MRI characteristics of intraosseous lesions of the patella

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Intra-osseous lesions of the patella are rare and there is little published literature. We describe MRI features of the most common patellar tumours and tumour-like lesions along with their histopathological diagnoses.
Background

The patella is an uncommon location for tumours. It is involved in 1 to 4 out of 1000 cases of bone tumours.

Intra-osseous lesions of the patella present with non-specific symptoms such as pain, swelling, reduced range of movement, mass or pathological fracture. A tumourous condition should be suspected in cases with resistant night pain.

Pre-operative diagnosis is often difficult because radiographs only allow evaluation of aggressiveness and not the histological diagnosis. Imaging with the use of CT and MRI plays an important part in the diagnostic work-up.

Majority of patellar tumours are benign, the vast majority are giant cell tumours and chondroblastomas but some uncommon tumours and tumour like conditions can cause diagnostic dilemmas.
Imaging findings OR Procedure Details

All cases of tumours and tumour-like lesions of the patella diagnosed in the department of Radiology at the Royal National Orthopaedic Hospital between 2008 and 2015 were reviewed.

The clinical and surgical records, radiological findings and histopathology of 10 cases with 11 patellar lesions were reviewed.

There were 5 male and 5 female patients with age range 14 to 68 years. The presenting symptom was knee pain in all cases.

The most common patellar intraosseous lesion in our series were benign tumours (4 cases). The most common benign patellar intraosseous lesion in our case series was giant cell tumour (3 cases). The second most common benign patellar intraosseous lesion in our series was chondroblastoma. There was one malignant tumour (lymphoma). There were six non-neoplastic condition (one gout, one tuberculosis, three dorsal defects and one rheumatoid disease).

Benign patellar tumors

Giant cell tumour/GCT

It is the most common type of diagnosed patellar tumours (33% of all the patellar tumours). GCT has a peak incidence in the third or fourth decade of life. Patients present with non-specific knee pain and/or swelling. Plain radiographs demonstrate an osteolytic lesion with faded boundaries. CT findings include an intraosseous lytic lesion with cortical thinning or cortical erosion and joint effusion. Pathological fracture may be found. On MRI, the lesion shows higher signal intensity compared to skeletal muscle onT1-weighted sequences and heterogenous signal intensity on T2-weighted spectral presaturation with inversion recovery sequences. Contrast-enhanced fat-suppressed T1-weighted sequences demonstrate heterogenous strong enhancement of the lesion. There was no obvious soft tissue or intra-articular extension. An incisional biopsy was performed and histopathological diagnosis of GCT was made. The surgical treatment for small benign patellar GCT includes curettage with bone graft and partial patellectomy. Total patellectomy has been recommended as the preferred treatment for aggressive GCT of the patella.

Chondroblastoma
It is the second most common benign patellar tumour (16% of all the patellar tumours). Patients present with knee pain and/or swelling. Plain radiographs demonstrate a radiolucent lesion with well-defined sclerotic margin. Pathological fracture may be present. MRI shows the lesion as low to intermediate signal on T1-weighted sequences and intermediate to high signal on T2-weighted sequences. Appearances are of a lobulated lesion within an expanded patella with a low-signal intensity rim; fluid-fluid levels may occasionally be seen. Low signal intensity foci within the tumour corresponding to calcification seen on plain radiographs or CT may be seen. Bone marrow oedema is present in majority of cases, for which STIR sequence is of particular value. The recommended treatment is curettage and bone grafting. If large or recurrent patellectomy is indicated.

Other even rarer benign patellar lesions include osteoid osteoma, aneurysmal bone cyst, chondroma, osteochondroma, osteoblastoma, haemangioma, simple bone cyst, lipoma, osteitis fibrosa cystica, ganglion, osteoma, non-ossifying fibroma.

**Malignant patellar tumours**

Malignant patellar tumours are even more rare. The most common described malignant patellar tumours is osteosarcoma. Others include chondrosarcoma, primary osseous lymphoma, malignant fibrous histiocytoma, leiomyosarcoma, angiosarcoma, haemangioendothelioma and Ewing’s sarcoma.

We had one case of a malignant patellar tumour which was histologically proven to be a lymphoma. Plain radiographs show a well-defined radiolucent lesion or moth-eaten appearance and multiple lytic lesions. Pathological fracture may be present. MRI shows a marrow-replacing lesion with heterogenous and mostly hypointense signal intensity on T1-weighted sequences, heterogenous and mostly hyperintense signal on T2-weighted sequences. Heterogenous enhancement and peri-lesional oedema and soft-tissue extension may be seen. The common treatment includes a combination of chemotherapy and radiotherapy, chemotherapy alone and radiotherapy alone.

**Tumour-like conditions**

Various tumour-like conditions that mimic tumours have been described including osteomyelitis, brown tumour of hyperparathyroidism, gout, tuberculosis and Paget’s disease.

In our series, there were six non-neoplastic conditions (one gout, one tuberculosis, three dorsal defects and one rheumatoid disease).
Gout

Tophus of the patella can cause knee pain in patients with gouty arthritis. In cases with patellar involvement, patients may experience a variety of symptoms including pain, swelling, tissue mass and limited range of movement. Plain radiographs show lobulated, well-defined expansile osteolytic lesion with sclerotic rim. MRI shows bone marrow oedema and well-defined expansive soft-tissue lesions with low signal intensity on T1-weighted and high signal intensity on T2-weighted sequences. Thickening and heterogenous signal intensity in the patellar tendon has been described. Differential diagnosis also includes chronic rheumatoid arthritis, pigmented villonodular synovitis, chronic infectious arthritis and amyloidosis. The constellation of clinical and MRI findings often allow the specific diagnosis be rendered. Early diagnosis and treatment are essential since tophus deposition urges adequate hypouricaemic medical treatment.

Tuberculosis

The knee is the third most frequent skeletal locations for tuberculosis. Knee tuberculosis mainly involves the synovium with local extension eroding the bone. Patellar tuberculosis is rare. Plain radiographs may show lytic area with sclerotic borders, sequestrum may be present as a density. MRI detects intraosseous lucency with central calcific densities, suggesting chronic osteomyelitis with sequestrum. early bone marrow oedema and soft tissue abnormalities. Diagnosis is usually confirmed by histology and bacteriology. Treatment is based on multiple antibiotherapy.

Rheumatoid arthritis

Plain radiograph findings include soft tissue swelling, osteopenia, loss of joint space, erosions, growth disturbance (epiphyseal overgrowth) and joint subluxation. MRI shows synovial hypertrophy, joint effusions as well as osseous and cartilaginous erosions. Active synovitis is characterised by enhancement on T1-weighted gadolinium contrast studies.

Dorsal defect of the patella

A characteristic lytic patellar lesion, the dorsal defect is a variant related to normal ossification. It usually is an incidental radiographic finding but occasionally may be symptomatic with knee pain. Dorsal defect of the patella presents in 0.3 to 1% of the population. On plain radiographs, dorsal patellar defect is a round, radiolucent lesion surrounded by a zone of sclerosis located on the superolateral aspect of the dorsal surface of the patella. MR shows a hemispherical defect in the deep cortical surface of the patella with intact overlying cartilage that thickens to fill the defect. It demonstrates low signal on T1 and high signal on T2 images. The location, radiographic appearance and clinical course are unique, distinguishing it from other lesions of the patella. It should not undergo biopsy.
**Fig. 1:** There is a poorly-defined destructive lesion involving the patella, which is resulting in a minimally displaced pathological fracture. There is marked overlying soft tissue swelling and also effusion in the suprapatellar pouch. The features could be those of a giant cell tumour.

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Fig. 2: Patellar lesion with mild permeation and destruction of the cortex, no appreciable surrounding soft tissue mass. There is reactive pre-patellar bursitis and also a large joint effusion. There is no evidence of matrix mineralisation. The features are most likely those of a giant cell tumour.

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**Fig. 3:** The patellar lesion has heterogeneous intermediate signal on T1. GCT

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**Fig. 4:** Following contrast, it shows fairly extensive central necrosis. GCT

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Fig. 5: There is a poorly-defined lytic lesion involving the medial half of the patella. The knee joint itself appears intact and there is no appreciable synovitis. Possibilities would include a chondroblastoma, GCT and TB.

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Fig. 6: Poorly-defined lytic lesion involving the medial half of the patella. The knee joint itself appears intact and there is no appreciable synovitis. Possibilities would include a chondroblastoma, GCT and TB.

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Fig. 7: Lobulated intraosseous lesion which is mildly hyperintense on T1-weighted imaging. There is a slender rim of sclerosis demonstrated around the lesion. Chondroblastoma

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Fig. 8: Several fluid-fluid levels at the medial aspect of the lesion. Chondroblastoma

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Fig. 9: There is ill-defined focus of bone destruction in the medial aspect of the patella. Mild expansion of the patella is noted, with loss of definition of the inferior aspect the articular surface. There is also a surrounding soft tissue swelling. A further subtle focus of lucency is identified in the tibial tubercle with no adjacent soft tissue abnormality. Lymphoma

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Fig. 10: There are small lobules of abnormal signal suggesting tumour in the adjacent soft tissues suggesting extraosseous extension. There is also marked soft tissue oedema in the prepatellar region and Hoffa’s fat pad proximally. There is a further area of abnormal marrow signal at the tibial tubercle. Lymphoma

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Fig. 11: There is a well-defined lytic lesion present in the lateral aspect of the patella.

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Fig. 12: Well-defined lytic lesion with a lobular outline and matrix mineralisation. Gout
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Fig. 13: The lesion present in the patella demonstrates a slightly bright signal intensity on fat suppressed sequences. Gout

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**Fig. 14:** Rim enhancement of the bone abscess with general enhancement of the oedematous patella. Enhancing inflammatory tissue is seen in the superior aspect of the fat pad adjacent to the inferior pole of the patella and within this, there is also evidence of an abscess collection. Enhancing synovitis of the knee joint is also noted. TB

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Fig. 15: Enhancing inflammatory tissue is seen in the superior aspect of the fat pad adjacent to the inferior pole of the patella and within this, there is also evidence of an abscess collection. TB

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**Fig. 16:** Plain radiograph of knees show bilateral well-defined lucencies in the superolateral patellae Dorsal defect of patella

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Fig. 17: T1-weighted sagittal image shows a well-circumscribed defect in the superolateral aspect of the patella. Dorsal defect of patella

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Fig. 18: Axial T1-weighted image shows a well-circumscribed defect in the dorsal patella with chondral thickening covering the defect. Dorsal defect of patella

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Conclusion

MRI imaging features, in conjunction with other radiographic features on plain radiographs or CT, may help narrow the differential of tumours and tumour-like lesions of the patella.

Imaging may obviate the need for tissue diagnosis in some cases. If there is a suspicion of malignancy, histological diagnosis should be obtained before definitive treatment.
References


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