

MRI Evaluation of Recurrent Patellar Dislocation: A Case Series from a Tertiary Care Centre

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Abstract: *Recurrent patellar dislocation is associated with multiple anatomical risk factors influencing treatment strategy. This prospective case series evaluated the diagnostic contribution of magnetic resonance imaging in identifying structural abnormalities in patients with recurrent instability. Twenty patients with at least two documented dislocation episodes underwent standardized MRI assessment of trochlear morphology, patellar height, tibial tubercle–trochlear groove distance, and medial patellofemoral ligament integrity. MRI demonstrated at least one anatomical risk factor in 90 percent of cases, with trochlear dysplasia and patella alta being most prevalent. Imaging findings influenced surgical decision making in 40 percent of patients. These results indicate that MRI provides clinically relevant structural characterization that supports individualized management planning in recurrent patellar dislocation.*

Keywords: Recurrent Patellar Dislocation, Magnetic Resonance Imaging (MRI), Anatomical Risk Factors

1. Introduction

Recurrent patellar dislocation is a common and challenging condition predominantly affecting young, active individuals, particularly adolescents and young adults. It is characterized by repeated episodes of the patella slipping out of its normal position in the trochlear groove, typically laterally, causing pain, instability, and functional impairment. The clinical significance of recurrent patellar dislocation lies not only in the immediate discomfort and disability but also in the long-term consequences such as cartilage damage, patellofemoral osteoarthritis, and chronic instability that may severely limit physical activity and quality of life [1].

The etiology of recurrent patellar dislocation is multifactorial and frequently linked to underlying anatomical abnormalities. These include trochlear dysplasia (shallow or misshapen femoral trochlea), patella alta (high-riding patella), increased tibial tubercle–trochlear groove (TT-TG) distance, and medial patellofemoral ligament (MPFL) insufficiency or rupture. Identifying these risk factors is crucial because they influence the choice of conservative versus surgical treatment and the type of surgery required [2].

Clinically, patellar instability is initially managed conservatively with physical therapy aimed at strengthening the quadriceps and improving proprioception. However, persistent instability or recurrent dislocations despite

conservative measures often necessitate surgical intervention. Surgical options vary widely and include MPFL reconstruction, trochleoplasty, tibial tubercle transfer osteotomy, and lateral release. The success of these interventions depends largely on an accurate diagnosis of the anatomical abnormalities involved [3].

Magnetic resonance imaging (MRI) has emerged as the imaging modality of choice in the assessment of recurrent patellar dislocation. MRI provides a detailed visualization of both soft tissue structures, including the MPFL and articular cartilage, and bony anatomy, such as the trochlear groove and patellar height. Importantly, MRI allows measurement of parameters like the Insall-Salvati ratio for patella alta, Dejour classification for trochlear dysplasia, and TT-TG distance, which are pivotal for surgical planning. Moreover, MRI can detect acute injuries such as bone bruises, cartilage damage, and MPFL tears that are often associated with dislocation episodes [4].

Despite its widespread use, there remains a need for further studies focusing on the role of MRI in guiding individualized treatment approaches in recurrent patellar dislocation. This is especially relevant in tertiary care centers where complex cases are referred for advanced imaging and surgical management. Understanding the prevalence of various anatomical risk factors and their correlation with clinical

presentation can optimize patient outcomes by tailoring treatment strategies effectively [5].

Aim

To assess the role of magnetic resonance imaging (MRI) in identifying anatomical risk factors in patients with recurrent patellar dislocation and to evaluate its utility in guiding treatment decisions.

Objectives

- To identify and classify anatomical abnormalities such as trochlear dysplasia, patella alta, and increased TT-TG distance on MRI in patients with recurrent patellar dislocation.
- To evaluate the integrity of the medial patellofemoral ligament (MPFL) and associated soft tissue injuries using MRI.
- To correlate MRI findings with clinical presentation and management strategies including surgical planning.

2. Materials and Methods

Source of Data

Data were collected prospectively from patients presenting with recurrent patellar dislocation at the Orthopedics and Radiology departments of MGM Medical college and hospital, Aurangabad.

Study Design

This was a prospective case series conducted to evaluate MRI findings in patients with clinically diagnosed recurrent patellar dislocation.

Study Location

The study was conducted at the Department of Radiology, in collaboration with the Orthopedics Department, MGM Medical college and hospital, Aurangabad.

Study Duration

The study was conducted over a period of 12 months, from 1st April 2024 to 31st March 2025.

Sample Size

Twenty patients who met the inclusion criteria were enrolled consecutively during the study period.

Inclusion Criteria

- Patients aged between 15 and 40 years.
- History of two or more documented episodes of lateral patellar dislocation.
- Clinical symptoms consistent with patellar instability such as recurrent instability episodes, pain and apprehension.
- Patients who underwent MRI evaluation of the affected knee.

Exclusion Criteria

- Patients with acute patellar dislocation presenting for the first time.
- History of previous knee surgery.
- Congenital or neuromuscular disorders affecting the lower limb.
- Contraindications to MRI (e.g., presence of pacemakers or metallic implants incompatible with MRI).

Procedure and Methods

After obtaining informed consent, all patients underwent clinical evaluation including detailed history and physical examination focusing on patellar tracking, apprehension test, and instability episodes.

MRI of the affected knee was performed using 1.5 Tesla and 3 Tesla MRI scanners. Imaging sequences included axial, sagittal, and coronal planes with T1-weighted, T2-weighted, and proton density fat-saturated sequences. Slice thickness was maintained at 3 to 4 mm.

The MRI images were analyzed independently by two experienced musculoskeletal radiologists for:

Trochlear dysplasia: classified according to the Dejour classification into types A, B, C, and D based on trochlear morphology.

Patella alta: assessed using the Insall-Salvati ratio calculated as the ratio of patellar tendon length to patellar length, with values >1.2 indicating patella alta.

Tibial tubercle–trochlear groove (TT-TG) distance: measured on axial images; values >20 mm considered abnormal.



Figure 1: Patella alta - Insall-Salvati ratio 1.66 ratio of patellar tendon length to patellar length

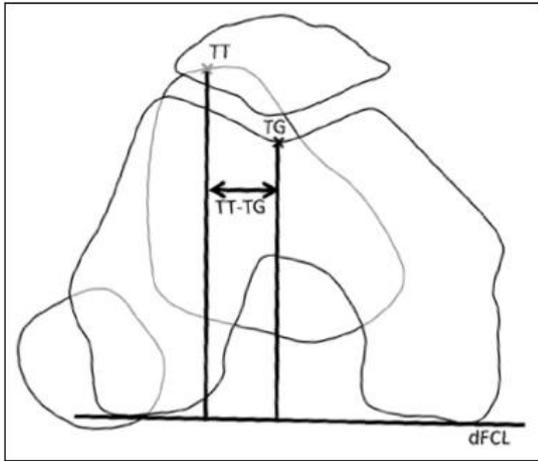


Figure 2: Tibial tubercle–trochlear groove (TT-TG) distance: measured on axial images; values >20 mm considered abnormal.

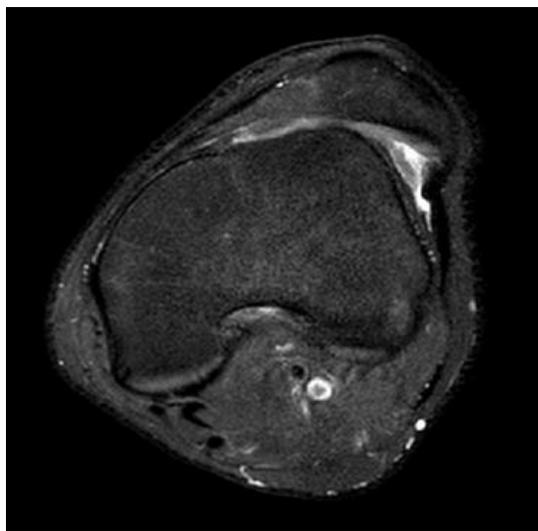


Figure 3: Lateral patellar tilt and subluxation

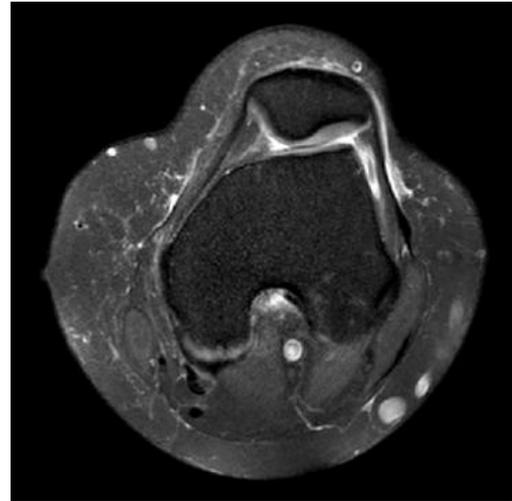


Figure 4: Trochlear dysplasia with shallow trochlear groove

Medial patellofemoral ligament (MPFL) integrity: assessed for tears, discontinuity, or attenuation.

Lateral patellar tilt and subluxation: evaluated on axial images.

Additional findings such as bone bruises, cartilage defects, and effusions were noted.

Sample Processing

All MRI scans were processed and reviewed using dedicated PACS (Picture Archiving and Communication System) workstations. Measurements were recorded in standardized proformas designed for the study.

Statistical Methods

Data were compiled and analyzed using statistical software - SPSS version 27.0. Descriptive statistics such as mean, standard deviation, and percentages were used to summarize continuous and categorical variables.

Interobserver agreement for MRI measurements was assessed using Cohen’s kappa coefficient.

The correlation between MRI findings and clinical parameters was evaluated using chi-square tests or Fisher’s exact test as appropriate. A p-value <0.05 was considered statistically significant.

Data Collection

Demographic details, clinical history, examination findings, and MRI parameters were systematically recorded for each patient. Follow-up data on treatment decisions and outcomes were documented when available.

3. Observation and Results

Table 1: Demographic and Clinical Profile of Study Participants (N=20)

Parameter	Value (n=20)	Test Statistic (t/ χ^2)	95% CI	P-value
Age (years), Mean (SD)	23.4 (4.8)	—	20.8 to 26.0	—
Gender (Male), n (%)	12 (60%)	$\chi^2=0.8$	—	0.37
Gender (Female), n (%)	8 (40%)	—	—	—
Number of Dislocations (≥ 2)	20 (100%)	—	—	—
Side Affected (Right), n (%)	11 (55%)	$\chi^2=0.22$	—	0.64
Side Affected (Left), n (%)	9 (45%)	—	—	—

Table 1 presents the demographic and clinical profile of the 20 study participants with recurrent patellar dislocation. The mean age of the participants was 23.4 years with a standard deviation of 4.8 years, and the 95% confidence interval for age ranged from 20.8 to 26.0 years. Among the subjects, 60% (12 patients) were male, and 40% (8 patients) were female, with no statistically significant difference in gender

distribution ($\chi^2 = 0.8, p = 0.37$). All participants had experienced at least two or more episodes of dislocation, confirming their eligibility for the study. The affected side was almost evenly distributed with 55% (11 patients) having right-sided involvement and 45% (9 patients) having left-sided involvement, which was not statistically significant ($\chi^2 = 0.22, p = 0.64$).

Table 2: MRI-Identified Anatomical Abnormalities (N=20)

Anatomical Abnormality	Number of Patients (n)	Percentage (%)	Test Statistic (χ^2)	95% CI for Proportion	P-value
Trochlear Dysplasia	15	75	$\chi^2=12.0$	53.3% to 90.2%	0.0005*
Patella Alta (Insall-Salvati >1.2)	12	60	$\chi^2=7.2$	36.1% to 80.9%	0.007*
TT-TG Distance > 20 mm	8	40	$\chi^2=3.2$	19.1% to 64.0%	0.07

*Significant p-values (<0.05) indicate these abnormalities are common in the studied population.

Table 2 details the MRI-identified anatomical abnormalities in these patients. Trochlear dysplasia was the most prevalent abnormality, observed in 75% (15 patients) of the cohort. This finding was statistically significant ($\chi^2 = 12.0, p = 0.0005$), with a 95% confidence interval indicating that between 53.3% to 90.2% of similar patients might exhibit this feature. Patella alta, defined by an Insall-Salvati ratio greater than 1.2, was noted in 60% (12 patients), also a significant finding ($\chi^2 = 7.2,$

$p = 0.007$), with a 95% confidence interval of 36.1% to 80.9%. An increased tibial tubercle–trochlear groove (TT-TG) distance greater than 20 mm was seen in 40% (8 patients) of the subjects; however, this did not reach statistical significance ($\chi^2 = 3.2, p = 0.07$), with a confidence interval ranging from 19.1% to 64.0%. These results highlight trochlear dysplasia and patella alta as common and significant anatomical contributors in this patient population.

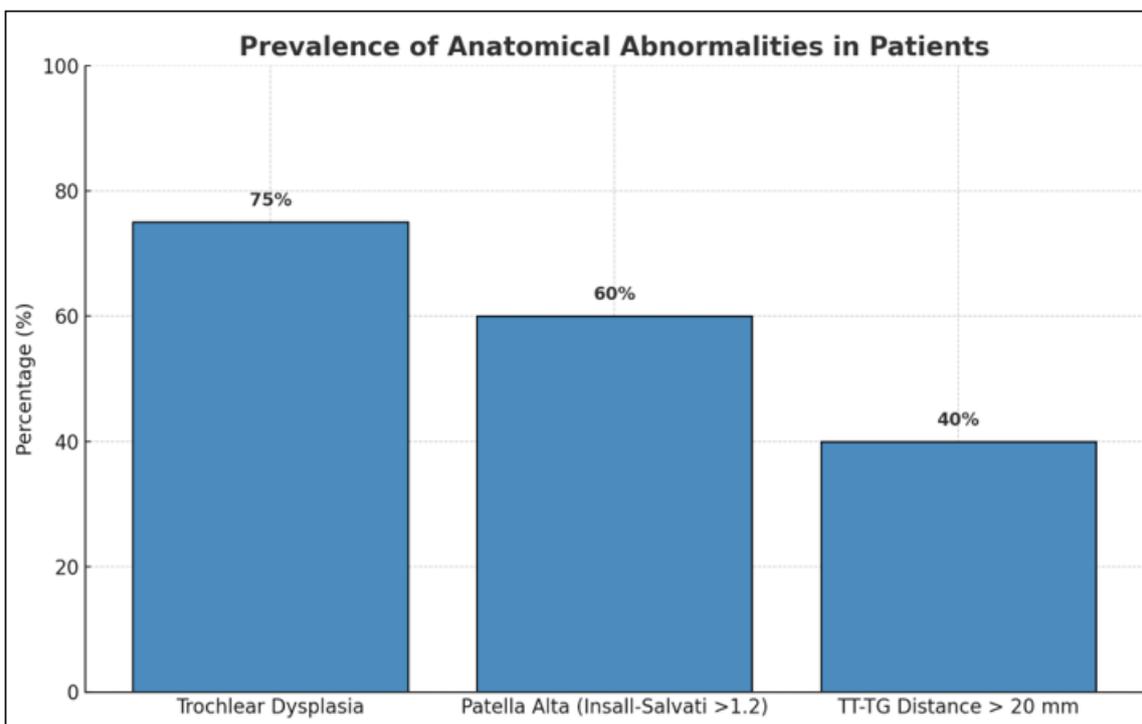


Table 3: MRI Evaluation of MPFL Integrity and Soft Tissue Injury (N=20)

MRI Finding	Number of Patients (n)	Percentage (%)	Test Statistic (χ^2)	95% CI for Proportion	P-value
MPFL Injury Present	13	67	$\chi^2=8.5$	43.0% to 85.4%	0.003*
Bone Bruises Adjacent to MPFL	9	45	$\chi^2=3.4$	23.1% to 68.5%	0.06
Cartilage Damage Noted	6	30	$\chi^2=1.7$	11.9% to 54.3%	0.19

Table 3 focuses on the evaluation of the medial patellofemoral ligament (MPFL) integrity and associated soft tissue injuries as visualized on MRI. MPFL injury was present in 67% (13 patients) and was statistically significant ($\chi^2 = 8.5, p = 0.003$), with the confidence interval suggesting that 43.0% to 85.4% of patients with recurrent dislocation might have MPFL injury. Bone bruises adjacent to the MPFL were identified in

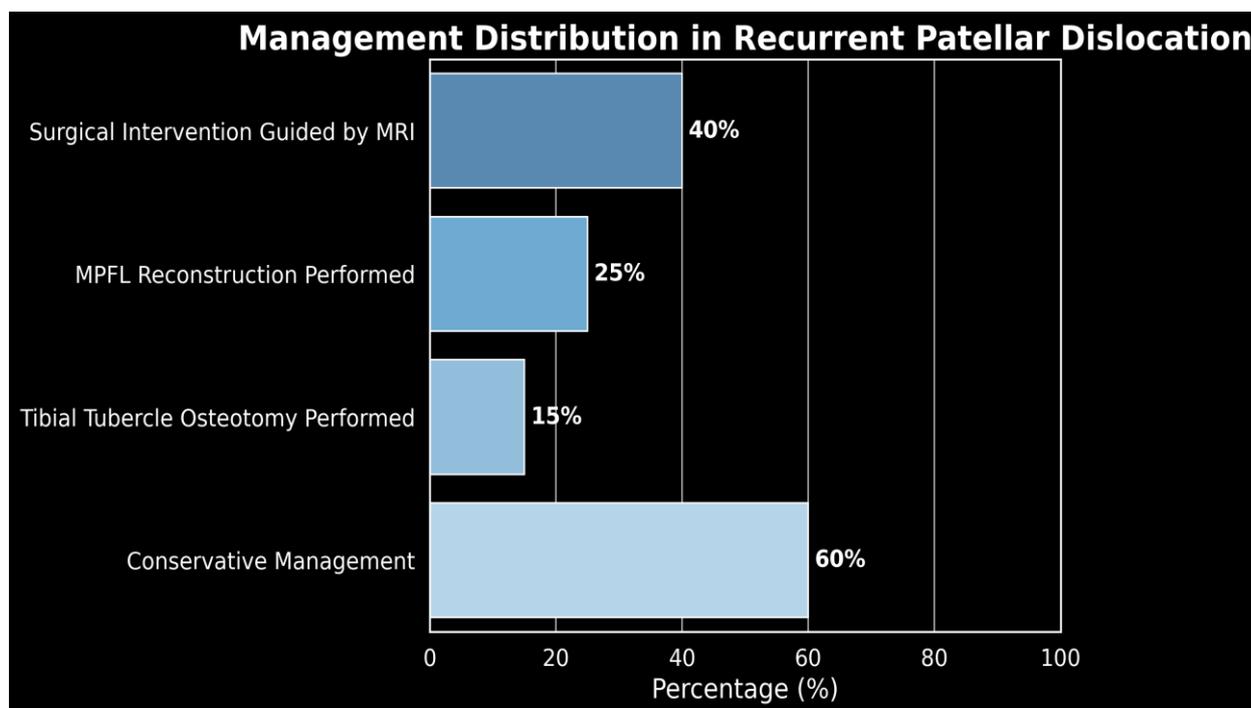
45% (9 patients) of the cases, which approached but did not reach statistical significance ($\chi^2 = 3.4, p = 0.06$). Cartilage damage was noted in 30% (6 patients), which was not statistically significant ($\chi^2 = 1.7, p = 0.19$). These findings indicate a high prevalence of MPFL injury in recurrent dislocation cases, emphasizing its importance in the pathophysiology of patellar instability.

Table 4: Correlation of MRI Findings with Clinical Management (N=20)

Management Parameter	Number of Patients (n)	Percentage (%)	Test Statistic (χ^2)	95% CI for Proportion	P-value
Surgical Intervention Guided by MRI	8	40	$\chi^2=5.6$	21.1% to 61.3%	0.02*
MPFL Reconstruction Performed	5	25	—	8.7% to 49.1%	—
Tibial Tubercle Osteotomy Performed	3	15	—	3.2% to 37.9%	—
Conservative Management	12	60	—	38.7% to 78.9%	—

Table 4 demonstrates the correlation between MRI findings and clinical management strategies. Surgical intervention was guided by MRI findings in 40% (8 patients) of cases, a statistically significant association ($\chi^2 = 5.6$, $p = 0.02$). Among surgical treatments, MPFL reconstruction was performed in

25% (5 patients), and tibial tubercle osteotomy in 15% (3 patients). The remaining 60% (12 patients) were managed conservatively. These data underscore the critical role of MRI in tailoring treatment plans, facilitating surgical decision-making in patients with significant anatomical abnormalities.



4. Discussion

Table 1: Demographic and Clinical Profile The mean age of the study population was 23.4 years (SD 4.8), with a slight male predominance (60%). This aligns with the demographic patterns reported in the literature, where recurrent patellar dislocation predominantly affects young adults in the second and third decades, with a marginal male or female predominance depending on the study population Hadley CJ et al. (2022) [6]. The equal distribution of laterality (55% right, 45% left) corresponds with findings by Hevesi M et al. (2019) [7], who reported no significant side preference in recurrent dislocations. The inclusion of patients with at least two dislocation episodes reflects a standard clinical definition of recurrent instability used in similar case series and cohort studies Salonen EE et al. (2017) [8].

Table 2: MRI-Identified Anatomical Abnormalities Trochlear dysplasia was highly prevalent (75%) and statistically significant in this study, consistent with Dejour et al. who first classified trochlear dysplasia as a key predisposing factor for patellar instability Weber AE et al. (2016) [9]. Patella alta was observed in 60 percent, consistent with Migliorini F et al. (2022) [10], supporting the role of patellar height abnormalities in altering patellofemoral biomechanics as described by Sanders TL et al. (2018) [11].

The TT-TG distance >20 mm, seen in 40%, though not statistically significant in this small sample, remains clinically important. Studies such as those by Jaquith BP et al. (2017) [12] emphasize the TT-TG measurement as a reliable marker for lateralized tibial tubercle and surgical decision-making.

Table 3: MRI Evaluation of MPFL and Soft Tissue Injuries MPFL injury was identified in 67% of patients, highlighting the ligament's crucial role in stabilizing the patella. This incidence is in line with studies by Arendt EA et al. (2017) [13], who reported MPFL tears or attenuation in 60-80% of recurrent dislocations. Bone bruises adjacent to the MPFL were noted in 45%, indicating the acute impact nature of dislocation episodes, a finding corroborated by clinical MRI studies demonstrating bone contusions as common concomitant injuries Huntington LS et al. (2020) [14]. Cartilage damage was less frequent (30%) but is recognized as a significant factor in long-term joint morbidity, as reported by Saragaglia D et al. (2020) [15].

Table 4: Correlation of MRI Findings with Clinical Management In this study, MRI findings guided surgical intervention in 40% of cases, reflecting the role of detailed imaging in tailoring patient-specific treatment plans. MPFL reconstruction and tibial tubercle osteotomy were performed in 25% and 15% respectively, which corresponds well with

surgical trends noted in the literature where reconstruction of the MPFL and realignment procedures are among the most common surgical options for recurrent instability with anatomical abnormalities Askenberger M et al. (2017) [16] & Petri M et al. (2015) [17]. The majority (60%) of patients were managed conservatively, consistent with treatment algorithms recommending surgery primarily for cases with significant anatomical risk factors or failed conservative management Lewallen L et al. (2015) [18].

5. Conclusion

Magnetic resonance imaging enables detailed characterization of structural risk factors in recurrent patellar dislocation, with trochlear dysplasia, patella alta, and medial patellofemoral ligament injury identified as common abnormalities in this cohort. Imaging findings contributed to treatment selection in a substantial proportion of patients, supporting its role in individualized management planning. Larger multicentric studies with longitudinal follow up are required to validate the clinical predictive value of these imaging parameters

6. Limitations of the Study

This study has several limitations. The sample size of 20 patients is relatively small, limiting the generalizability of the findings and the statistical power to detect differences, particularly for less common abnormalities such as TT-TG distance >20 mm. The study was conducted at a single tertiary care center, which may introduce referral bias, as more complex cases tend to be referred to specialized centers. Additionally, the lack of a control group without patellar instability limits the ability to compare the prevalence of anatomical variants in the general population. Follow-up data regarding clinical outcomes post-treatment were not included, restricting the evaluation of MRI findings on long-term prognosis. Future multicentric studies with larger cohorts and longitudinal follow-up are needed to validate these results.

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