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Original Research Article

Clinical and MRI profile of patients with knee injuries and correlation of MRI with arthroscopic findings

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ABSTRACT

Background: MRI is radiation free modality and has ability to understand the soft tissue, anatomy and musculoskeletal system pathologies. MRI has the advantage of demonstrating the cartilages, bones, soft tissue in detail. Objectives of current study were evaluation of ligaments and meniscal injuries using magnetic resonance imaging, to study the pattern and spectrum of knee injuries in relation to mechanism of injury and to correlate MRI findings with that of arthroscopic findings.
Methods: All the MRI studies were done using a 1.5T MRI scanner (Siemens Magnetom) in our department, department of radiodiagnosis, ACS medical college, Chennai. Patient taken up for arthroscopy and the arthroscopic findings were collected. The data of MRI collected was compared with arthroscopy findings.
Results: On correlation of the overall findings the sensitivity of MRI versus arthroscopy was 90.62% Specificity was 84.55% positive predictive value was 92.06%, negative predictive value was 80.00% Between them with a kappa 0.059
Conclusions: MRI of knee is considered efficacious especially in the setting of indeterminate clinical finding and can stratify patients, thereby increasing the diagnostic confidence of the clinicians leading to appropriate surgical planning and management.

Keywords: MRI, Knee joint, Arthroscopy, Ligament injuries

INTRODUCTION

The knee joint is a synovial and weight bearing type of joint. The stability of joint is dependent on its supporting ligamentous and tendinous structures.[1] Trauma to the knee joint is a significant cause of morbidity in the young active individuals. An accurate diagnosis, grading and extent of injuries are essential for further management of the patient.[2-3] Complete evaluation of the internal structures of the knee is not possible with other modalities like conventional radiography, arthrography, ultrasonography and computed tomography. Even with arthroscopy, complex and inferior surface tears are difficult to detect. Multi planar MR images provide significant improvement in assessing these structures. It is also being used for pre and postoperative evaluation.[4-9] The role of MRI in imaging of knee has progressively augmented over the years and is frequently the foremost or sole imaging modality that is used for assessment of suspected knee pathology.[10] Knee injuries are among the most common injuries in the athletic population. In a study of injuries involving the knee joint, they stated that approximately half of the injuries were related to sports or recreation, with soft-tissue injuries accounting for the bulk of the injuries.[11] Awwad et al stated that in professional rugby league team players the average age at the time of injury was 24.1 years with an average BMI of 29.2kg/ m2 with knee injury being the commonest at 616.7 injuries/1000 players. The most

frequently occurring knee injuries were MCL and chondral/meniscal injuries accounted for 56.2% of all knee injuries.[12] The multiplanar capability of MR imaging allows for oblique sagittal image acquisition oriented parallel to the lateral femoral condyle, which optimizes evaluation of the anterior cruciate ligament (ACL), horns of the menisci, femorotibial joint and femoral trochlear articular cartilage, cruciate ligaments, and extensor mechanism.[13,14] The present objective of this study is to understand the importance of MRI in the assessment of various types of injuries in the complex knee joint and aids the clinician to arrive at an accurate diagnosis.

METHODS

Study design, duration and equipment

Current study was an observational validation study conducted for a duration of 6 months from January 2022 to June 2022. Imaging was done by a 1.5T MRI scanner (Siemens Magnetom).

Statistical tool

Availability of data and materials using Medsynapse software from our ACS Medical college and hospital, Velappanchavadi, Chennai Tamilnadu, India database.

Inclusion and exclusion criteria

The patients who will present with injury to knee were included. Exclusion criteria for current study were; Those who do not have subsequent MRI. Those who do not have subsequent arthroscopy. Those not giving consent for participating in the study. Age related degenerative/infective arthrosis of knee joint. Those having history of knee arthroscopy in the past.

Plan of study

Informed and written consent taken from each of the patients. All the MRI studies were done using a 1.5T MRI scanner (Siemens Magnetom) in our department, department of radiodiagnosis, ACS medical college and hospital, Chennai. The field strength, coil (volume surface phased array), slice thickness, field of view, matrix size, and other select imaging parameters are optimized with the goal of increasing the signal to noise ratio and decreasing scan time, thereby decreasing motion artifact. Metal artifact reduction can be achieved by orienting the long axis of metallic prosthesis parallel to both magnetic field and frequency encoding axis, employing fast spin echo techniques with increased echo train length, increasing receiver band width, decreasing field of view, and increasing the matrix size in the direction of the frequency encoding gradient. All images were viewed in the workstation settings. Patient taken up for arthroscopy by orthopedician and the arthroscopic findings were collected. The data of MRI collected was compared with arthroscopy findings. Clinical details/arthroscopic findings and Magnetic resonance imaging findings of the case were recorded as per the proforma.

Sequences

The following sequences were taken PDW STIR transverse, T2W TSE transverse, T2W TSE coronal, PDW STIR coronal, PDW TSE, T2W TSE sagittal, T1W TSE sagittal, PDW STIR sagittal, T2W TSE THIN transverse

Sample size estimation

Total 75 patients were included. Wherein the sample size was determined based on the overall agreement (p=87.2%) according to the study on "Can MRI replace diagnostic arthroscopy in evaluation of internal derangement of knee joint" and allowable error being 7%. The formula used for calculation is

$$n = Z\alpha^2 p\,(1-p)\,/e^2$$

Where n=sample size, Zα=1.96 at 95% confidence interval and e=allowable error.

RESULTS

The total number of cases was 75. Maximum number of subjects were in the age group of 21-30 years, which constitute about 37.33% About 30.6% of cases were in the age of 30-40 years. Out of 75 subject's sports injury was the commonest mode of injury of knee joint.

Table 1: Age distribution of the study.

Age (years)	N	%
Less than 20	7	9.33
21-30	28	37.33
31-40	23	30.67
41-50	10	13.33
51-60	5	6.67
More than 60	2	2.67
Total	75	100.00
Mean/SD	33.30667	

Table 2: Mode of injury.

Mode of injury	N	%
RTA	17	22.6
Self-fall	20	26.6
Sports injury	38	50.6
Total	75	100

As per the MRI findings when the medial meniscus was evaluated, no tear was the commonest seen on 41 cases that accounted for 54.6%, vertical tear was 6 cases that accounted for 8 percent, horizontal tear in 5 cases accounted for 6.6 percent, complex tear in 7 cases accounted for 9.3%, and bucket handle tear seen in 12 cases accounted for 1.33% each accounted for 16%, radial

tear in 1 cases accounted for 1%, flap tear in 3 cases accounted for 4%.

Table 3: MRI findings in medial meniscus.

Medial menicus MRI findings	N	%
No tear	41	54.67
Vertical tear	6	8.00
Horizontal tear	5	6.67
Radial tear	1	1
Flap tear	3	4.00
Bucket handle tear	12	16.00
Complex tear	7	9.33
Medial Menicus MRI findings	75	100.00

Table 4: Arthroscopy findings of medial meniscus.

Arthroscopic findings in MM	N	%
No tear	42	56
Vertical tear	5	6.6
Horizontal tear	3	4
Radial tear	2	2.6
Flap tear	5	6.6
Bucket handle tear	12	16
Complex tear	6	8

As per the arthroscopy findings when the medial meniscus was evaluated, no tear was the commonest seen on 42 cases that accounted for 56%, vertical tear in 5 cases that accounted for 6.6 percent, horizontal tear in 3 cases accounted for 4 percent, complex tear in 6 cases accounted for 8%, and bucket handle tear seen in 12 cases accounted for 16%, radial tear in 2 cases accounted for 2.6%, flap tear in 5 cases accounted for 6.6%.

Table 5: MRI findings of lateral meniscus.

Lateral menicus MRI findings	N	%
No Tear	39	52.00
Vertical Tear	6	8.00
Horizontal Tear	9	12.00
Radial Tear	13	17.33
Flap Tear	2	2.67
Bucket Handle Tear	1	1.33
Complex Tear	5	6.67
Total	75	100.00

Table 6: Arthroscopy findings of lateral meniscus.

Arthroscopic findings in LM	N	%
No tear	38	50.6
Vertical tear	5	6.6
Horizontal tear	7	9.3
Radial tear	7	9.3
Flap tear	8	10.6
Bucket handle tear	1	1.3
Complex tear	9	12

As per the MRI findings when the lateral meniscus was evaluated, no tear was the commonest seen on 39 cases that accounted for 52.00%, vertical tear in 6 cases percent, horizontal tear in 9 cases 12 percent complex tear in 5 cases 6.67%, and bucket handle tear seen in 1 cases 1.33% each, radial tear in 13 cases, 17.33%.

Table 7: MRI findings of PCL.

MRI findings PCL	N	%
No tear	40	53.33
Intact	2	2.67
Low grade partial	4	5.33
High grade partial	2	2.67
Complete tear	5	6.67
Buckling of PCL	22	29.33

Table 8: Arthroscopy findings of PCL.

Arthroscopic findings in PCL	N	%
No tear	40	53.3
Intact (sprain)	2	2.6
Low grade partial tear	4	5.3
High grade partial tear	3	4
Complete tear	4	5.3
Buckling	22	29.3

Table 9: MRI findings of ACL.

ACL MRI	N	%
No tear	28	37.33
Intact	5	6.67
Low grade partial	8	10.67
High grade partial	9	12.00
Complete tear	25	33.33
Total	75	100.00

As per the arthroscopy findings when the lateral meniscus was evaluated, no tear was the commonest seen on 38 cases that accounted for 50%, vertical tear in 5 cases accounted for 6.6percent, horizontal tear in 7 cases accounted for 9.3%, complex tear in 9 cases accounted for 12%, and bucket handle tear seen in 1 cases accounted for 1.33%, radial tear in 7 cases accounted for 9.3% and flap tear in 8 cases accounted for 10.6%.

Table 10: Arthroscopy findings of ACL.

Arthroscopic findings in ACL	N	%
No tear	27	36
Intact (sprain)	6	8
Low grade partial tear	6	8
High grade partial tear	11	14.6
Complete tear	25	33.3

As per the MRI findings when the PCL was evaluated, no tear was seen in 40 cases, PCL was intact (sprain) in 2 cases, low grade partial tear was noted in 4 cases, high grade partial tear was noted in 2 cases, buckling of PCL in

22 and complete tear was noted in 5 cases. As per the arthroscopy findings when the PCL was evaluated, no tear was seen in 40 cases, PCL was intact (sprain) in 2 cases, low grade partial tear was noted in 4 cases, high grade partial year was noted in 3 cases, buckling of PCL in 22 and complete tear was noted in 4 cases. As per the MRI findings when the ACL was evaluated, no tear was seen in 28 cases, ACL was intact (strain) in 5 cases, low grade partial tear was noted in 8 cases, high grade partial tear was noted in 9 cases and complete tear was noted in 25 cases. As per the arthroscopy findings when the ACL was evaluated, no tear was seen in 27 cases, ACL was intact (sprain) in 6 cases, low grade partial tear was noted in 6 cases, high grade partial tear was noted in 11 cases and complete tear was noted in 25 cases. Overall, on correlation of the overall findings the sensitivity of MRI versus arthroscopy was 90.62% specificity was 84.55% positive predictive value was 92.06%, negative predictive value was 80.00% between them with a kappa 0.0595.

DISCUSSION

Maximum number of subjects were in the age group of 21-30 yrs which constitute about 37.3% and about 30.6% of cases were in the age group of 31-40 yrs. this study is showing same age predilection as study by Bucha et al.[16] Lateral meniscus is more involved (35 cases) compared to medial meniscus (34 cases). which does not correlate with a study by Drosos et al which showed lateral meniscus less prone to involve due to its loose attachment to the joint capsule.[17] This could be due to smaller sample size in our study and the difference being only one patient morethan medial meniscus.[18-25] In the present study, between MRI and arthroscopic findings for medial meniscus had a sensitivity of 96%, Specificity was 95.83%, positive predictive value was 92.86%, negative predictive value was 97.87%. the most common tear was bucket handle tear this is because of subjective variations. Reddy et al in his study that was done in the year 2019 on cases with knee injury concluded that the diagnostic sensitivity, specificity of medial meniscus (MM) as 100%, 93.3%, 98.2% respectively.[23] In the present study, between MRI and arthroscopic findings for lateral meniscus had a sensitivity of 69.09%, Specificity was 64.29%.[24]

Few earlier studies conducted by Rayan et al and Bari et al also showed low sensitivity of MRI in detecting lateral meniscus tears.[19,20] In the present study, between MRI and arthroscopic findings for ACL findings had a sensitivity of 89.36%.[21] Specificity was 96.43% positive predictive value was 97.67% negative predictive value was 84.37%, the most common tear seen was complete tears which was associated with buckling of PCL in 45.8% In the present study, between MRI and arthroscopic findings for PCL had a sensitivity of 97.73%.[22] Specificity was 96.77% positive predictive value was 97.73%, negative predictive value was 96.77% Muhammad et al found that the respective sensitivity and specificity of about 88% and 73% for detecting lateral meniscal tears.[26] Kulkarni et al reported the sensitivity and specificity of MRI with arthroscopy was 90.4% and 85.7%, which is correlating with our study.[27] Lateral meniscus is more involved (35 cases) compared to medial meniscus (34 cases). which does not correlate with a study by Drosos et al which showed lateral meniscus less prone to involve due to its loose attachment to the joint capsule.[28] Murmu et al the sensitivity and specificity of MRI with respect to 56 arthroscopy in anterior cruciate ligament tear is 87.5% and 66.6%. which is correlating without study.[28,29]

Limitations

Sample size of study was limited and larger study group with bigger sample size would be desirable. For meniscal tear we used types of tears to classify which leads to subject variations and so less sensitivity and specificity. Orthopedic surgeons had report of MRI available at the time of surgery that must have led to bias of arthroscopic categorization of the tears. Obstructed view of arthroscopic instruments was another limitation.

CONCLUSION

MRI is the best noninvasive modality used to evaluate the patient with internal derangement of the knee for the diagnosis of meniscal and ligament tear. Further the overall MRI diagnosis of internal derangement of knee correlates with arthroscopy findings and showed good correlation. We have seen different pattern of meniscal and ligament injury in knee and its association so radiologist while reporting should be aware of these patterns of associations. With the arthroscopy findings turning out to be negative, suspecting these injuriesfrom MRI help in directing the patient to specific management.

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