Joint Diseases and Related Surgery

Jt Dis Relat Surg
2025;36(2):467-471

CASE REPORT

A rare cause of knee pain: Multiple intraosseous lipomas mimicking bone metastasis

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ABSTRACT

Intraosseous lipomas (IOLs) are rare benign bone tumors which can closely mimic malignancy on imaging, leading to diagnostic challenges. A 34-year-old male patient was admitted with persistent knee pain which was initially suspected to be metastatic bone disease. The patient reported activity-related pain relieved by rest. Physical examination revealed mild tenderness without swelling or restricted motion. Laboratory findings, including serum calcium and inflammatory markers, were normal. Magnetic resonance imaging (MRI) showed hyperintense lesions in the tibial and femoral metaphyses with surrounding bone marrow edema, raising suspicion of malignancy. Bone scintigraphy revealed increased radionuclide uptake in the tibial tuberosity, iliac crest, and the ninth rib, further mimicking metastatic disease. A biopsy of the tibial lesion confirmed mature adipocytes without necrosis or atypia, diagnosing IOLs. The patient was managed conservatively with non-steroidal anti-inflammatory drugs and physiotherapy. At three months, symptoms resolved completely, with no recurrence or new complaints. Follow-up MRI confirmed lesion stability. In conclusion, this case highlights the diagnostic complexity of IOLs and emphasizes the need for multimodal imaging and histopathological confirmation to differentiate benign lesions from malignancies. Including IOLs in the differential diagnosis of unexplained bone pain can prevent unnecessary invasive procedures and mistreatment.

Keywords: Bone neoplasms, diagnostic imaging, histopathology knee pain, lipoma.

Intraosseous lipomas (IOLs) are rare benign bone tumors, constituting less than 0.1% of all primary bone tumors. These lesions primarily consist of mature adipose tissue and are often incidentally discovered during imaging for unrelated conditions.[1,2] Commonly affected sites include the metaphyses of long bones such as the femur, tibia, and fibula.[3] While typically asymptomatic, IOLs may occasionally cause localized bone pain, particularly in the presence of bone stress, necrosis, or secondary changes such as calcification or fibrosis.[4]

The clinical significance of IOLs lies in their potential to closely mimic malignant bone lesions, particularly metastases, in imaging studies. Magnetic resonance imaging (MRI) is the preferred modality for evaluating fat-containing lesions, as it provides detailed tissue characterization. However, in cases where bone marrow edema accompanies these lesions, distinguishing IOLs from aggressive malignancies becomes challenging.[5] Similarly, bone scintigraphy, a commonly employed tool for detecting metastases, may show increased tracer uptake in benign IOLs, further complicating the diagnostic process.[6]

Despite advancements in imaging techniques, the definitive diagnosis of IOLs requires histopathological confirmation, as their atypical imaging features can overlap with those of malignant bone conditions. These tumors may exhibit areas of fibrosis, necrosis, or calcification, which further obscure accurate diagnosis.[7] Moreover, computed tomography (CT), which is

Received: October 14, 2024
Accepted: January 22, 2025
Published online: April 05, 2025

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Doi: 10.52312/jdrs.2025.2017

Citation: Betigul Meral H, Agirman M. A rare cause of knee pain: Multiple intraosseous lipomas mimicking bone metastasis. Jt Dis Relat Surg 2025;36(2):467-471. doi: 10.52312/jdrs.2025.2017.

underutilized in the diagnostic evaluation of IOLs, provides valuable complementary information by quantifying fat content and excluding other primary bone malignancies.[8]

In this article, we report a rare case of multiple IOLs which was initially suspected to have metastatic bone disease due to inconclusive imaging findings. This report underscores the diagnostic challenges posed by IOLs, emphasizing the importance of a multimodal approach, combining advanced imaging techniques with histopathological evaluation, to achieve an accurate diagnosis and avoid unnecessary invasive interventions.

CASE REPORT

A 34-year-old male presented with a one-week history of progressive left knee pain following a football match. The patient denied any history of trauma, systemic symptoms, or prior malignancy. The pain was localized to the lateral aspect of the knee, exacerbated by weight-bearing, and alleviated with rest. Physical examination revealed mild tenderness over the lateral knee without visible swelling, erythema, or restricted range of motion. Neurovascular function was intact. Routine laboratory tests, including serum calcium, alkaline phosphatase, and inflammatory markers, were within normal limits. These findings excluded metabolic, infectious, or systemic inflammatory conditions as potential causes of the patient's symptoms. On MRI, T1-weighted sequences revealed hyperintense lesions in the tibial and femoral metaphyses, consistent with fat-containing tissue (Figure 1). Fat-suppressed sequences showed surrounding bone marrow edema, raising suspicion for malignancy. Late-phase bone scintigraphy demonstrated increased radionuclide uptake in the left tibial tuberosity, iliac crest, and the ninth rib, mimicking metastatic disease (Figures 2 and 3). The combination of MRI findings and bone scintigraphy results created significant diagnostic ambiguity, necessitating further investigation.

A biopsy was performed on the tibial lesion to establish a definitive diagnosis. Histopathological analysis revealed mature adipose tissue without evidence of necrosis, atypia, or malignancy, confirming the diagnosis of IOL.

The patient received conservative treatment, including non-steroidal anti-inflammatory drugs (NSAIDs) for pain relief and a personalized physiotherapy regimen to restore knee function and alleviate symptoms. Over the course of three months, the patient reported a significant reduction in symptoms, with complete resolution of pain by the end of the follow-up period.

Follow-up MRI at three months demonstrated no new lesions or changes in the existing lipomas, reinforcing the benign nature of the condition.

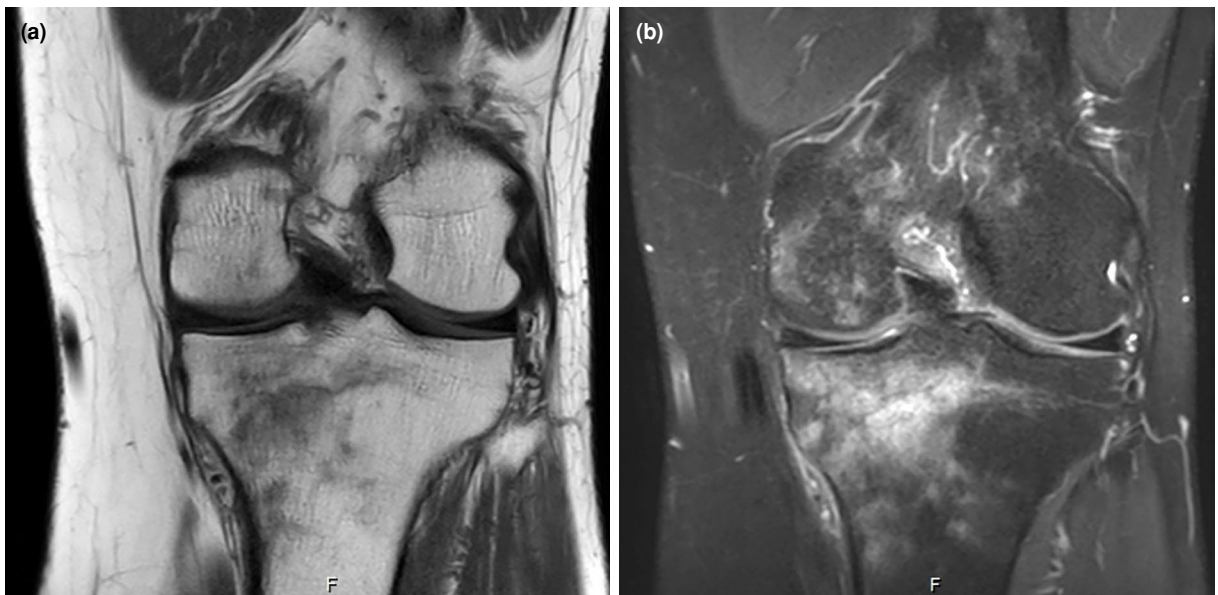

FIGURE 1. Coronal MRI images **(a)** T1-weighted turbo spin echo and **(b)** fat-suppressed proton-density sequence showing bone marrow edema in the tibial metaphysis.
MRI: Magnetic resonance imaging.

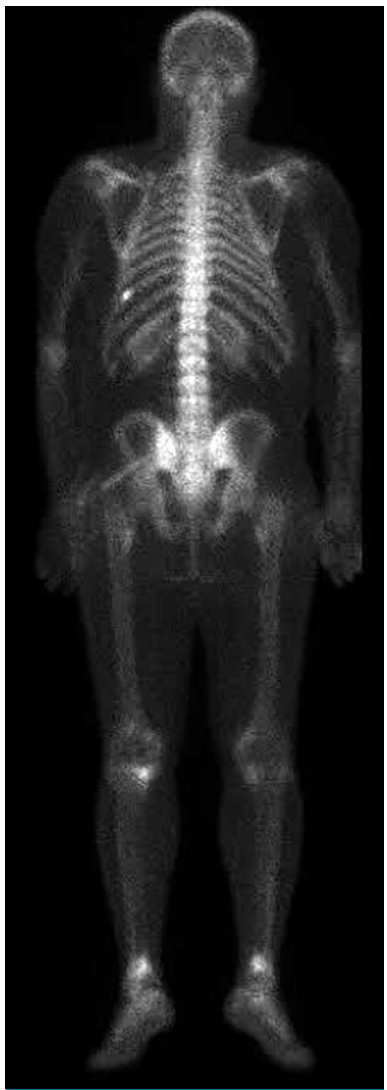

FIGURE 2. Bone scintigraphy images demonstrate increased radionuclide uptake in the left tibial tuberosity and 9th rib, which initially mimicked metastatic bone disease.

These findings confirmed the benign nature of the lesions and supported the initial diagnosis. The patient remained symptom-free, with no recurrence or additional complaints reported during subsequent clinical evaluations. A written informed consent was obtained from the patient.

DISCUSSION

Intraosseous lipomas present a broad differential diagnosis, encompassing conditions such as bone infarcts, unicameral bone cysts, aneurysmal bone cysts, chondromyxoid fibromas, fibrous dysplasia, osteoblastoma, giant cell tumors, liposclerosing myxofibrous tumors (LSMFTs).[9] Their potential to closely mimic malignant bone lesions on imaging underscores the importance of precise diagnostic differentiation, as this remains a significant challenge in clinical practice.[10] Diagnosing an IOL solely with a simple X-ray can be challenging. However, the presence of a well-defined osteolytic bone lesion with intralesional calcification, often known as the Cockade sign, can provide a helpful indication.[11] With the advancement of CT and MRI technologies, the characteristics of the lesion can be assessed without the need for biopsy or surgical removal.[5,12] Currently, MRI remains the preferred imaging modality for identifying fat-containing lesions, as it accurately characterizes their composition. However, as in our case, the presence of bone marrow edema complicates the diagnosis by mimicking aggressive lesions and often necessitates further investigation.[13] Similarly, bone scintigraphy, frequently used for assessing metastatic disease, may yield false-positive results in benign conditions such as IOLs due to increased radionuclide uptake. This underscores the critical role of histopathological confirmation in achieving an accurate diagnosis.[14]

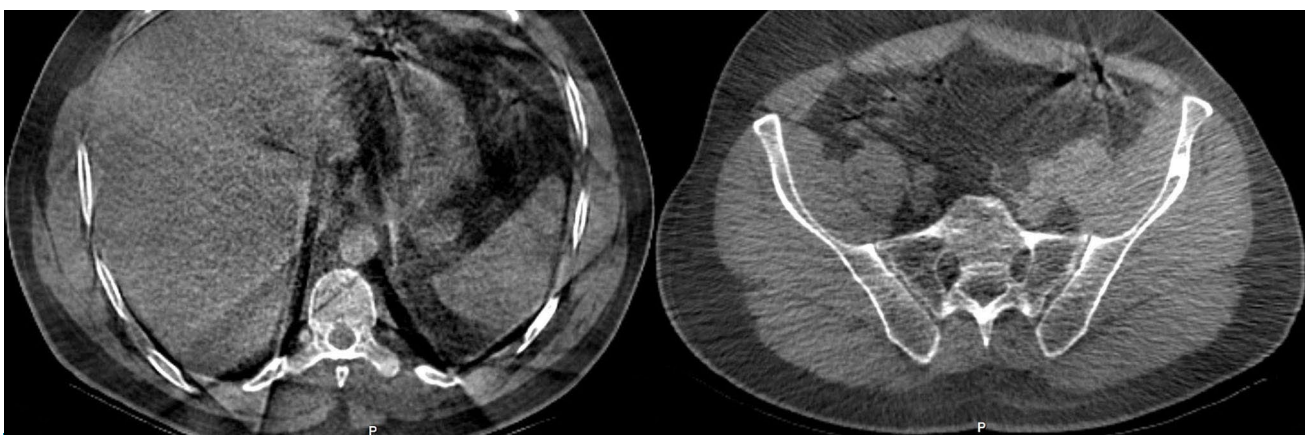

FIGURE 3. SPECT scans showing hyperdense lesions in the iliac crest and posterior 9th rib without cortical destruction.

Histopathologically, IOLs consist of mature adipose tissue but may show secondary changes, such as fibrosis, necrosis, or calcification. These features form the basis of Milgram's classification, which classifies IOLs into three stages based on the extent of necrosis and calcification.[15,16] In this case, histopathological analysis confirmed the presence of mature adipose tissue without necrosis or atypia, consistent with the diagnostic characteristics described in the literature. These findings underscore the importance of histopathological evaluation as the gold standard, particularly in cases with ambiguous imaging findings.[17] In our case, CT was not utilized, although it remains a valuable imaging modality for assessing fat-containing bone lesions. Of note, CT can accurately quantify fat density using Hounsfield units (typically ranging from −110 to −40 HU for fat) and detect subtle calcifications or cortical changes which may not be apparent on MRI. Integrating CT findings with MRI can enhance diagnostic accuracy, particularly in differentiating IOLs from primary bone malignancies or metastatic lesions.[18]

What distinguishes this case is the presence of multiple IOLs, a rare presentation in the literature. Most studies focus on single lesions, while the management of multiple IOLs remains less explored. The occurrence of multiple IOLs in a young adult with no prior history of malignancy highlights the variability in IOL presentations and underscores the need to expand the diagnostic framework to include such atypical presentations.[19]

Furthermore, IOLs are typically asymptomatic and progress slowly, often managed conservatively with a "watch and see" strategy. However, surgical intervention may be indicated in cases where the lesion causes significant pain, enlarges, or leads to complications such as pathological fractures.[20] Surgical options include curettage of the lesion, with or without filling the cavity with bone grafts, or substitutes such as hydroxyapatite or polymethylmethacrylate cement.[21] Resection or prophylactic internal fixation may also be required in lesions with high fracture risk. These approaches aim to stabilize the affected bone and alleviate symptoms, though conservative management remains the preferred approach in most cases, as demonstrated in this patient.

The complete resolution of symptoms in this case through NSAIDs and physiotherapy demonstrates the efficacy of a non-invasive approach. However, the presence of multiple lesions necessitates careful long-term monitoring to evaluate the risk of symptom development or complications. This underscores the importance of developing clinical guidelines for the management of multiple IOLs.[18]

This case adds to the limited body of literature on multiple IOLs, which are exceedingly rare compared to solitary lesions. A review of similar cases revealed that most reports describe solitary lesions in older adults, typically in the calcaneus or femur.[3,22] The occurrence of multiple lesions in a young adult, as seen in this case, highlights the need for clinicians to consider IOLs in the differential diagnosis even in atypical presentations.[23] Compared to prior reports, the use of multimodal imaging and biopsy in this case provided a definitive diagnosis while avoiding unnecessary invasive interventions.

This case highlights the diagnostic complexities of IOLs, particularly in scenarios where imaging findings mimic metastatic disease. While MRI and bone scintigraphy are essential tools, their limitations call for a multimodal diagnostic approach incorporating CT and histopathological confirmation. Increased utilization of CT in the diagnostic process may reduce dependence on invasive procedures, expedite diagnosis, and improve patient outcomes.[8]

Moreover, this report emphasizes the importance of including IOLs in the differential diagnosis of unexplained bone pain, particularly in younger patients. The imaging characteristics of IOLs often overlap with those of metastatic lesions, reminding clinicians to consider benign etiologies even when imaging findings are concerning. Addressing these diagnostic challenges contributes to the growing body of literature on IOLs and highlights the need for further research into their etiology, progression, and optimal management.[14] Exploring the genetic and molecular basis of IOLs may also offer insights into their pathogenesis and aid in developing non-invasive diagnostic tools.

In conclusion, this case underscores the importance of integrating clinical, radiological, and histopathological findings in diagnosing IOLs. In addition, it advocates for a multimodal diagnostic approach and emphasizes the need to develop comprehensive guidelines for the evaluation and management of multiple IOLs. Future research should focus on exploring the molecular and genetic underpinnings of IOLs to enhance diagnostic accuracy and minimize the necessity for invasive procedures.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Idea/concept, data collection and/or processing, literature review, writing the article, references and fundings: H.B.M.; Design, analysis and/or interpretation: H.B.M., M.A.; Control/supervision, critical review: M.A.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

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