ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 03 | March - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

MAGNETIC RESONANCE IMAGING OF PATELLAR INSTABILITY: UNVEILING INJURY PATTERNS, A PICTORIAL REVIEW

Radio-Diagnosis

Dr. Sana Shah Alam* Post Graduate, Department Radiodiagnosis, J.J.M. Medical College And Hospital. *Corresponding Author

Dr. Jeevika M U Professor & Head of department Radiodiagnosis, J.J.M. Medical College And Hospital.

ABSTRACT

Anterior knee pain (AKP) is a commonly encountered clinical scenario for radiologists and clinicians. Pain is localized to the peri- or retropatellar region and is exacerbated by activities that repetitively increase patellofemoral joint compressive forces, such as running, squatting or cycling. This entity is clinically known as patellofemoral syndrome (PFS). It can lead to chronic pain, limitation of activity and can predispose patients to the development of early osteoarthritis. **Materials And Methods:** A prospective study was conducted at the Department of Radiodiagnosis, JJM Medical College, Davangere, Karnataka. Imaging of patients was performed using a PHILIPS 1.5T MRI machine. The patients were analyzed for the presence of bone, hyaline cartilage and soft-tissue abnormalities, as well as anatomic variants that may contribute to patello-femoral mal-tracking or impingement abnormalities. **Conclusion:** Magnetic resonance imaging is the preferred diagnostic tool for younger patients experiencing anterior knee pain when patello-femoral instability is suspected clinically. MRI plays a crucial role in diagnosing various anatomical variations, ligament injuries, and cartilage damage that may lead to instability, assisting orthopedic surgeons in early diagnosis and treatment.

KEYWORDS

anterior knee pain, patellar instability, MRI knee, patella alta, patella baja, chondromalacia patellae, trochlear dysplasia,

INTRODUCTION

There are multifactorial causes of anterior knee pain with complex interactions between various anatomical structures that make the diagnosis of patellofemoral joint (PFJ) disorders challenging [1]. While anterior knee pain is primarily associated with abnormal PFJ morphology including patella alta and baja, trochlear dysplasia, lateralization of tibial tuberosity, lateral patellar tilt, abnormal patellar height, and excessive tibial tubercle–trochlear groove (TT–TG) distance. There can also be impingements around the knee joint leading to dysfunction in the extensor mechanism involving the anterior supra patellar (quadriceps) fat pad, posterior suprapatellar (pre femoral) fat pad and infra patellar (Hoffa's) fat pad. Other contributing factors include arthritic changes, and injuries to the ligaments and meniscus which alter the integrity of the PFJ. The longitudinal stabilizer of the joint is quadriceps tendon proximally and the patellar tendon distally. The transverse stabilizer includes medial and lateral retinacula, the ilio-tibial band and medial patello-femoral ligament (MPFL). PFJ imaging plays a vital role in identifying the source of anterior knee pain and guiding personalized treatment strategies. Key factors contributing to patellofemoral instability (PFI) can be assessed through imaging.

Table – 1 Morphological Abnormality And Assessment Criteria

ABNORMALITY	ASSESSMENT
Patellar Alta	- Insall Salvati ratio - Caton-Deschamps index
Trochlear Dysplasia	- Trochlear depth - Trochlear facet asymmetry (Fig 2) - Lateral trochlear inclination
Lateralization of tibial tuberosity	- Tibial tuberosity- trochlear groove distance (TT-TG)
Lateral patellar tilt	- Patellar tilt angle - Patellofemoral angle.

(table source: comprehensive textbook of clinical radiology by Amarnath C, Hemanth Patel)

1. TROCHLEAR DYSPLASIA

The Dejour classification identifies four types of trochlear dysplasia, based on radiographic images taken from a lateral view with the posterior condyles perfectly superimposed.

1. The four types are described as follows [2]
Type A: A crossing sign in the lateral view. The trochlea is concave and symmetrical but shallower than usual.
Type B: In addition to the crossing sign, a supratrochlear spur is present. The trochlea appears prominent and flat on axial images.
Type C: A crossing sign along with a double contour. On axial images, the lateral facet is convex, and the medial facet is underdeveloped, with no prominence observed.
Type D: All of the previous signs—crossing sign, supratrochlear spur, and double contour—and shows a distinct asymmetry between the medial and lateral facets.

Fig 1: T2 axial sequence shows Weiberg type III patella (Dejour classification).

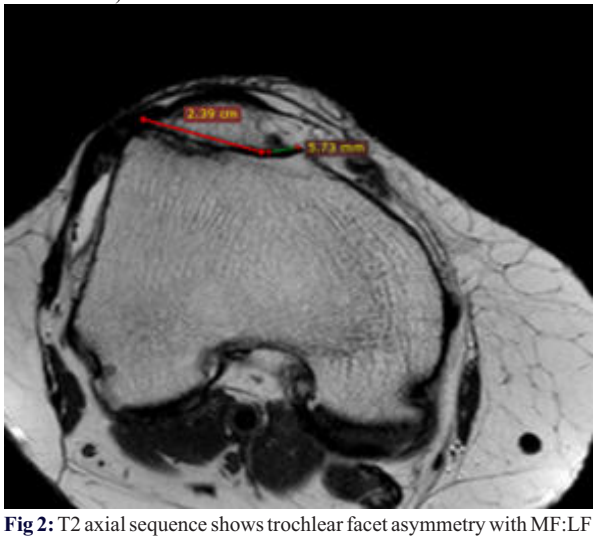

Fig 2: T2 axial sequence shows trochlear facet asymmetry with MF:LF measuring 23.9 percent (Normal >40).

Patella Alta And Baja

Patella alta and patella baja describe extreme variations in the relationship between the patella and patellar tendon length, both of which are linked to anterior knee pain [3]. Patella alta, or a high-riding patella, is associated with chondromalacia patella, increased risk of patellar subluxation or dislocation due to patellofemoral instability. Patella baja, or a low-riding patella, may be seen in neurological disorders, following trauma, or after patellar tendon harvest for ACL reconstruction [3].

The most popular method for assessment is the Insall-Salvati ratio or index is the ratio of the patella tendon length to the length of the patella and is used to determine patellar height [4]. On MRI the following is usually accepted as reasonable:
-patella baja: <0.74
-normal: 0.74-1.5
-patella alta: >1.5

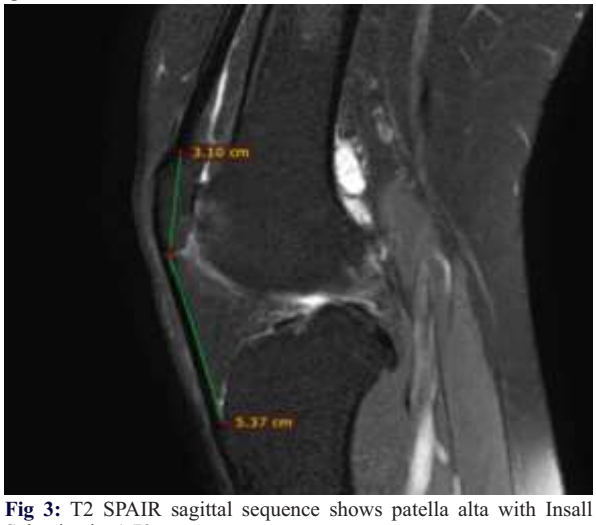

Fig 3: T2 SPAIR sagittal sequence shows patella alta with Insall Salvati ratio: 1.73

3. PATELLA SUBLUXATION

Partial displacement of the patella in the process of knee flexion. It may be lateral, medial, or lateral to medial.

- Lateral subluxation: The ridge of the patella is laterally displaced in relation to the center of femoral trochlear groove, or the lateral facet of the patella overlaps the lateral aspect of femoral trochlea.

- Medial subluxation: Medial displacement of the patellar ridge relative to the femoral trochlear groove or the center most part of the femoral trochlea.

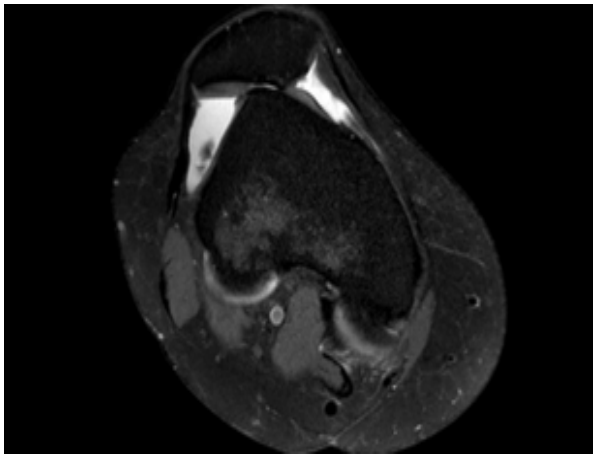

Fig 4: T2 SPAIR sequence in axial section showing lateral subluxation of patella outside the trochlear groove. Joint effusion noted.

4. HOFFA'S FAT PAD EDEMA

Hoffa's infrapatellar fat pad is one of three anterior fat pads of the knee, the other two being the anterior suprapatellar (quadriceps) and posterior suprapatellar (pre-femoral) fat pads. Impingement of the fat pad leads to fat pad enlargement and an increased T2 signal[5]. Recently, this signal change in the superolateral Hoffa's fat pad has been proposed as a secondary indicator of patellofemoral mal-tracking, specifically in patellar tendon-lateral femoral condyle friction syndrome [5].

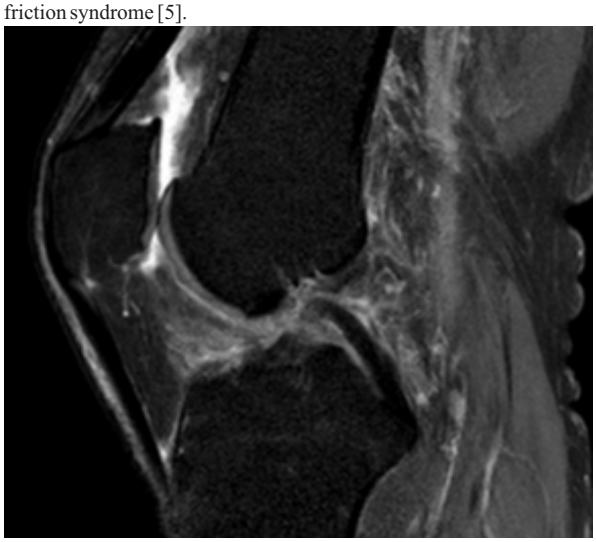

Fig 5: T2 SPAIR sagittal sequence shows edema and fluid in patello-femoral joint space with mild hyperintensity in Hoffa's fat pad.

5. INJURY TO MEDIAL PATELLAR STABILIZERS

Disruption of medial ligamentous stabilizers, such as the MPFL and the medial patellar retinaculum, is diagnosed on MR images in 70%–100% of the patients examined after lateral patellar dislocation [6].

A full-thickness tear of a medial stabilizer on MR imaging shows complete ligament disruption with local soft tissue edema, appearing as high signal intensity on T2-weighted images. A partial tear is seen as an irregular or partially discontinuous ligament, accompanied by tendinous or peritendinous edema [6]. Edema at the patellar border and femoral condyles suggest damage to at least one medial ligamentous compartment.

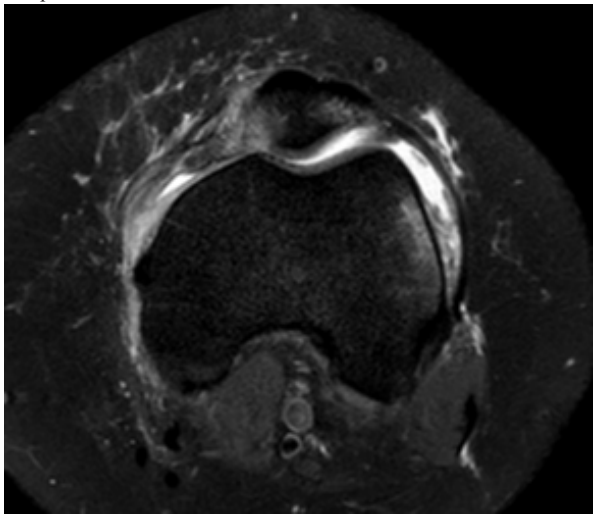

Fig 6: T2 SPAIR sequence in axial section, medial patellar retinaculum appears thickened, edematous, wavy, with mid-substance hyperintensity and discontinuity at the patellar attachment.

6. CHONDROMALACIA PATELLAE

Chondromalacia patellae is the softening and degeneration of the patellar articular cartilage that interacts with the femoral trochlear groove, often leading to anterior knee pain [7].

The Outerbridge classification of chondrosis states:
grade 0 - normal

grade 1 - cartilage signal abnormality, but appears architecturally

intact

grade 2 - surface fraying or focal defects involving less than 50% of cartilage thickness

grade 3 - defects involving more than 50% of cartilage thickness, without bone edema

grade 4 - full-thickness cartilage defect/loss with associated bone marrow edema

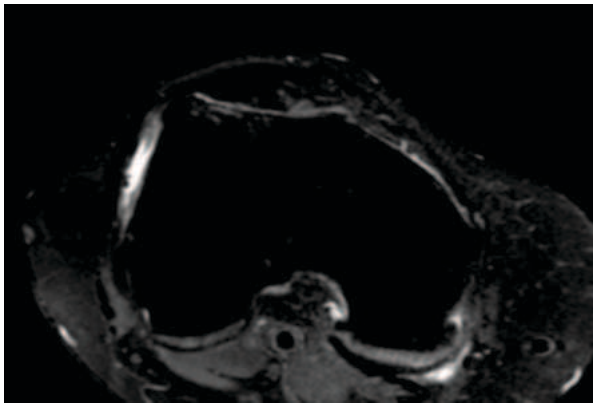

Fig 7: T2 SPAIR sequence in axial section, Cartilage defect noted in patellar articular cartilage with underlying signal intensity, and cortical irregularity – Grade III chondromalacia patellae

CONCLUSIONS

MR imaging contributes to the diagnosis of different anatomic variants, ligamentous injuries and chondral lesions that predispose to instability, and guides the orthopedic surgeons in selecting the most optimal treatment. MRI can detect the different grades of some knee pathologies such as trochlear dysplasia, chondromalacia patella or factors that may predispose to them. The differentiation among these lesions is important to direct appropriate patient management and prevent patellofemoral articular cartilage loss.

REFERENCES:

[1] Barbosa RM, da Silva MV, Macedo CS, Santos CP. Imaging evaluation of patellofemoral joint instability: a review. Knee Surg Relat Res. 2023 Mar 13;35(1):7. doi: 10.1186/s43019-023-00180-8. PMID: 36915169; PMCID: PMC10012577.

[2] Berruto M, Ferrua P, Carimati G, Uboldi F, Gala L. Patellofemoral instability: classification and imaging. Joints. 2013 Oct 24;1(2):7-14. PMID: 25606511; PMCID: PMC4295697.

[3] Shabshin, Nogah & Schweitzer, Mark & Morrison, William & Parker, Laurence. (2004). MRI criteria for patella alta and baja. Skeletal radiology. 33. 445-50. 10.1007/s00256-004-0794-6.

[4] Gaillard F, Jones J, Roberts D, et al. Insall-Salvati ratio. Reference article, Radiopaedia.org (Accessed on 03 Mar 2025) https://doi.org/10.53347/rID-1503

[5] Saddik D, McNally EG, Richardson M. MRI of Hoffa's fat pad. Skeletal Radiol 2004; 33:433–444

[6] Elias DA, White LM, Fithian DC. Acute lateral patellar dislocation at MR imaging: injury patterns of medial patellar soft-tissue restraints and osteochondral injuries of the inferomedial patella. Radiology 2002;225(3):736–743.

[7] Farooq S, Walizai T, Nassar I, et al. Chondromalacia patellae. Reference article, https://doi.org/10.53347/rID-9173

[8] Gaillard F, Knipe H, Jones J, et al. Modified Outerbridge grading of chondromalacia., https://doi.org/10.53347/rID-1120