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Magnetic Resonance Imaging Evaluation of Patellofemoral Joint

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ABSTRACT

Background: Patellofemoral pain is the leading cause of knee pain in young adults. Magnetic resonance imaging plays an important role in early diagnosis of patellofemoral joint pathology. This study was carried out to evaluate the patellofemoral joint using magnetic imaging resonance and describe various predisposing factors for patellofemoral instability.

Methods: The study was carried in Department of Radiology, BPKIHS over a period of six months from February 2020 to August 2020. All patients with clinical diagnosis of patellar instability were included and Magnetic resonance imaging was done using standard knee protocol and findings were noted on structured proforma. Analysis was done using statistical package for the social sciences version 20 applying simple descriptive statistical methods.

Results: A total of 60 patients who underwent MRI knee were analyzed, out of which 28(46.7%) patients were male while 32(53.3%) patients were female. 44 patients (58.3%) had various predisposing factors for patellar instability. The commonest predisposing factor was patellar subluxation (73.3%) followed by abnormal trochlear groove angle (58.3%) and patellar translation (increased tibia tubercle trochlear groove distance) (53.3%). Various MRI findings in our study were bone contusion (28 cases,46.7%), joint effusion (36 cases,60%), medial patellofemoral ligament injury (11cases ,18.3%), erosion of patellar cartilage (5 cases,8.3%), femoral cartilage erosion (3 cases,5%),loose bodies (2 cases,3.3%), subchondral edema (3 cases,5%) and meniscus injury (18 cases,30%).

Conclusions: Magnetic resonance imaging is not only useful in assessing lesions of the bone, cartilage and ligaments of patellofemoral joint but also enables detection of various predisposing factors for patellofemoral instability.

Keywords: Magnetic resonance imaging; patellofemoral instability; patellofemoral joint

INTRODUCTION

Patellofemoral pain is the leading cause of knee pain in patients younger than 45 years of age. It is observed in 15%-33% of young age group and approximately in 21%-45% in adolescence.[1]

Patellar maltracking and instability are responsible for majority of patellofemoral pain and are associated with development and progression of osteoarthritis. Various parameters like Insall-Salvati ratio, trochlear sulcus angle, sulcus depth, lateral patello-femoral angle, patellar translation and tibial tubercle-trochlear groove distance are useful predictors of patellar instability.

MRI plays an important role in early diagnosis of patellofemoral joint pathology because of its high sensitivity in detecting chondral, ligament and marrow abnormalities.[2] MRI is also useful for measurements of various parameters with same accuracy as CT scans.[3] This study will determine the incidence of various predisposing factors for patella femoral instability and its associated findings on MRI in patients with clinical diagnosis of patellar instability.

METHODS

A hospital based cross sectional study was carried out in the Department of Radiodiagnosis and Imaging at BPKIHS over a period of 6 months from February 2020 to August 2020 after taking ethical approval from local institutional review committee. Patellar instability is defined as recurrent lateral movement of the patella out of its normal position from trochlear groove due to subluxation or dislocation. 60 patients referred for MRI of knee with complain of anterior knee pain and history of recurrent patellar dislocation were included in our

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study. These patients were referred from orthopedic OPD with clinical evidence of patellar maltracking on examination by referring orthopedic surgeon. After informed consent, all cases were evaluated on 0.35 Tesla MRI scanner (Siemens) using dedicated surface coil for knee to look for features patellar instability. MRI sequences included T1-weighted, T2-weighted, STIR (Short tau inversion recovery) and proton density (PD) sequences in the axial, coronal and sagittal planes. Demographic records of patient along with various findings like bone contusions, meniscal tear, medial patellofemoral ligament injury, joint effusion, cartilage erosion, loose bodies and subchondral edema were assessed on MRI and recorded in the structured porforma and data was analysed using latest version of SPSS.

The presence of morphological or joint geometrical abnormalities were evaluated using the following measurements/criteria:

Type I (lateral and medial patellar facets of equal size), type II (medial facet slightly smaller than the lateral facet) and type III (a minor medial facet and convex articular surface).

Patellar tendon length (TL) by patellar length (PL) in mid sagittal plane (Figure 1). Normal value of this ratio is 0.8-1.2 . Value more than 1.2 indicates patella alta (high riding patella) and value less than 0.8 indicates patella baja (low lying patella).

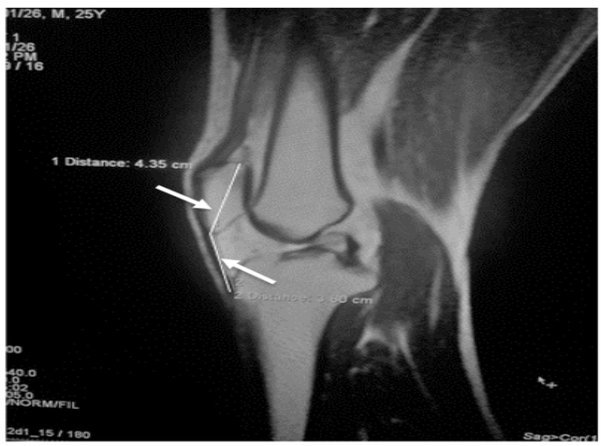

Figure 1. T1 W image of MRI in mid sagittal plane showing measurement of patellar tendon length TL (distance 2) and patellar length PL (distance 1) for calculation of Insall-Salvati ratio (TL/PL).

Distance between the line perpendicularly drawn to the medial corner of the patella and the line perpendicularly drawn to the most anterior segment of the medial femoral condyle. Distance more than 2mm indicates subluxation (Figure 2)

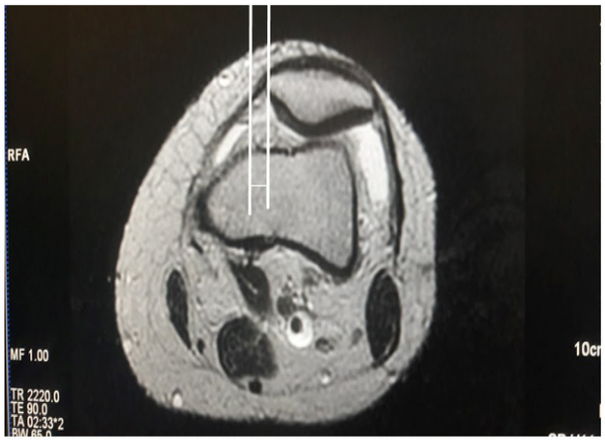

Figure 2. T2W axial MRI image showing lateral patellar subluxation. It is measured by distance between the line perpendicularly drawn to the medial corner of the patella and the line perpendicularly drawn to the most anterior segment of the medial femoral condyle.

Angle between the line drawn along the lateral patellar facet and the line drawn tangent to the anterior femoral condyle. Angle opening laterally with > 8 °, parallel angle or angle opening medially indicate abnormality (Figure 3).

Figure 3. T1W MRI axial image showing abnormal patellofemoral angle opening medially. It is the angle between the line drawn along the lateral patellar facet and the line drawn tangent to the anterior femoral condyle. Normally it is open laterally with angle $<8^0$.

Angle between the lines drawn tangent to the medial and lateral facet joint surfaces of the femoral condyles. Angle $>144^0$ indicates abnormality (Figure 4).

Trochlear depth: <3mm indicates trochlear dysplasia and <5mm indicates trochlear hypoplasia.

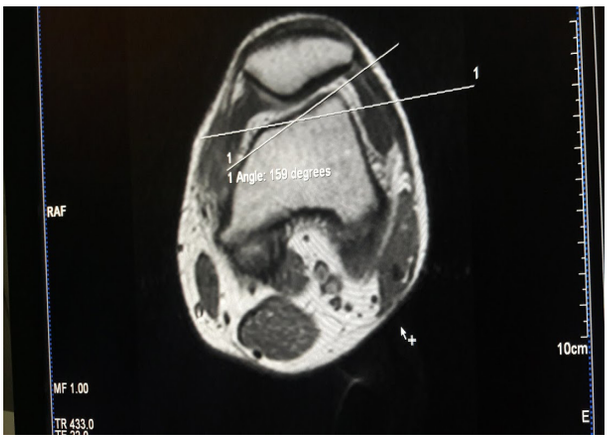

Figure 4. T1W axial MRI image showing increased trochlear angle in a dysplastic trochlea. It is the angle measured between the lines drawn tangent to the medial and lateral facet joint surfaces of the femoral condyles(normal value <144^0.)

Distance from the tibial tuberosity to the trochlear groove parallel to the tangential line through posterior femoral condyles. Distance >20mm is considered abnormal.

RESULTS

MRI knee of total 60 patients were analyzed in our study, out of which 28 were male (46.7%) and 38 were female (53.3%). Age ranged from 12 to 59 years, with a mean age of 33.9 years (±10) and median age of 30.5 years. 25 patients (41.7%) presented with complain of anterior knee pain and 35 patients (58.3%) complained of giving way of knee while walking.

Various morphological parameters of knee joint that could predispose towards joint instability were analyzed in our study. Out of 60 patients, 44 patients (58.3%) had various predisposing factors for patellar instability. Forty nine patients (81.7%) had normal type 2 patella. Ten patients (16.7%) had type 1 patella and only one patient (1.7%) had type 3 patella. Insall-Salvati ratio was normal in 50 cases (83.3%) while it was high (patella alta, high riding patella) in 5 cases (8.3%) and low (patella baja, low lying patella) in 5 cases (8.3%). Patellofemoral angle was normal in 36 cases (60%), >8^0 and opening laterally in 13 cases (21.7%), parallel in 7 cases (11.7%) and opening medially in 4 cases (6.7%). Trochlear groove angle was normal in 25 cases (41.7%) and abnormal in 35 cases (58.3%). There were 5 cases (8.3%) of dysplastic trochlea and 17 cases of hypoplastic trochlea (28.3%). In rest of the cases, trochlea was normal (38,6.3.3%). Forty four patients (73.3%) showed features of partial lateral patellar dislocation/subluxation with mild patellar subluxation seen in 16 cases (26.7%), moderate subluxation in 26 cases (43.3%) and severe subluxation in 2 cases (3.3%). There was no subluxation in 16 cases (26.7%). Increased tibia tubercle trochlear groove distance was seen in 9 cases (15%), borderline increased in 23 cases (38.3%) and normal in 28 cases (46.7%).

Various associated findings on MRI in patellar instability were also noted in our study. Most common of these were bone contusion (28 cases,46.7) and joint effusion (36 cases,60%) findings typical of recent patellar dislocation. Bone contusions were predominantly seen in medial aspect of patella and lateral femoral condyle region due to lateral dislocation of patella from trocheal groove. Often medial patellofemoral ligament gets injured during lateral dislocation of patella and was seen in 11 cases (18.3%) in our study. Spectrum of various MRI findings in our study are summarized in Table 1.

Table 1. showing spectrum of MRI abnormalities in study group(n=60).

MRI findings	Percentage	Frequency
Contusion	46.7%	28
Joint effusion	60%	36
Meniscus injury	30%	18
MPFL injury	18.3%	11
Patellar cartilage erosion	8.3%	5
Femoral cartilage erosion	5%	3
Subchondral edema	5%	3
Loose bodies	3.3%	2
Arthosis	1.7%	1
Fracture	1.7%	1

DISCUSSION

Anterior knee pain is one of the common clinical complains among patients referred for MRI knee. Patello-femoral disorders including patello-femoral maltracking and instability are among the most commonly reported sources of anterior knee pain.[3] In most cases of patello-femoral disorder, there is underlying predisposing anatomical factor.[4] Trochlear dysplasia is considered one of the main anatomical risk factors for instability which can be easily identified using MRI by assessing trochlear facet asymmetry, trochlear groove angle or trochlear depth.[5,6] MRI is also useful in detecting patellar abnormalities including patellar subluxation, patellar translation and patellar position and facet variations.[7,8]

In our study group, the mean age of patients was 33.9 yrs (+/-10 yrs) with predominance of female patients (53.3%) which is similar to studies done elsewhere.[9-11]

Various previous studies have shown that MRI is a good diagnostic tool in identifying cartilage and soft tissue lesions as well as detecting underlying predisposing anatomical factors of patellar instability[12] In fact, in the study by Souza et al. (2013), anatomical or joint geometry abnormalities that were considered to be predisposing factors for patellofemoral instability were identified in 73% of the cases with trochlear dysplasia noted in more than 50 percent of cases. High patella and lateral patellar inclination was noted in 53% and 56% cases respectively in their study.[9] In the study by Fahmy et al (2016) morphological factors that predisposed towards patellofemoral instability were found in 41 cases (74.5%), and the common predisposing factors were high patella in 56%, trochlear dysplasia in 63% and lateral patellar inclination in 54%.[13] Souza et al. (2013) stated that MR imaging is an excellent method in diagnosing trochlear dysplasia and reported high riding patella and lateral patellar inclination in 53% and 56% respectively.[9] In our study, out of 60 patients, 44 patients (73.3%) had various predisposing factors for patellar instability which is similar to findings in above studies. Similar common predisposing factors were also noted in our study with lateral patellar inclination seen in 40% of cases, trochlear dysplasia/hypoplasia in 36.6% of cases and abnormal high riding /low lying patella in 16.6% of cases.

In our study increased TT-TG distance was noted in 53.3% of cases in agreement with Berruto et al. (2013) who stated that TT-TG value was greater in symptomatic patients.[14] An increased TT-TG distance was also found in 16 cases (29%) in the study by Fahmy et al (2016).[13]

MRI is also a useful tool for detecting osteochondral lesions and for evaluating the medial patellofemoral ligament (MPFL).[15] Cartilage lesions of the patellofemoral compartment are generally related to instability, as also observed in the present study, in which chondral lesions were found in 13.3% of cases while it was seen in 64% of the cases in a study by Souza et al. (2013) and in 58% of cases in study by Fahmy et al (2016).[9,13] Lesions of the joint cartilage predispose towards early arthrosis, and this was observed in 1 case (1.7%) in our study and was seen in five cases (12%) in study by Souza et al. (2013).[9] MRI also presents excellent results for detecting lesions of the MPFL. In the study by Souza et al. (2013), lesions of the MPFL were detected in 29% of the cases and 34% of cases in study by Fahmy et al (2016).[13] In our study there were 18.3% of cases with MPFL lesion, thus confirming that MPFL is among the common ligaments that gets injured in cases of patellar instability and should be closely evaluated.

Bone contusion of the medial aspect of the patella and the femoral condyle and reactive joint effusion are associated radiological features of patellar instability and are typically seen after patellar dislocation.[16] Bone marrow contusions and joint effusion were noted in 46.7% and 60% of cases respectively in our study similar to that seen in study by Souza et al. (2013) where it was noted in 44% and 49% of cases respectively.[9] Bone marrow contusion was seen in only 27% of cases in study by Fahmy et al (2016).[13] Injury to a meniscus, collateral ligament or even cruciate ligament may also occur in patellar instability due to close anatomical relation of these structures to the femoral attachment of the medial stabilizers. Medial meniscus injury was noted in 30% of cases in our study while it was only seen in 4% of cases in the study by Souza et al. (2013).[9] Thus MRI is not only valuable in detecting soft tissue and chondral lesion, it is also excellent method for detecting bone marrow changes and reactive changes like joint effusion in cases of patellar instability.

There are some limitations in our study to consider. Small sample size (60 cases) and including only symptomatic patients with complain of anterior knee patient and giving way of knee could have resulted in detection of high percentage of predisposing factors (73.3%) for patellar instability in our study. Less number of cases with chondral injury (13.3%) were detected in our study which could be due to evaluation by a low tesla MRI scanner (0.35T) which is not ideal for detecting chondral pathology. Measurement of various anatomical parameters like TT-TG distance and patella-femoral angle may not be always be accurate on MRI and in such cases CT scan may be required for confirmation which was not done in our study.

CONCLUSIONS

This study shows that MRI is useful in detecting various predisposing anatomical factors of patellofemoral instability and associated lesions of knee joint thereby enabling orthopedic surgeons to treat joint pathology as well as correct underlying anatomical abnormality.

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