short-Term Follow-up Outcome
1	Present case	29/F	Left distal femoral medial condyle	17×12×25mm, Osteolytic lesion, Multilocular osteolytic lesion with cortical thinning and heterogeneous enhancement	Complete surgical resection	No recurrence
2	Dudhe S et al. [2]	12/M	Left mandible	Expansile osteolytic lesion with homogeneous enhancement	Hemimandibulectomy	No recurrence
3	Kamalakaran A et al. [3]	5/M	Right mandibular angle & ramus	Mixed-density expansile bony lesion	Segmental mandibulectomy + reconstruction	No recurrence at 1 year
4	Shi H et al. [1]	37/F	Right zygomatic bone	Benign bony expansile lesion	3D-guided en bloc resection + PEEK implant	No recurrence at 12 months
5	Guo L et al. [5]	22/M	Left maxillary hard palate	Unilocular radiolucent lesion	Complete tumor enucleation	No recurrence at 9 months
6	Rahyussalim AJ et al. [6]	40/M	T9 vertebral body	Solid vertebral lesion involving neural foramen	Total spondylectomy + reconstruction	Pain relief, mild intermittent backache
7	Papageorge [7]	4.5/M	Right mandibular ramus	Unilocular well-defined radiolucency	Complete resection + autologous bone graft	No recurrence at 1 year
8	Sharma et al. [8]	5/M	Right maxillary alveolus	Homogeneous soft-tissue mass	Complete mucosal-sparing resection	No recurrence at 1 year
9	Iwai C et al. [9]	30/M	C6 vertebral body	Osteolytic vertebral lesion encasing vertebral artery	Staged tumor resection + spinal fusion	No recurrence at 2 years, bony fusion achieved
10	Sikkimath BC et al. [10]	19/M	Left mandibular body	Unilocular cystic expansile lesion	Tumor curettage + neurolysis	No recorded recurrence
11	Huang GS et al.[11]	22/M	Left proximal tibia	Osteolytic lesion with sclerotic border	Curettage + bone grafting post-fracture	No recurrence at 3 year

No.	Reference	Age/Sex	Lesion Site	Core Imaging Feature	Treatment	Short-Term Follow-up Outcome
12	Iqbal et al. [12]	13/M	Right mandibular body	Ill-defined radiolucency with cortical perforation	Biopsy followed by complete resection	New bone formation, mild local paresthesia
13	Gujjar et al. [13]	28/F	Left mandible	Homogeneous radiopaque lesion involving mandibular canal	Segmental mandibulectomy	No recurrence at 1 year
14	Tao et al. [14]	16/F	Left mandible	Multilocular honeycomb bony destruction	Tumor resection + iliac bone graft	Normal mouth opening, no recurrence
15	Jangam et al. [15]	62/F	Bilateral mandible	Diffuse radiolucency with pathological fracture	Bilateral mandibulectomy + fibula free flap	No recurrence at 2 years, satisfactory function
16	Behrad et al. [16]	32/F	Left mandible	Unilocular radiolucent lesion with cortical expansion	Complete surgical resection	No postoperative recurrence
17	Zhang et al. [17]	37/F	Right mandibular body	Unilocular hypodense lesion with root resorption	Tumor resection + tooth extraction	No recurrence at 9 months, persistent lip numbness
18	Silva et al. [18]	60/F	Right posterior mandible	4 cm unilocular radiolucent lesion	Marginal mandibulectomy + enucleation	Satisfactory recovery, prosthetic rehabilitation planned

Table 2 Sequencing results of NF1, NF2, and SPRED1

SNV/Indel (Single-Nucleotide Variant and Small Insertion/Deletion Variant)							
Gene	Chromosomal Location	Variant Information	Zygosity	Disease Name	Inheritance Mode	Variant Origin	Variant Classification
None							
Copy Number Variation (CNV)							
Chromosomal Band	Variant Type	Relevant Genes in Region	Associated Disease		Variant Origin	Variant Classification	
None							
SNV/Indel (Single-Nucleotide Variant and Small Insertion/Deletion Variant)							
Gene	Chromosomal Location	Variant Information	Zygosity	Disease Name	Inheritance Mode	Variant Origin	Variant Classification
None							
Large-Fragment Copy Number Variation (CNV)							
Chromosomal Band	Variant Type	Relevant Genes in Region	Associated Disease		Variant Origin	Variant Classification	
None							
Other Variants Only Partially Associated with the Subject's Clinical Phenotype							
Gene	Chromosomal Location	Variant Information	Zygosity	Disease Name	Inheritance Mode	Variant Origin	Variant Classification
None							

Abbreviations

MRI	Magnetic Resonance Imaging
T1WI	T1-weighted imaging
T2WI	T2-weighted imaging
FS-PDWI	fat-suppressed proton density-weighted images (FS-PDWI)
DR	Digital Radiography
HE	Hematoxylin and Eosin
MPNSTs	Malignant Peripheral Nerve Sheath Tumors
NF1	Neurofibromatosis type 1
CT	Cone Beam Computed Tomography
MRA	Magnetic Resonance Angiography

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Not applicable.

Authors' contributions

QX, YL and LP participated in data collection, analysis and study design. YL, LP, QX, SS and YZ drafted the manuscript. YL, LP, WZ and YZ interpreted the data. All authors have read and approved the final version of the manuscript.

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Data availability

The targeted next-generation raw sequence data for NF1, NF2 and SPRED1 in this paper have been deposited in the NCBI Sequence Read Archive under BioProject PRJNA1553444 (SRA study SRP750903; runs SRR41460747 and SRR41460748; BioSample SAMN64539021) and can be accessed directly at https://www.ncbi.nlm.nih.gov/bioproject/PRJNA1553444. All other de-identified clinical, radiological and histopathological data supporting the findings of this study are presented within the article and its Supplementary Information files; any additional raw data are available from the corresponding author upon reasonable request, subject to approval by the Institutional Review Board of Central People's Hospital of Zhanjiang.

Ethics

This study was conducted in full accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments. The Clinical Research Ethics Committee (Institutional Review Board) of Zhanjiang Central Hospital, Guangdong Medical University, Zhanjiang, Guangdong, China confirmed that formal ethical approval was not required, because the study was a retrospective analysis of data generated during routine clinical care, involved no additional intervention or deviation from standard practice, and used only de-identified data with the patient's written informed consent. These procedures strictly align with the Declaration of Helsinki and the Ethical Review Measures for Life Science and Medical Research Involving Human

Subjects promulgated by the National Health Commission of the People's Republic of China (2023).
Clinical trial number: not applicable”

Consent to participate

Written informed consent to participate in this study was obtained from the patient.

Consent to publish

Written informed consent for publication of this case report and any accompanying images was obtained from the patient.

Competing interests

The authors declare no competing interests.

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