

# Intra-articular osteoid osteoma at the femoral trochlea treated with osteochondral autograft transplantation

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## ABSTRACT

We present the case of an intra-articular osteoid osteoma at the femoral trochlea. Intra-articular osteoid osteoma can present a diagnostic challenge both clinically and with imaging because it presents differently from the classic cortical osteoid osteoma. Given the lesion's proximity to overlying cartilage, the patient underwent resection of the lesion with osteochondral autograft transplantation at the surgical defect. A comprehensive literature review and discussion of intra-articular osteoma will be provided.

## CASE REPORT

### CASE REPORT

#### *Clinical History:*

A 20 year-old otherwise healthy man presented with a two-year history of right knee pain. The pain started when the patient returned to physical activity following a severe contralateral (left) ankle sprain that had required 2.5 months of recovery on crutches. Because of the prior gait alteration and immobility, the pain was thought to result from disuse and abnormal joint loading. However, his pain progressed and prevented him from jogging, running, or playing basketball. Physical examination of the knee revealed no effusion or atrophy, intact range of motion, and pain with squatting or active leg straightening. Tests for meniscal or ligamentous pathology were insignificant, but the patient showed patellofemoral apprehension and a positive Clarke's test.

#### *Imaging Findings:*

Radiographs of the right knee did not show any abnormality (Fig 1). CT images demonstrated a round subchondral lucent lesion with a thin sclerotic rim at the lateral

femoral trochlea (Fig 2). A Tc-99m methylene diphosphonate bone scan was then performed which demonstrated a focus of uptake at the femoral trochlea (Fig 3). On magnetic resonance imaging, a rounded T2 hyperintense subchondral lesion at the femoral trochlea was associated with cartilage edema and surrounding marrow edema (Fig 4).

#### *Management:*

Given that the lesion was in a direct subchondral location and RF ablation would have potentially damaged the overlying cartilage, alternative surgical interventions were considered. The patient underwent excision of the intra-articular osteoid osteoma. Subsequently, an osteochondral autograft was harvested from the superomedial trochlea and transplanted to the resection site.

Histologically, the excised lesion showed osteoblastic proliferation with microtrabecular arrays of immature bone and osteoid lined by osteoblasts (Fig 5). Given the imaging, intraoperative appearance, and histology, a diagnosis of osteoid osteoma was made.

*Follow-up:*

Six months after surgery, the patient was pain-free and able to participate in sports. A postoperative MRI at this time revealed an incorporated osteochondral graft with an intact chondral surface (Fig 6).

## DISCUSSION

*Etiology & Demographics:*

Since Jaffe first described osteoid osteoma as an entity in 1935 [1], it has been well-documented in the literature as a relatively common benign bone tumor. Osteoid osteoma makes up approximately 10-20% of benign bone tumors and 2-3% of all bone tumors[2]. The majority of patients affected are between 10 and 20 years of age with a male to female ratio of 2-3:1[3]. The tumor classically presents with bone pain, which is worse at night and relieved by non-steroidal anti-inflammatory drugs. The pain associated with intra-articular lesions is often less dramatic than that associated with diaphyseal lesions with a less impressive response to salicylic acids[4]. The tumor is composed of a central nidus which contains organized trabecular bone embedded in fibrovascular tissue with surrounding reactive cortical bone[3]. The etiology of the tumor is unknown[5].

Intra-articular osteoid osteomas make up 10-13% of cases[2]. This subtype has been associated with adjacent synovitis, a feature not typically associated with extra-articular lesions[6, 7]. Kawaguchi and colleagues postulated that increased cyclooxygenase-2 expression by osteoblasts within the nidus may be responsible for accompanying synovitis secondary to upregulation of the arachidonic acid metabolism pathway[8]. Delays in diagnosis and treatment of these lesions may result in early secondary osteoarthritis and joint destruction as a result of synovitis[9].

*Imaging Findings:*

Osteoid osteomas are classified as cortical, medullary, subperiosteal, or intra-articular, depending on their location within the bone (Fig 7). The classic radiographic appearance of a cortical osteoid osteoma is typified by a central radiolucent nidus with surrounding sclerosis and accompanying periosteal reaction[7]. However, intra-articular osteoid osteomas often lack or show only minimal surrounding sclerosis and so the lucent nidus of the lesion may not be discernible[10]. As there is no periosteum within the joint capsule, periosteal reaction will be absent[10]. A joint effusion may be present[7]. With ultrasound evaluation, focal cortical irregularity can be seen at the site of the intra-articular osteoid osteoma with overlying hypochoic synovitis[10]. On MR, intra-articular osteoid osteomas can elicit extensive bone marrow signal abnormality with periarticular edema and joint effusion[11]. On Tc-99m MDP bone scan, due to the presence of hyperemia, osteoporosis, and effusion, the classic "double density" sign of osteoid osteoma may be absent in the setting of intra-articular osteoid osteoma[11].

*Treatment & Prognosis:*

Surgical resection represented the mainstay of treatment until the early 1990's until the advent of radiofrequency (RF) ablation [12], a minimally-invasive technique. Rosenthal et al. documented a clinical success rate of 77% with RF ablation, similar as compared to surgery [13].

In terms of treatment options for intra-articular osteoid osteoma, certain authors believe RF ablation to be effective in the treatment of intra-articular lesions while others feel that RF ablation is technically-challenging in the setting of these lesions and that surgical excision should remain the treatment of choice[14, 15]. Our patient's lesion occurred in a subchondral location at the femoral trochlea and RF ablation would have likely resulted in damage to the overlying cartilage with the potential for joint pain, degenerative disease, subchondral fractures and eventually osteoarthritis with associated disability.

Osteochondral autograft transplantation is typically utilized in cases of focal cartilage damage or osteochondral lesions (such as osteochondritis dissecans) [16]. Adachi et al. reported the successful use of retrograde autogenous osteochondral graft to reconstruct an osteochondral defect after resection of an intra-articular osteoid osteoma at the lateral tibial plateau[17].

*Differential Diagnosis:*

Several processes can appear similar to intra-articular osteoid osteoma on imaging in that they may present as a subchondral lucency. An erosion in the setting of juvenile idiopathic arthritis can mimic intra-articular osteoid osteoma. However, these erosions demonstrate low T1 and high T2 signal on MRI, are typically marginal, and are associated with a joint effusion. Other helpful radiographic findings in juvenile idiopathic arthritis include joint space narrowing, physeal overgrowth in the chronic phase, and subluxations. The polyarticular involvement and distribution pattern can often lead to the correct diagnosis in these cases.

An osteochondral injury usually presents as a flattening or attenuation of the subchondral bone plate with overlying cartilage injury. Often, there is a history of either recent or remote trauma to the affected region.

An intra-articular fracture presents with cortical step-off with linear lucency. Intra-articular fracture fragments are frequently present. A large effusion is usually appreciated.

A subchondral cyst in the setting of osteoarthritis can appear as a focal lucency. Often there will be additional evidence of osteoarthritis including non-uniform joint space narrowing, subchondral sclerosis and osteophytes on radiographs and CT. On MRI, cartilage loss will frequently be evident.

In conclusion, intra-articular osteoid osteoma can present a diagnostic challenge as it presents differently from classic cortical osteoid osteoma both clinically and on imaging. Osteochondral autograft transplantation is a viable alternative

for treating intra-articular osteoid osteomas in order to mitigate cartilage damage and the potential for secondary osteoarthritis.

#### TEACHING POINT

On radiography and CT, intra-articular osteoid osteoma typically will not have periosteal reaction and will only have minimal, if any, surrounding sclerosis. These features make the lesion more difficult to diagnose than the classic cortical osteoid osteoma. Therefore, this diagnosis should be added to the differential in the case of a focal subchondral lucency in the appropriate patient population.

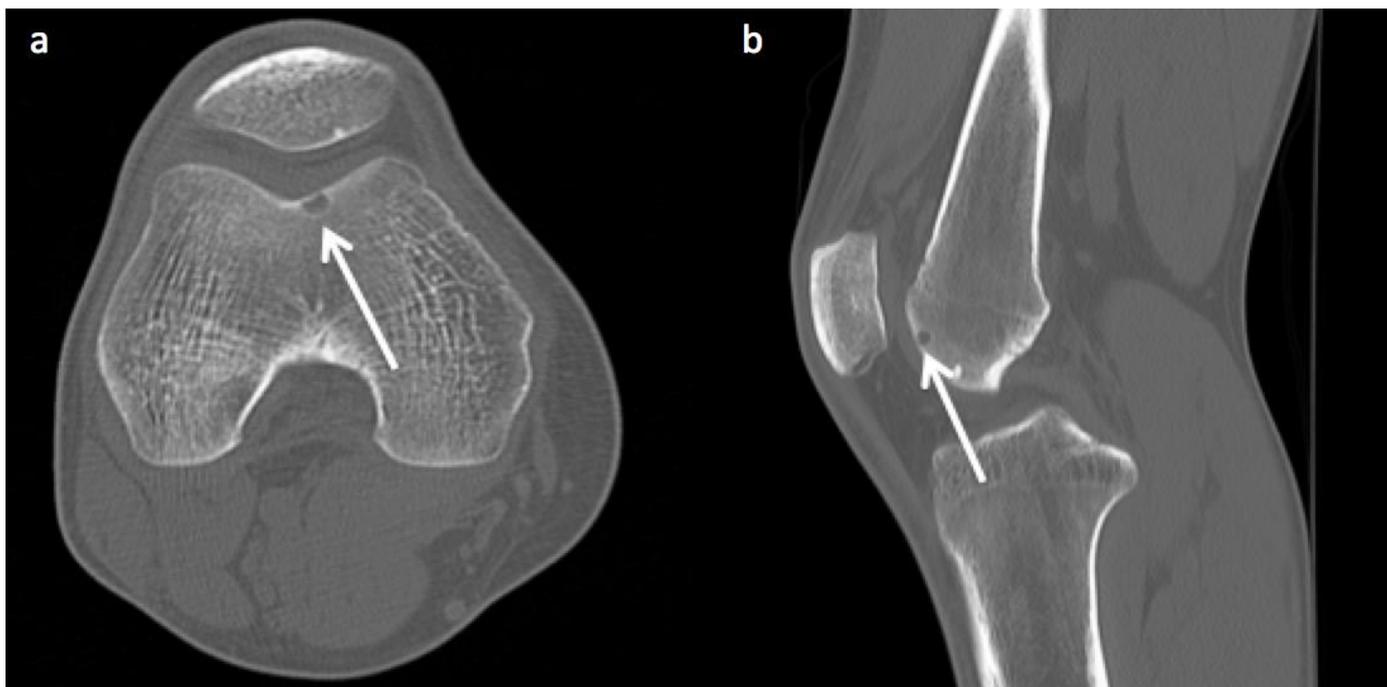
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FIGURES



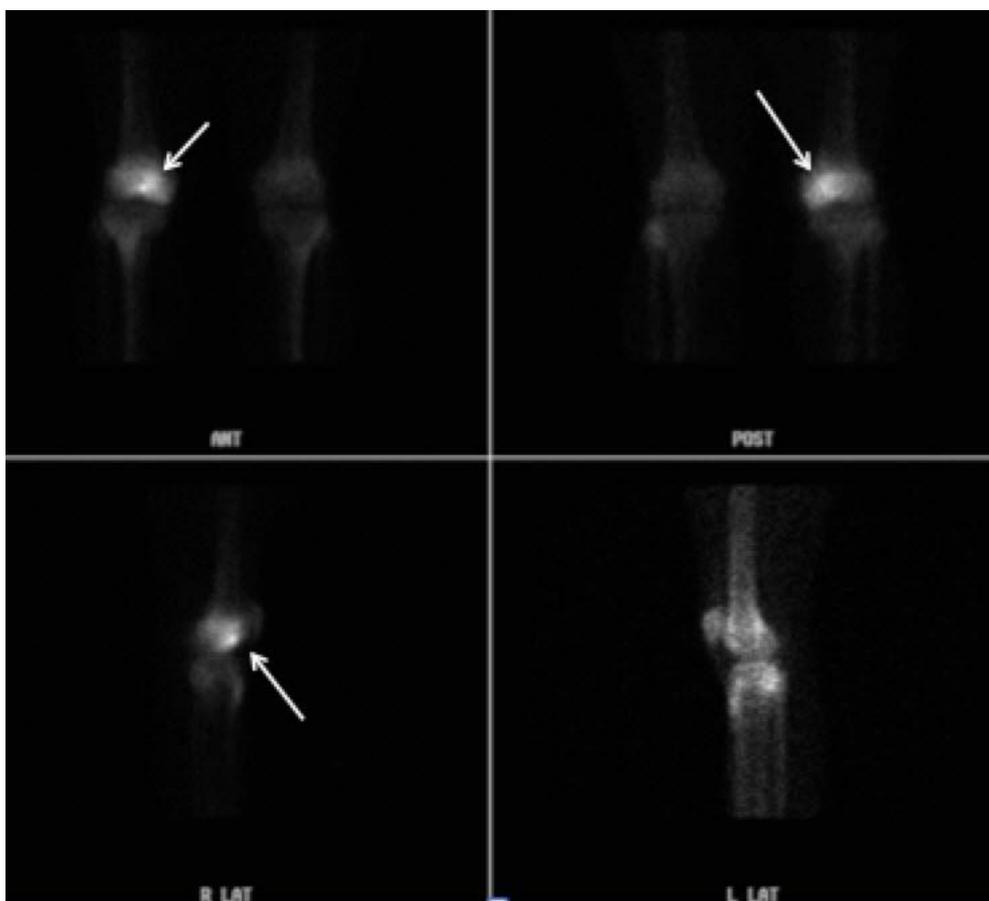
**Figure 1:** 20 year old man with intra-articular osteoid osteoma.  
Findings: Conventional radiography. Lateral (a), sunrise (b), and anteroposterior (c) radiographs do not show any abnormality.



**Figure 2:** 20 year old man with intra-articular osteoid osteoma.

Findings: Axial (a) and sagittal (b) images demonstrate a rounded subchondral lucent lesion (arrow) with a thin rim of sclerosis. Note the lack of dense surrounding sclerosis or periosteal reaction which is characteristic of intra-articular osteoid osteoma.

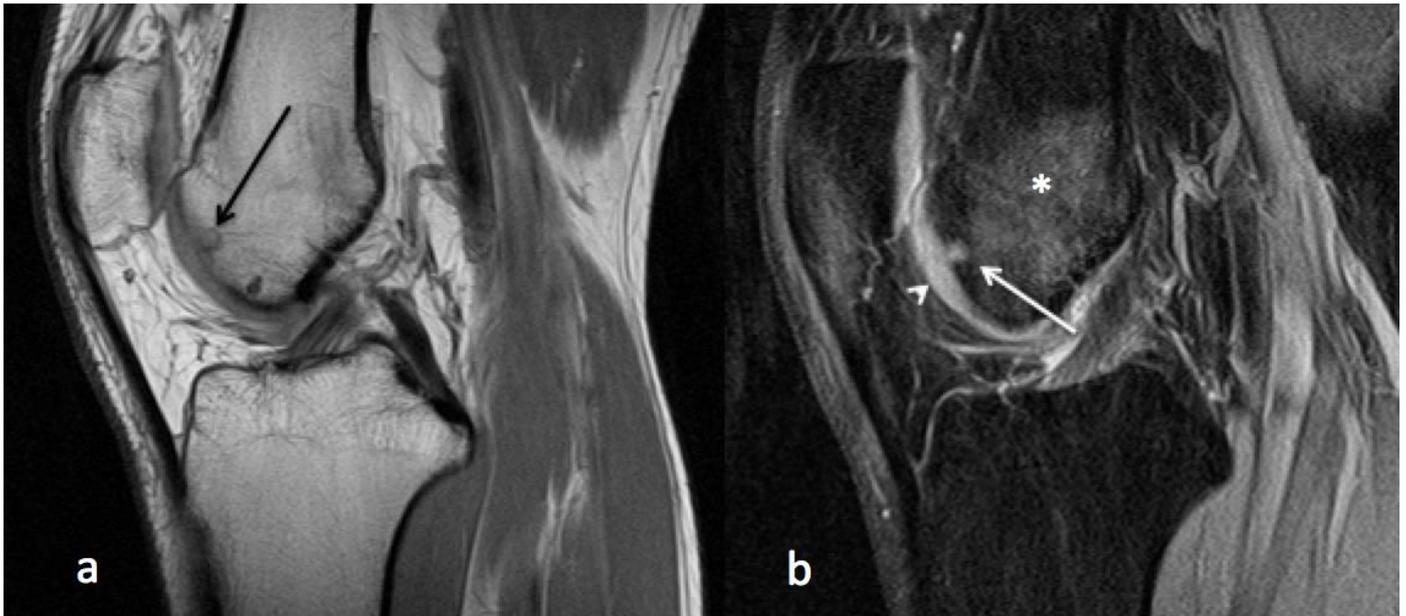
Technique: Unenhanced CT images were acquired kVp 120, slice width 2mm.



**Figure 3:** 20 year old man with intra-articular osteoid osteoma.

Findings: Radiotracer uptake is depicted at the distal femur (arrows) at the site of the lesion.

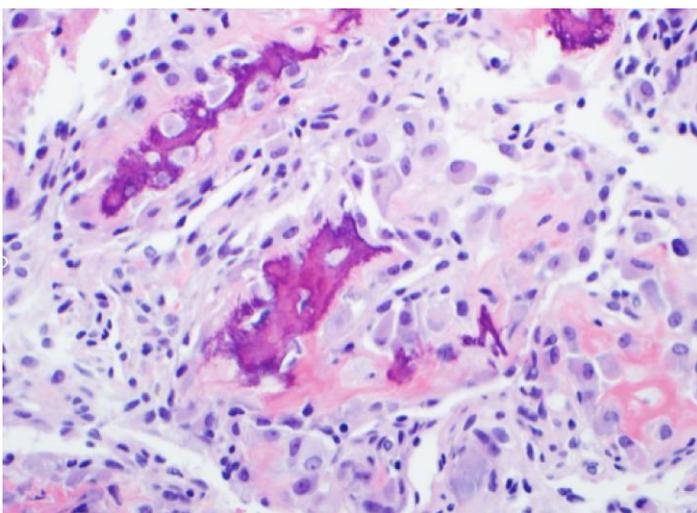
Technique: Nuclear bone scan with coned images of the right knee after the intravenous administration of 25.0 mCi of Tc-99m MDP (methylene diphosphonate). Images were obtained approximately 3 hours after injection of the radiopharmaceutical.



**Figure 4:** 20 year old man with intra-articular osteoid osteoma.

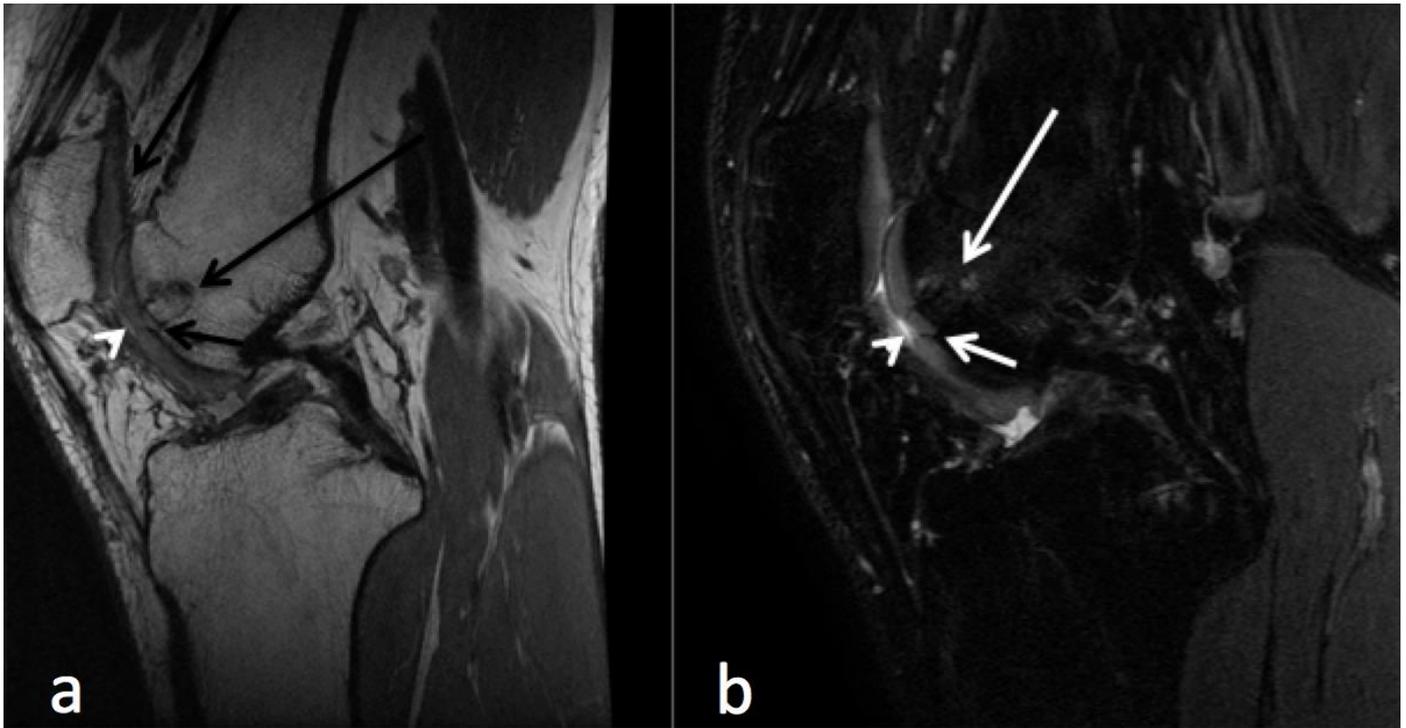
Findings: 3a) Sagittal T1WI and 3b) Sagittal intermediate-weighted sequence with fat saturation (TR 4200 TE 50) images demonstrate a focal round hyperintense subchondral lesion at the trochlea in a subchondral location (arrows). Note the overlying cartilage swelling (arrowhead) and bone marrow edema pattern (asterisk) affecting the distal femur adjacent to the lesion.

Technique: Magnetic resonance (MR) images were acquired at 3.0 T. Sagittal T1WI images were acquired with TR 1500 TE 25. Sagittal intermediate-weighted images were acquired with fat saturation and with TR 4200 and TE 50.



**Figure 5 (left):** 20 year old man with intra-articular osteoid osteoma.

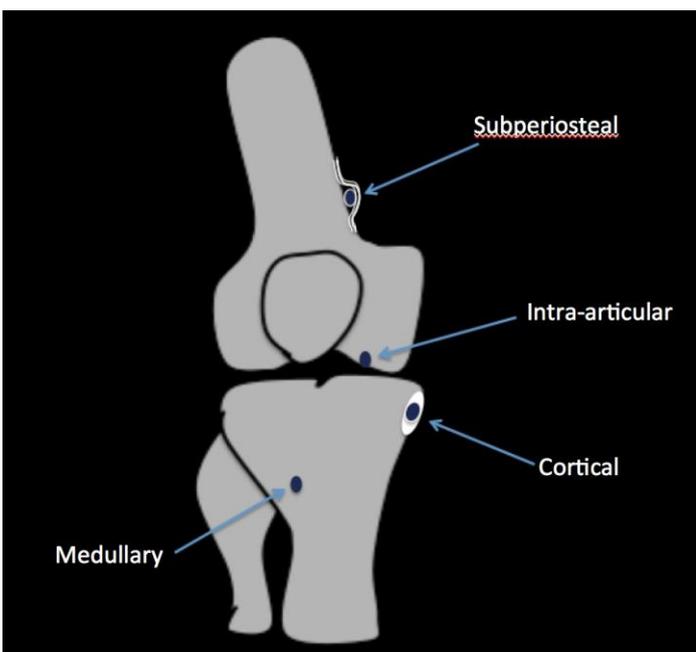
Findings: Hematoxylin and eosin stained section of the excised lesion reveals small fragments of microtrabecular woven bone and osteoid matrix. The matrix was rimmed by plump, reactive-appearing osteoblasts surrounded by a loose fibrovascular stroma. No atypia was identified. (A, original magnification 400X).



**Figure 6:** 20 year old man with intra-articular osteoid osteoma approximately six months following excision and osteochondral autograft transplant.

Findings: 5a) Sagittal T1WI and 3b) sagittal intermediate-weighted sequence with fat saturation images show a well-corporated osteochondral plug in the region of the excised osteoid osteoma (long arrows). The graft does not show dislocation or evidence of necrosis. While there is a slight step-off at the bone plate of the graft with the adjacent native subchondral bone plate, this offset is an expected finding (short arrows). Importantly, the cartilage surface of the graft is flush with the adjacent native cartilage (arrowhead).

Technique: Magnetic resonance (MR) images were acquired at 3.0 T. Sagittal T1WI images were acquired with TR 1500 TE 25. Sagittal intermediate-weighted images were acquired with fat saturation and with TR 4200 and TE 50.



**Figure 7 (left):** Subtypes of osteoid osteoma. Osteoid osteomas are classified as cortical, medullary, subperiosteal, or intra-articular, depending on their location within the bone. Note that intra-articular and medullary subtypes are associated with little if any surrounding osteosclerosis. The cortical subtype classically has prominent surrounding sclerosis. The subperiosteal subtype lies on the surface of the cortex and may result in exuberant periosteal reaction.

<b>Etiology</b>	Majority of patients affected are between 10 and 20 years of age with a male predominance
<b>Incidence</b>	10-13% of cases of osteoid osteoma[2]
<b>Gender ratio</b>	Male to female 2-3:1 [3]
<b>Clinical Findings</b>	Pain associated with intra-articular lesions is less dramatic than that associated with diaphyseal lesions with a less impressive response to salicylates [4].
<b>Risk Factors</b>	Idiopathic
<b>Treatment</b>	Surgical resection, RFA, osteochondral autograft transplantation.
<b>Prognosis</b>	May resolve spontaneously over time. RFA and surgical resection have theoretical risk of leading to cartilage injury and secondary osteoarthritis.
<b>Imaging findings</b>	Focal subchondral lucency often with minimal surrounding sclerosis and absent periosteal reaction. Joint effusion is frequent.

**Table 1:** Summary table for intra-articular osteoid osteoma.

	<b>X-ray</b>	<b>CT</b>	<b>MRI</b>	<b>Ultrasound</b>
<b>Intra-articular osteoid-osteoma</b>	Less surrounding sclerosis, often missed	Lucent nidus +/- internal calcification, with minimal surrounding sclerosis	Focal low to intermediate on T1WI and high signal on T2WI. Edema in adjacent marrow and soft tissues	Cortical irregularity with adjacent hypoechoic synovitis
<b>Juvenile idiopathic arthritis</b>	Joint spaces narrowing, erosions, physeal overgrowth, subluxations	Joint spaces narrowing, erosions, physeal overgrowth, subluxations	Low T1, high T2 signal erosions, enhancing, thickened synovium, effusion	Effusions with synovitis, erosions
<b>Osteochondral injury</b>	Flattened or irregular subchondral bone plate with cystic change	Flattened or irregular subchondral bone plate with cystic change	Cartilage loss, abnormal subchondral bone plate, marrow edema	Difficult to assess.
<b>Intra-articular fracture</b>	Step-off of articular surface, +/- intra-articular fracture fragment	Step-off of articular surface, +/- intra-articular fracture fragment	Linear low T1, high T2 signal extending to an articular surface, marrow edema.	Step-off of the echogenic cortical margin, effusion.
<b>Subchondral cyst</b>	Subchondral lucency, +/- joint space narrowing, osteophytes, sclerosis	Subchondral lucency, +/- joint space narrowing, osteophytes, sclerosis	Cartilage loss, osteophytes, reactive marrow edema.	Difficult to assess.

**Table 2:** Differential diagnosis table for intra-articular osteoid osteoma.

**ABBREVIATIONS**

CT: Computed tomography  
MRI: Magnetic resonance imaging  
RF: radiofrequency  
Tc-99m MDP: Technetium-99m methylene diphosphonate

**KEYWORDS**

osteoid osteoma; cartilage; repair; femur; osteochondral autograft; MRI

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