Osteoid Osteoma Detected by Ultrasound: A Case report and Literature review

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Abstract-Background: Osteoid osteoma is a benign osteogenic tumor typically presenting with nocturnal pain relieved by nonsteroidal anti-inflammatory drugs. Although computed tomography is the gold standard for diagnosis, early lesions may be difficult to detect.

Case presentation: An 8-year-old female presented with persistent nocturnal ankle pain responsive to oral NSAIDs. Radiography and CT showed subtle cortical irregularity of the distal tibia without clear identification of a nidus. Ultrasound demonstrated a well-defined hypoechoic lesion adjacent to the cortex, consistent with osteoid osteoma, enabling accurate localization. Surgical curettage was performed, and histology confirmed the diagnosis. The patient had complete postoperative symptom resolution.

Conclusion: Ultrasound can serve as a useful complementary modality in the diagnosis of osteoid osteoma, particularly in superficial lesions with inconclusive conventional imaging.

Keywords— Osteoid osteoma; ultrasound; nidus; bone tumor; pediatric; diagnosis; curettage

1. INTRODUCTION

Osteoid osteoma was first described by Bergstrand in 1930 and later defined as a distinct clinicopathological entity by Jaffe in 1935[1].It is a benign osteogenic tumor characterized by a small, well-circumscribed nidus—typically less than 1.5–2 cm in diameter—composed of osteoid and woven bone produced by osteoblasts within a highly vascularized stroma. This nidus is commonly surrounded by a variable degree of reactive sclerosis, which contributes to its characteristic imaging appearance.
From an anatomical standpoint, osteoid osteoma is most frequently classified into intracortical (approximately 75%), medullary (20%), and less commonly subperiosteal or endosteal forms[1]. This classification has practical diagnostic implications.

Cortical lesions typically demonstrate prominent reactive sclerosis and a classic clinical presentation, whereas medullary and subperiosteal variants often lack marked reactive changes and may present atypically, contributing to delayed or missed diagnosis.

Epidemiologically, osteoid osteoma accounts for approximately 10% of all benign bone tumors, with an annual incidence of around 1 per 100,000 individuals. It predominantly affects young patients between 5 and 25 years of age, with a male predominance (male-to-female ratio ~3:1), although it may occur outside this range. The lesions most commonly involve the diaphysis and metaphysis of long bones, particularly the femur and tibia, while less frequent locations include the spine, upper extremity, and bones of the foot.

Despite its benign nature, osteoid osteoma can lead to significant morbidity due to persistent pain and functional limitation. The hallmark symptom is localized pain with marked nocturnal exacerbation and rapid relief following administration of nonsteroidal anti-inflammatory drugs. This characteristic response is explained by the markedly increased production of prostaglandins—particularly PGE_2 and PGI_2—within the nidus, mediated by overexpression of cyclooxygenase-2 (COX-2)[2]. Elevated intraosseous pressure, vascular congestion, and the presence of nerve fibers within the surrounding fibrous tissue further contribute to pain generation.

At the molecular level, rearrangements involving the **FOS** gene, and less frequently **FOSB**, have been identified in the majority of osteoid osteoma cases, supporting its classification as a true neoplasm rather than a purely reactive process[3].

Clinically, osteoid osteoma most frequently presents with localized pain of increasing intensity, characteristically worsening at night and demonstrating a marked and rapid response to nonsteroidal anti-inflammatory drugs (NSAIDs)[4]. This response is attributed to the high levels of prostaglandin production within the nidus. Despite these typical clinical features, diagnosis may be delayed, particularly in atypical locations or when imaging findings are subtle.

Computed tomography (CT) is widely regarded as the gold standard imaging modality for the diagnosis of osteoid osteoma, owing to its superior ability to clearly delineate the nidus and surrounding reactive sclerosis. Conventional radiography is often used as an initial diagnostic tool but may be inconclusive, especially in early-stage disease or in anatomically complex regions. Magnetic resonance imaging (MRI), while sensitive in detecting associated bone marrow and soft tissue edema, may lack specificity and can occasionally obscure the nidus, leading to potential misinterpretation.

Ultrasonography, although not routinely emphasized in standard diagnostic algorithms, has emerged as a potentially valuable modality in selected cases, particularly for superficially located lesions. Its advantages include absence of ionizing radiation, real-time dynamic assessment, and the ability to detect cortical irregularities and associated hyperemia.

In this report, we present a clinical case in which ultrasonography played a pivotal role in the diagnostic process, demonstrating its utility as both a complementary and, in certain scenarios, a leading imaging modality in the identification of osteoid osteoma.

2. Clinical case

Clinical presentation

An 8-year-old female patient presented with a history of left ankle pain beginning in August 2025. The pain was progressive, with nocturnal exacerbation and significant intensity during the night. Topical nonsteroidal anti-inflammatory drugs (NSAIDs) were applied without effect, while orally administered NSAIDs resulted in rapid and marked pain relief.

On physical examination, painful dorsiflexion of the left ankle joint was noted, along with localized tenderness on palpation over the distal tibial region. No significant swelling or deformity was observed.

Management and outcome

The patient underwent surgical treatment consisting of curettage of the lesion with removal to macroscopically clean margins. Tissue samples were obtained intraoperatively and sent for histopathological analysis.

Histological examination confirmed the diagnosis of osteoid osteoma.

The postoperative course was uneventful. At follow-up, the patient reported complete resolution of pain, with no complications observed.



Figure 1. Plain radiographs of the left ankle joint (anteroposterior) demonstrated a subtle cortical irregularity, described as a discreet bone defect located on the lateral aspect of the distal tibia[5].

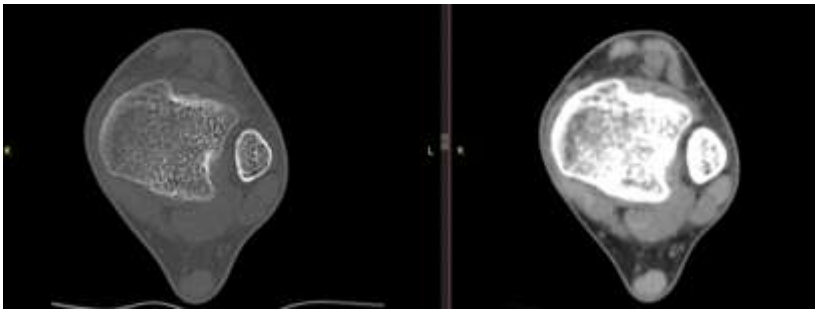


Figure 2. Computed tomography (CT) of the lower limb revealed a corresponding small cortical defect on the lateral side of the distal tibia, best visualized on axial (transverse) sections. However, a clearly defined nidus was not distinctly identifiable on CT imaging.

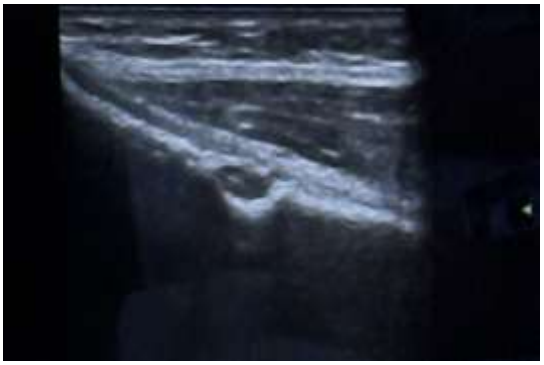


Figure 3. Ultrasound examination of the left ankle joint demonstrated a well-defined hypoechoic lesion adjacent to the cortical surface, corresponding to the suspected nidus. This finding, in correlation with clinical presentation and other imaging modalities, supported the diagnosis of osteoid osteoma with subcortical localization.



Figure 4. Preoperative ultrasound being used to pinpoint the exact localization of the lesion

3. DISCUSSION

Imaging plays a central role in diagnosis, as clinical features alone are insufficiently specific. Conventional radiography may demonstrate a radiolucent nidus with surrounding sclerosis; however, findings can be subtle or absent, particularly in atypical locations or early disease. Computed tomography remains the gold standard due to its superior ability to precisely identify the nidus and delineate surrounding reactive changes. Magnetic resonance imaging, although sensitive for detecting bone marrow and soft tissue edema, may lack specificity and occasionally obscure the nidus, potentially leading to diagnostic uncertainty.

In this context, ultrasonography emerges as a valuable complementary imaging modality, particularly for superficially located lesions. In both presented cases, high-resolution ultrasound enabled visualization of a focal cortical abnormality associated with a small, well-defined hypoechoic lesion corresponding to the nidus. These findings, in conjunction with clinical features, raised early suspicion for osteoid osteoma and guided further diagnostic evaluation.

Ultrasound offers several practical advantages, including absence of ionizing radiation, wide availability, and the ability to perform dynamic, point-of-care assessment. Additionally, it allows precise correlation between imaging findings and the patient's point of maximal tenderness, which may enhance diagnostic confidence. These features make it particularly suitable for pediatric and young adult populations.

However, the diagnostic performance of ultrasound is influenced by lesion depth and anatomical location. Deeply situated or medullary lesions may not be adequately visualized due to acoustic limitations, and the method remains highly operator-dependent. Consequently, while ultrasound can raise suspicion and aid early detection, confirmatory imaging—most commonly with CT—remains necessary.

4. CONCLUSION

Ultrasound represents a valuable complementary imaging modality in the evaluation of osteoid osteoma, particularly in superficially located cortical and subcortical lesions. While conventional radiography remains the first-line investigation and computed tomography (CT) is widely regarded as the gold standard for definitive identification of the nidus, both modalities may be inconclusive in early-stage disease or when reactive sclerosis is minimal.In the present case, high-resolution ultrasonography performed with a **linear transducer operating in the high-frequency range (approximately 7–15 MHz)** on a **ProSound ultrasound system** enabled clear visualization of a well-defined hypoechoic nidus adjacent to the cortical surface[6]. This allowed more precise localization than radiography and complemented CT findings, which demonstrated only subtle cortical changes without definite nidus identification. Compared to X-ray and CT, ultrasound offers several advantages, including absence of ionizing radiation, real-time dynamic assessment, and the ability to correlate imaging findings directly with the site of maximal tenderness. These features are particularly relevant in pediatric patients and in lesions located close to the cortical surface. Additionally, ultrasound may assist in preoper-

ative planning and intraoperative localization, contributing to more targeted surgical intervention and reduced iatrogenic tissue damage.However, ultrasound has important limitations. Its diagnostic performance is reduced in deeply located or medullary lesions due to acoustic constraints, and its accuracy is highly operator-dependent. Therefore, it should not replace CT but rather serve as a complementary tool within a multimodal imaging approach.In conclusion, although CT remains indispensable for definitive diagnosis, high-frequency musculoskeletal ultrasound—when performed with appropriate technique and expertise—can play a significant role in the early detection and perioperative management of osteoid osteoma.

5. REFERENCES

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