MIGIEL, Marcin, BRYNCZKA, Izabela, SIUTA, Natalia, RYPEL-BOŚKA, Joanna, MIAŚNIKIEWICZ, Jakub, GOLENIEWSKA, Klaudia, STUPECKA, Aleksandra, CECUŁA, Wiktoria and CIECHOMSKI, Kamil. Osteoid osteoma - A literature review. Quality in Sport. 2025;47:66808. eISSN 2450-3118.
https://doi.org/10.12775/QS.2025.47.66808
https://apcz.umk.pl/QS/article/view/66808

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 l.p. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).
The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 22.11.2025. Revised: 29.11.2025. Accepted: 29.11.2025. Published: 05.12.2025.

Osteoid osteoma - A literature review

Marcin Migiel

ORCID: https://orcid.org/0009-0003-3562-5051

Private Health Care Facility in the Commune of Nowy Targ, 2 Podhalańska Street, 34-471 Ludźmierz, Poland

Email: migielmarcin@gmail.com

Izabela Brynczka

ORCID: https://orcid.org/0009-0002-1527-5659

Ludwik Rydygier Specialist Hospital, 1 Złota Jesień Street, 31-826 Kraków, Poland

Email: iza.brynczka@gmail.com

Natalia Siuta

ORCID: https://orcid.org/0000-0001-8441-5382

Private Health Care Facility in the Commune of Nowy Targ, 2 Podhalańska Street, 34-471 Ludźmierz, Poland

Email: natalia.siuta.99@gmail.com

Joanna Rypel-Bośka

ORCID: https://orcid.org/0009-0002-2380-571X

Klara Helska Specialist Hospital of Lung Diseases „Odrodzenie", 1 Gładkie Street, 34-500 Zakopane, Poland

Email: joanna.rypel1999@gmail.com

Jakub Miaśnikiewicz

ORCID: https://orcid.org/0009-0003-3186-010X

Central Teaching Hospital of the Medical University of Lodz, 251 Pomorska Street, 92-213 Łódź, Poland

Email: j.miasnikiewicz@gmail.com

Klaudia Goleniewska

ORCID: https://orcid.org/0009-0002-1597-9699

University Clinical Hospital No. 2 of Medical University of Łódź, 113 Żeromskiego Street, 90-549 Łódź, Poland

Email: kla.goleniewska@gmail.com

Aleksandra Stupecka

ORCID: https://orcid.org/0009-0004-3585-9664

University Clinical Hospital No. 1 named after Norbert Barlicki, 22 Dr. Stefama Kopcinskiego Street, 90-153 Łódź, Poland

Email: aleksandragieras@gmail.com

Wiktoria Cecuła

ORCID: https://orcid.org/0009-0005-8749-2312

Central Clinical Hospital of the Medical University of Łódź, 251 Pomorska Street, 92-213 Łódź, Poland

Email: wiktoria.cecula@stud.umed.lodz.pl

Kamil Ciechomski

ORCID: https://orcid.org/0009-0002-0049-2714

Healthcare Service Center in Łowicz, 28 Ułańska Street, 99-400 Łowicz, Poland

Email: kamil.ciechomski@stud.umed.lodz.pl

Corresponding author:

Marcin Migiel

Email: migielmarcin@gmail.com

Abstract

Introduction and purpose

Osteoid osteoma is a benign osteogenic tumor most commonly diagnosed in adolescents and young adults, predominantly males. It typically presents with nocturnally exacerbated bone pain responsive to NSAIDs, attributed to prostaglandin overproduction within the nidus. This review aims to synthesize current knowledge on the clinical presentation, diagnosis, classification, and management strategies for osteoid osteoma.

State of knowledge: Although small in size, osteoid osteomas often cause significant morbidity due to intense, localized pain. Conventional radiographs may be inconclusive, especially in atypical cases, necessitating the use of computed tomography as the diagnostic gold standard. Advances in image-guided therapies have largely replaced traditional surgery. Radiofrequency ablation (RFA) has become the first-line treatment due to its high success rate, low recurrence, and rapid functional recovery. Alternative modalities like cryotherapy and laser ablation are effective in select scenarios.

Materials and methods: A review was conducted using PubMed and Google Scholar databases, concerning osteoid osteoma published between 2000 and 2024.

Conclusions: Osteoid osteoma is a curable condition with excellent prognosis when appropriately managed. Accurate diagnosis and tailored intervention—particularly with minimally invasive techniques—enable full symptom resolution in most patients.

Keywords: Osteoid osteoma; Bone tumor; Radiofrequency ablation; Computed tomography; Minimally invasive treatment

1. Introduction

Osteoid osteoma (OO) is a benign osteogenic neoplasm that constitutes approximately 10–14% of all benign bone tumors. Histologically, it is defined by a central nidus typically less than 15 mm in diameter, surrounded by a dense rim of reactive bone and a fibrovascular stroma [1]. The nidus is rich in immature osteoid tissue, osteoblasts, and vascular components. This tumor is most commonly seen in adolescents and young adults, predominantly affecting males, with the majority of cases occurring between the ages of 5 and 25. The classic symptom of OO is localized bone pain, often intensifying at night, which characteristically responds to salicylates or NSAIDs this response being attributed to the overproduction of prostaglandins within the lesion [2-4].

The diaphyseal and metaphyseal regions of long bones, especially the femur and tibia, are the most common sites of involvement, although atypical presentations have been documented. Imaging plays a central role in diagnosis. Plain radiography may reveal a small, radiolucent nidus encircled by dense sclerosis [1,4]. However, computed tomography (CT) remains the gold standard, offering superior delineation of the lesion and its cortical localization. Magnetic resonance imaging (MRI), while highly sensitive, is less specific, and bone scintigraphy can aid in confirming metabolically active lesions by demonstrating a characteristic „double-density sign" [1-5].

Historically, surgical excision was the mainstay of treatment but has largely been supplanted by minimally invasive image-guided ablation techniques, such as radiofrequency ablation (RFA), cryotherapy, and laser photocoagulation. These modalities offer comparable or superior efficacy with reduced morbidity, shorter hospital stays, and faster functional recovery. Pharmacological management with NSAIDs may be considered in select cases; however, prolonged therapy is often limited by systemic side effects and the risk of incomplete symptom resolution [1-3].

2. Pathogenesis

The pathogenesis of osteoid osteoma remains a subject of ongoing debate. Some investigators regard it as a true benign neoplasm derived from osteoblastic lineage, while others propose it represents a reactive or reparative process, possibly triggered by antecedent trauma or localized inflammation. Histologically, the nidus comprises immature woven bone interspersed with osteoblasts and scattered osteoclasts, surrounded by a fibrovascular matrix and bordered by dense sclerotic bone. Vascular proliferation within the nidus and surrounding zone is a prominent feature, underscoring the lesion's hyperemic character [6-8].

A key pathophysiological hallmark is the markedly elevated production of prostaglandins—particularly prostaglandin E2—within the nidus, with concentrations reported to be up to 1000 times higher than in adjacent normal bone. These eicosanoids promote vasodilation, increase vascular permeability, and stimulate nociceptive nerve endings, resulting in the characteristic intense, nocturnal pain. Immunohistochemical studies have confirmed the presence of unmyelinated nerve fibers both within and around the nidus, supporting the role of prostaglandin-mediated neurogenic inflammation in the symptomatology of OO [9,10].

Further supporting the neoplastic hypothesis, angiographic studies have demonstrated a discrete arterial supply to the nidus, with early arterial enhancement and contrast pooling consistent with tumor vascularity. Nevertheless, the self-limited nature of many OO lesions and their potential for spontaneous resolution raise questions about whether the tumor truly behaves as a proliferative neoplasm or a benign growth with reactive characteristics[11].

3. Epidemiology

Osteoid osteoma ranks as the third most prevalent benign bone tumor, following enchondroma and non-ossifying fibroma, and accounts for 2–3% of all primary bone neoplasms [1]. The condition primarily affects individuals between the ages of 5 and 30, with a peak incidence during adolescence. Males are disproportionately affected, with reported male-to-female ratios ranging from 2:1 to 3:1 [1-4].

The tumor most frequently involves the appendicular skeleton, particularly the long bones of the lower extremity. Over 50% of cases are localized to the femur and tibia, especially in their meta-diaphyseal regions. Upper limb involvement is less common, with the humerus being the most frequently affected bone, followed by the ulna and radius [7,8].

Involvement of the axial skeleton occurs in approximately 6–20% of cases, predominantly affecting the posterior elements of the lumbar spine, such as pedicles, laminae, and transverse processes. Cervical and thoracic vertebrae are less commonly involved, and sacral lesions are rare. Small bones of the hands and feet account for a minority of cases, with the talus being the most commonly involved tarsal bone. The calcaneus, phalanges, and metatarsals are affected less frequently. Involvement of the skull and facial bones, including the mandible and maxilla, is exceptionally rare [7,8].

Age and anatomical location may influence clinical presentation and time to diagnosis. Intra-articular or juxta-articular lesions, which represent about 10% of cases, often present with atypical symptoms such as joint effusion, restricted mobility, or synovitis, thereby mimicking

inflammatory or degenerative joint disease and delaying diagnosis. Similarly, spinal OO may present with scoliosis or radicular pain, further complicating early recognition [7-9].

4. Screening

The initial clinical presentation of osteoid osteoma (OO) is often misleading, particularly in pediatric populations, where symptoms such as localized limb pain, night-time discomfort, and limping may be erroneously attributed to benign overuse injuries or growth-related discomfort. These symptoms may precede imaging findings and often lack systemic manifestations such as fever or overt inflammation. A typical patient may report progressive, localized pain frequently exacerbated at night and transiently alleviated by nonsteroidal anti-inflammatory agents without a clear history of trauma [12-14].

Physical examination in OO is typically non-specific. Localized tenderness may be noted without accompanying swelling, erythema, or deformity. Systemic examination, including neurological and vascular assessments, usually remains within normal limits. Laboratory investigations such as inflammatory markers (CRP, ESR) and complete blood count are often unremarkable, which helps exclude infectious or systemic inflammatory etiologies [15] .

Conventional radiographs serve as the first-line imaging modality in the evaluation of suspected bone lesions. However, their sensitivity may be limited particularly in early or atypical presentations. Up to one-third of OO cases may initially appear normal on standard radiographs. When visible, OO often appears as a well-circumscribed radiolucent lesion within the cortical bone, sometimes with surrounding sclerosis. The classic radiographic feature is the identification of a central nidus, although this may be obscured by reactive sclerosis or lesion location [14,15].

Further diagnostic clarity is achieved through computed tomography (CT), which is considered the gold standard for localizing the nidus, especially in cases where radiographs are inconclusive. CT offers high-resolution detail of cortical and subcortical bone, making it particularly valuable for identifying small lesions, cortical thickening, and subtle sclerosis [12-14].

Magnetic resonance imaging (MRI) plays a supplementary role and may be misleading in OO, as it is highly sensitive to bone marrow edema and soft tissue changes, which are not specific to this tumor. The lesion typically appears hypointense on T1-weighted sequences and hyperintense on T2-weighted sequences, with surrounding bone and periosteal edema. MRI is more informative in excluding alternative diagnoses, such as subacute osteomyelitis, stress fractures, or other bone-forming tumors [15].

Bone scintigraphy using technetium-labeled agents offers excellent sensitivity, particularly in metabolically active lesions. It typically reveals a "double-density" sign indicative of increased osteoblastic activity surrounding the nidus. However, its specificity is limited, and it is generally reserved for cases in which other modalities are inconclusive [12,13].

The differential diagnosis of diaphyseal bone lesions in children includes osteomyelitis, Brodie abscess, stress fracture, osteoblastoma, and other benign neoplasms such as nonossifying fibroma. Clinical and imaging features must be integrated to distinguish OO from these entities. For example, unlike OO, osteomyelitis often presents with systemic signs, elevated inflammatory markers, and radiographic features such as periosteal reaction or medullary involvement. In contrast, OO is typically cortically based, with limited inflammatory response and a discrete nidus [12-14].

In challenging or atypical presentations, histological confirmation via biopsy may be required to differentiate OO from other entities such as osteoblastoma or infectious processes. However, in many cases, the combination of clinical features, characteristic imaging findings on CT, and therapeutic response to NSAIDs is sufficient to establish a presumptive diagnosis and guide treatment [13,14].

Examination:

The clinical assessment of patients with osteoid osteoma (OO) is frequently delayed due to its insidious and non-specific presentation. The average duration from symptom onset to definitive diagnosis can extend over a year and a half, with some cases spanning decades. Pain remains the predominant symptom, reported in over 90% of cases, often with nocturnal intensification and partial relief following NSAID administration. Involvement of small bones, particularly phalanges, may present with localized swelling and, occasionally, deformities such as nail bed hypertrophy or clubbing of digits [15].

Limitation in joint mobility is variably reported but may affect a subset of patients when the lesion is near articular surfaces or causes reactive soft tissue changes[16]. Upon examination, tenderness is generally localized to the involved bone without systemic signs of infection or inflammation. Objective findings such as erythema, warmth, or fluctuation are usually absent, distinguishing OO from infectious etiologies[16,17].

The standard diagnostic approach begins with physical inspection and palpation of the affected site, followed by plain radiography. However, early-stage lesions may evade detection due to their small size and subtle radiographic features. A typical radiograph may show a small radiolucent nidus with surrounding sclerosis, though such findings are not universal. In small

bones, particularly in the distal extremities, visualization of the nidus may be impaired due to limited reactive changes[17,18].

Advanced imaging is essential for conclusive diagnosis. Computed tomography (CT) offers the highest sensitivity for nidus detection, especially in cortical and subperiosteal locations. It is particularly valuable when standard radiographs are inconclusive or the lesion is located in anatomically complex or small bones, such as the phalanges. CT provides detailed visualization of the nidus, including its size, internal calcification, and the degree of surrounding bone sclerosis [17].

Magnetic resonance imaging (MRI) is highly sensitive to reactive bone marrow and soft tissue edema, which may assist in lesion localization, especially in juxta-articular regions. However, it may lack specificity and occasionally fails to identify the nidus itself. This limitation is especially relevant in small bones where peritumoral edema may obscure focal cortical lesions [16-18].

Nuclear medicine techniques such as bone scintigraphy and SPECT are capable of detecting increased osteoblastic activity and can be helpful in localizing lesions when CT is inconclusive. However, these modalities are rarely required when clinical suspicion is high and CT imaging is available [17,18].

Objective evaluation of pain intensity is critical both in diagnostic assessment and post-treatment follow-up. Scales such as the Visual Analog Scale (VAS) and the Numerical Pain Scale (NPS) are routinely used to quantify symptom severity, both during the day and at night, as OO-related pain typically intensifies during nocturnal hours [15-17].

Histological confirmation is generally reserved for surgical cases, particularly when percutaneous ablation is not feasible due to lesion location or size. In such instances, curettage or en bloc excision not only achieves definitive diagnosis but also serves as a therapeutic intervention. Surgical exploration enables direct visualization and removal of the nidus, which is often confirmed by histopathologic analysis. In large case series, histological sensitivity has approached 98%, affirming its diagnostic value when imaging findings are ambiguous [17,18].

In summary, a thorough clinical examination, coupled with targeted imaging, particularly CT, remains the cornerstone of osteoid osteoma diagnosis. Pain patterns, particularly nocturnal exacerbation relieved by NSAIDs, provide a strong clinical clue, while imaging helps exclude mimicking conditions such as stress fractures, osteomyelitis, and other benign bone tumors [15-18].

5. Classification

Osteoid osteomas are classified according to their anatomical location within the affected bone, particularly in long tubular bones. While these lesions can appear throughout the skeletal system, they demonstrate a predilection for the diaphyseal region [19]. The classification system most commonly adopted is based on imaging findings, particularly computed tomography (CT) and magnetic resonance imaging (MRI), which enable precise spatial localization of the nidus [19]. The widely accepted categorization includes four subtypes: intracortical, subperiosteal, endosteal, and medullary. Among these, intracortical osteoid osteomas are by far the most prevalent, representing approximately three-quarters of all cases. These lesions are typically located within the diaphyseal or metaphyseal cortex of long bones, with the tibia and femur being particularly common sites of involvement [19,20].

Medullary osteoid osteomas account for about 20% of cases and are often situated in juxta-articular locations. These include the femoral neck, small bones of the hands and feet, and the posterior vertebral elements. The presentation in these regions can be atypical, sometimes complicating early diagnosis due to the absence of characteristic cortical thickening [20].

Subperiosteal lesions, which are the least common, develop on the external surface of the cortex and are frequently encountered along the medial side of the femoral neck or within the small bones of the hands, feet, and talus. Because of their superficial positioning, these tumors may resemble soft-tissue masses and often elicit minimal surrounding bone reaction, posing additional diagnostic challenges [20].

Endosteal osteoid osteomas, also rare, occur along the inner cortical surface, abutting the medullary cavity. Their localization may result in overlapping imaging features with medullary lesions, requiring detailed cross-sectional imaging for accurate classification [20].

This anatomical subclassification not only aids in diagnostic accuracy but also influences the choice of therapeutic approach, particularly when minimally invasive techniques such as CT-guided radiofrequency ablation are considered. Lesions located near critical neurovascular structures or articular surfaces may necessitate tailored surgical planning to ensure effective and safe nidus removal [19,20].

6. Treatment

The therapeutic approach to osteoid osteoma has evolved significantly over recent decades, transitioning from conventional surgical techniques to advanced minimally invasive methods [20,21]. Historically, surgical excision through en bloc resection or curettage was the preferred

method, often involving cortical windowing and mechanical debridement using high-speed burrs. While effective in eradicating the nidus and alleviating symptoms, surgery carries inherent risks including postoperative stiffness, pain, and, in some cases, pathological fractures [22]. To address structural compromise, bone grafts, either autologous or allogeneic, may be used to reinforce the affected area, especially when curettage leaves the bone weakened [20,23].

In response to these limitations, image-guided percutaneous thermal ablation techniques have emerged as the standard of care. Among them, radiofrequency ablation (RFA) has become the most extensively validated modality due to its high efficacy, minimal invasiveness, and favorable safety profile [24-26]. During RFA, stereotactic navigation or CT imaging is utilized to precisely localize the nidus. A probe is then introduced under real-time imaging guidance, and the lesion is thermally ablated typically at temperatures reaching 90 °C for approximately 5-6 minutes resulting in coagulative necrosis of the tumorous tissue. In cases of eccentric or large lesions, repositioning of the electrode and multiple overlapping ablations may be required to achieve complete coverage [25].

Modifications to RFA protocols such as reducing the target temperature to 75 °C or implementing dual ablation cycles separated by cooling intervals have demonstrated promise in minimizing heat-related complications, especially in anatomically delicate areas such as the phalanges. Additional protective strategies, including the application of chilled saline-soaked gauze at the electrode entry point, further reduce the risk of thermal damage to surrounding soft tissues [22,26].

Other energy-based modalities, such as interstitial laser ablation (ILA), cryoablation, and high-intensity focused ultrasound (HIFU), have also been explored. ILA employs optical fibers to deliver focused light energy that is converted into heat, offering a precise ablation zone with minimal collateral injury [27-30]. Cryoablation, in contrast, induces cell death through extreme hypothermia and allows real-time visualization of the ice-ball margin on imaging. Meanwhile, MR-guided HIFU represents a non-invasive alternative that combines ultrasonic thermal delivery with real-time MRI-based thermometry, thereby eliminating the need for skin penetration altogether [30,31].

Though each technique presents unique advantages, RFA remains the most widely adopted due to its consistent clinical outcomes, broad applicability, and relatively low recurrence and complication rates [24,25]. Nonetheless, patient-specific factors such as lesion location, proximity to neurovascular structures, and size must inform the choice of treatment. In select cases where thermal ablation is contraindicated or technically unfeasible, surgical curettage remains a viable alternative [22].

7. Prognosis

The overall prognosis for patients with osteoid osteoma is highly favorable, especially when definitive treatment is administered. Spontaneous resolution has been documented in some cases over a period of 18 to 24 months with conservative management using nonsteroidal anti-inflammatory drugs; however, persistent or debilitating pain often necessitates interventional therapy [20].

Surgical resection and curettage are associated with high success rates, typically ranging between 88% and 97%. However, these procedures often require hospitalization, extended recovery time, and carry a higher incidence of postoperative complications, particularly when large bone segments are involved [22,23]. In contrast, percutaneous ablation techniques especially RFA offer equivalent or superior rates of pain resolution and lesion eradication, with significantly reduced procedural morbidity [24-26,28]. Clinical success rates following RFA consistently exceed 90%, and recurrence rates are generally reported between 2% and 12%, depending on the lesion size, ablation duration, and operator experience [29].

Notably, a second ablation procedure is usually effective in patients who experience symptomatic relapse after initial treatment, with complete resolution of symptoms in the vast majority of re-treated cases [29]. Moreover, MRI follow-up often reveals characteristic post-ablation changes, including the replacement of the nidus with fibrous tissue, reduction of surrounding bone marrow edema, and progressive bone remodeling, all of which support long-term treatment efficacy [30].

The risk of treatment failure has been associated primarily with inadequate ablation time and imprecise probe positioning. However, neither patient age nor anatomical site has shown a statistically significant correlation with recurrence in most studies. The implementation of longer ablation durations (>7 minutes) has been correlated with lower failure rates [29].

While the data supporting alternative techniques such as ILA, MWA, and cryoablation are expanding, these methods are still considered adjuncts in most institutions and reserved for cases where RFA is contraindicated or has failed. Prognostic outcomes with these approaches remain encouraging, with comparable success and safety profiles [27,28,31].

In summary, when appropriately selected and executed, both surgical and image-guided ablative treatments provide excellent long-term outcomes for patients with osteoid osteoma, with the vast majority achieving full resolution of pain and a return to normal activities [24-30].

8. Conclusions

Osteoid osteoma is a benign, yet frequently debilitating bone tumor that predominantly affects young individuals. Despite its small size, the lesion's biologically active nidus produces intense, often nocturnal pain due to elevated prostaglandin synthesis and perinidal neurovascular irritation. Accurate diagnosis requires a high index of clinical suspicion, especially in atypical anatomical locations or when standard radiographic findings are inconclusive. Advanced imaging modalities, particularly computed tomography, are essential for precise localization of the nidus and planning of therapeutic intervention.

The therapeutic paradigm has shifted from conventional open surgery to image-guided percutaneous ablation techniques, with radiofrequency ablation emerging as the treatment of choice in most cases. These minimally invasive modalities offer high success rates, rapid symptom relief, low complication profiles, and faster return to daily activities. Nonetheless, the optimal management approach should be individualized based on lesion location, size, proximity to critical structures, and technical feasibility.

Although surgical excision remains effective, particularly in complex or refractory cases, the advent of alternative thermal ablation methods—such as interstitial laser ablation, cryotherapy, and MR-guided focused ultrasound—has broadened the armamentarium available for clinicians. Each modality presents unique advantages and may serve as a valuable alternative when standard RFA is contraindicated or suboptimal.

In conclusion, with advances in imaging and interventional technology, osteoid osteoma has become a highly manageable condition. Early recognition, precise diagnosis, and selection of an appropriate, evidence-based therapeutic strategy are key determinants of favorable long-term outcomes and complete symptom resolution.

Disclosure

The authors declare no conflict of interest in relation to this study.

Authors's contribution

Conceptualization: Marcin Migiel, Izabela Brynczka

Methodology: Joanna Rypel-Bośka, Natalia Siuta

Formal analysis: Kamil Ciechomski, Jakub Miaśnikiewicz

Invastigation: Klaudia Goleniewska, Aleksandra Stupecka

Writing-rough preparation: Wiktoria Cecuła, Marcin Migiel

Writing-review: Marcin Migiel, Izabela Brynczka

Supervision: Joanna Rypel-Bośka, Natalia Siuta

Receiving funding - no specific funding.

All authors have read and agreed with the published version of the manuscript.

Funding Statement

This research received no external funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

Conflict of interest

The authors declare no conflict of interests.

In preparing this work, the authors used ChatGPT for the purpose of improving language and readability, text formatting, and verification of bibliographic styles. After using this tool/service, the authors have reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication.

References:

[1] Carneiro BC, Da Cruz IAN, Ormond Filho AG, Silva IP, Guimarães JB, Silva FD, Nico MAC, Stump XMGRG. Osteoid osteoma: the great mimicker. Insights Imaging. 2021 Mar 8;12(1):32. doi: 10.1186/s13244-021-00978-8. PMID: 33683492; PMCID: PMC7940467.

[2] Johnson CS, Cook LM. Osteoid cell-derived chemokines drive bone-metastatic prostate cancer. Front Oncol. 2023 Mar 21;13:1100585. doi: 10.3389/fonc.2023.1100585. PMID: 37025604; PMCID: PMC10070788.

[3] Malghem J, Lecouvet F, Kirchgesner T, Acid S, Vande Berg B. Osteoid osteoma of the hip: imaging features. Skeletal Radiol. 2020 Nov;49(11):1709-1718. doi: 10.1007/s00256-020-03515-8. Epub 2020 Jun 19. PMID: 32561955; PMCID: PMC7497518.

[4] Dookie AL, Joseph RM. Osteoid Osteoma. 2023 Aug 14. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan–. PMID: 30725964.

[5] Napora J, Wałejko S, Mazurek T. Osteoid Osteoma, a Diagnostic Problem: A Series of Atypical and Mimicking Presentations and Review of the Recent Literature. J Clin Med. 2023 Apr 5;12(7):2721. doi: 10.3390/jcm12072721. PMID: 37048803; PMCID: PMC10095250.

[6] Farid AR, Liu DS, Morcos MM, Hogue GD. Spinal osteoid osteoma in the pediatric population: A management algorithm and systematic review. J Child Orthop. 2023 Aug 30;17(5):428-441. doi: 10.1177/18632521231192477. PMID: 37799321; PMCID: PMC10549702.

[7] Tepelenis K, Skandalakis GP, Papathanakos G, Kefala MA, Kitsouli A, Barbouti A, Tepelenis N, Varvarousis D, Vlachos K, Kanavaros P, Kitsoulis P. Osteoid Osteoma: An Updated Review of Epidemiology, Pathogenesis, Clinical Presentation, Radiological Features, and Treatment Option. In Vivo. 2021 Jul-Aug;35(4):1929-1938. doi: 10.21873/invivo.12459. PMID: 34182465; PMCID: PMC8286494.

[8] Chen C, Fu S, Su Y, Shi Z. Intra-articular Osteoid Osteoma of the Intermediate Cuneiform Bone Causing Articular Degeneration: A Rare Case and Literature Review. Orthop Surg. 2023 Sep;15(9):2471-2476. doi: 10.1111/os.13805. Epub 2023 Jul 11. PMID: 37431565; PMCID: PMC10475673.

[9] Singh DK, Kumar N, Rustagi A, Jalan D, Krishna LG, Sharma A. Percutaneous CT-guided radiofrequency ablation of osteoid osteoma: Potential Pitfalls and complications and how to avoid them. J Clin Orthop Trauma. 2022 Apr 16;28:101869. doi: 10.1016/j.jcot.2022.101869. PMID: 35494487; PMCID: PMC9043674.

[10] Palander A, Fauch L, Turunen MJ, Dekker H, Schulten EAJM, Koistinen A, Bravenboer N, Kullaa A. Molecular Quantity Variations in Human-Mandibular-Bone Osteoid. Calcif Tissue Int. 2022 Dec;111(6):547-558. doi: 10.1007/s00223-022-01017-4. Epub 2022 Aug 17. PMID: 35978052; PMCID: PMC9613710.

[11] Somma F, Stoia V, D'Angelo R, Fiore F. Imaging-guided radiofrequency ablation of osteoid osteoma in typical and atypical sites: Long term follow up. PLoS One. 2021 Mar 18;16(3):e0248589. doi: 10.1371/journal.pone.0248589. PMID: 33735214; PMCID: PMC7971862.

[12] Soheili A, Momeni MG, Tehranzadeh J. Tumors. In: Tehranzadeh J, ed. Basic Musculoskeletal Imaging, Second Edition. McGraw-Hill Education; 2021.

[13] Light J, Retrouvey M, Conran RM. Educational Case: Osteoid Osteoma. Acad Pathol. 2021 Dec 13;8:23742895211060536. doi: 10.1177/23742895211060536. PMID: 34926796; PMCID: PMC8679056.

[14] El Haj NI, Hafidi S, Karam R, Boubia S, Karkouri M, Ridai M. Osteoid osteoma of the rib: A report of an extremely rare condition. Int J Surg Case Rep. 2022 May;94:107139. doi: 10.1016/j.ijscr.2022.107139. Epub 2022 May 6. PMID: 35658306; PMCID: PMC9097650.

[15] Izzo A, Zugaro L, Fascetti E, Bruno F, Zoccali C, Arrigoni F. Management of Osteoblastoma and Giant Osteoid Osteoma with Percutaneous Thermoablation Techniques. J Clin Med. 2021 Dec 7;10(24):5717. doi: 10.3390/jcm10245717. PMID: 34945013; PMCID: PMC8709302.

[16] Meyer J, Rolvien T, Reiter A, Priemel M, Frosch KH, Krukenberg A, Yarar-Schlickewei S. Osteoid osteoma in the bones of the hand: a systematic literature review. Arch Orthop Trauma Surg. 2023 Aug;143(8):5437-5444. doi: 10.1007/s00402-023-04839-5. Epub 2023 Mar 20. PMID: 36939892; PMCID: PMC10374483.

[17] Bhakhar A, Sharma A, Kaganur R, Pragadeeshwaran J, Paul N, Kumar Dhukia R, Bagarhatta M, Joshi N, Mor A, Sachdeva A. Outcomes of Osteoid Osteoma Treated by Percutaneous CT-Guided Radiofrequency Ablation. Cureus. 2023 Jul 30;15(7):e42675. doi: 10.7759/cureus.42675. PMID: 37649955; PMCID: PMC10463101.

[18] van Straaten A, Clockaerts S, Vanhoenacker F. Osteoid Osteoma of the Hallux: A Diagnostic Challenge. J Belg Soc Radiol. 2021 Jun 11;105(1):36. doi: 10.5334/jbsr.2497. PMID: 34164601; PMCID: PMC8195252.

[19] Kamil S, Sweeney E, Darwish N. A Narrative Review of Osteoid Osteomas and an Audit on the Practice of CT-Guided Radiofrequency Ablation in the Northern Irish Population: A First in the Literature. Cureus. 2023 Jul 17;15(7):e42034. doi: 10.7759/cureus.42034. PMID: 37593307; PMCID: PMC10431733.

[20] Tepelenis K, Skandalakis GP, Papathanakos G, Kefala MA, Kitsouli A, Barbouti A, Tepelenis N, Varvarousis D, Vlachos K, Kanavaros P, Kitsoulis P. Osteoid Osteoma: An Updated Review of Epidemiology, Pathogenesis, Clinical Presentation, Radiological Features, and Treatment Option. In Vivo. 2021 Jul-Aug;35(4):1929-1938. doi: 10.21873/invivo.12459. PMID: 34182465; PMCID: PMC8286494.

[21] Ambulgekar RK, Ghag NS. Osteoid Osteoma of the Distal Phalanx of Little Finger. J Orthop Case Rep. 2022 Sep;12(9):88-91. doi: 10.13107/jocr.2022.v12.i09.3330. PMID: 36873331; PMCID: PMC9983399.

[22] Vita F, Tuzzato G, Pederiva D, Bianchi G, Marcuzzi A, Adani R, Spinnato P, Miceli M, Donati D, Manzetti M, Pilla F, Faldini C. Osteoid Osteoma of the Hand: Surgical Treatment versus CT-Guided Percutaneous Radiofrequency Thermal Ablation. Life (Basel). 2023 Jun 8;13(6):1351. doi: 10.3390/life13061351. PMID: 37374133; PMCID: PMC10301533.

[23] Smolle MA, Gilg MM, Machacek F, Smerdelj M, Tunn PU, Mavcic B, Lujic N, Sopta J, Repsa L, Igrec J, Leithner A, Bergovec M. Osteoid osteoma of the foot : Presentation, treatment and outcome of a multicentre cohort. Wien Klin Wochenschr. 2022 Jun;134(11-12):434-441. doi: 10.1007/s00508-021-01966-0. Epub 2021 Nov 4. PMID: 34735614; PMCID: PMC9213275.

[24] Dalili D, Dalili DE, Isaac A, Martel-Villagrán J, Fritz J. Treatment of Osteoid Osteoma. Semin Intervent Radiol. 2023 May 4;40(1):100-105. doi: 10.1055/s-0043-1767692. PMID: 37152792; PMCID: PMC10159722.

[25] Niazi GE, Basha MAA, Elsharkawi WFA, Zaitoun MMA. Computed Tomography-Guided Radiofrequency Ablation of Osteoid Osteoma in Atypical Sites: Efficacy and Safety in a Large Case Series. Acad Radiol. 2021 Jan;28(1):68-76. doi: 10.1016/j.acra.2020.01.028. Epub 2020 Feb 25. PMID: 32111469.

[26] Parmeggiani A, Martella C, Ceccarelli L, Miceli M, Spinnato P, Facchini G. Osteoid osteoma: which is the best mininvasive treatment option? Eur J Orthop Surg Traumatol. 2021 Dec;31(8):1611-1624. doi: 10.1007/s00590-021-02946-w. Epub 2021 Apr 11. PMID: 33839926; PMCID: PMC8578134.

[27] Parvinian A, Welch BT, Callstrom MR, Kurup AN. Trends in Musculoskeletal Ablation: Emerging Indications and Techniques. Tech Vasc Interv Radiol. 2020 Jun;23(2):100678. doi: 10.1016/j.tvir.2020.100678. Epub 2020 May 25. PMID: 32591190.

[28] Bianchi G, Zugaro L, Palumbo P, Candelari R, Paci E, Floridi C, Giovagnoni A. Interventional Radiology's Osteoid Osteoma Management: Percutaneous Thermal Ablation. J Clin Med. 2022 Jan 29;11(3):723. doi: 10.3390/jcm11030723. PMID: 35160184; PMCID: PMC8836989.

[29] Lindquester WS, Crowley J, Hawkins CM. Percutaneous thermal ablation for treatment of osteoid osteoma: a systematic review and analysis. Skeletal Radiol. 2020 Sep;49(9):1403-1411. doi: 10.1007/s00256-020-03435-7. Epub 2020 Apr 8. PMID: 32270226.

[30] Cobianchi Bellisari F, Palumbo P, Masciocchi C, Zoccali C, Barile A, Arrigoni F. Needleless Ablation of Osteoid Osteoma and Osteoblastoma: The Emergent Role of MRgFUS. J Clin Med. 2021 Dec 27;11(1):128. doi: 10.3390/jcm11010128. PMID: 35011867; PMCID: PMC8745067.

[31] Seemann RJ, Märdian S, Schwabe P, Streitparth F. Atypically Located Osteoid Osteoma: Characteristics and Therapeutic Success After Image-Guided Thermal Ablation. Rofo. 2020 Apr;192(4):335-342. English, German. doi: 10.1055/a-1012-2143. Epub 2019 Nov 20. PMID: 31747706.