International Journal of Research in Orthopaedics
Chintapalli SSK et al. Int J Res Orthop. 2023 Mar;9(2):367-371
http://www.ijoro.org

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20230466

Original Research Article

Correlation of magnetic resonance imaging findings and arthroscopy findings in diagnosis of intra articular ligament injuries of knee joint

Surya Sri Karun Chintapalli*, Pavith Janardhan Thekkada

Department of Sanjay Gandhi institute of Trauma and Orthopaedics, Bangalore, Karnataka, India

Received: 20 December 2022
Revised: 17 January 2023
Accepted: 31 January 2023

***Correspondence:**
Dr. Surya Sri Karun Chintapalli,
E-mail: srikarun.karun@gmail.com

ABSTRACT

Background: The knee is the largest synovial joint in body with extra and intra articular ligaments which act as supporting structures around the joint. The intra articular ligaments of knee are more commonly injured. An accurate and early diagnosis of the internal derangement of knee is necessary for planning the treatment. In this study we compare the findings of magnetic resonance imaging (MRI) with arthroscopy and evaluate the accuracy of MRI in diagnosing intra-ligament injuries of knee.
Methods: It is a prospective study conducted in the department of orthopaedics, Raja Rajeswari medical college and hospital, Bangalore from July 2018 to May 2021. Selection criteria include 80 patients who presented with history of ligamentous injury to the knee. The MRI was obtained and selected cases were posted for arthroscopic surgery after obtaining the informed consent. The MRI findings and Arthroscopy findings were correlated and statistical data analysis is prepared to obtain accuracy of MRI.
Results: In this study 80 patients were selected and data was prepared. ACL tear presented with 100% sensitivity and 95% accuracy, PCL injuries shows 100% sensitivity and 97% accuracy, medial meniscus tears presented with sensitivity 96.15% and accuracy 95%, lateral meniscus tears presented with sensitivity 95.83% and accuracy 97.50% of MRI.
Conclusions: In our study the MRI has more capable in detecting anterior horn tears, multiple tears and underneath tears that may be overlooked in arthroscopy. However, appropriate sequences, analysed in different planes, newer techniques, powerful tomograms will improve the diagnostic accuracy and reduce errors.

Keywords: Arthroscopy, MRI, Correlation, Accuracy, Statistical analysis

INTRODUCTION

The knee is the largest synovial joint in body with a complex anatomy of extra and intra articular ligaments which act as supporting structures around the joint.[1] The intra-articular ligaments include Anterior cruciate ligament, posterior cruciate ligament, medial meniscus and lateral meniscus. The cruciate ligaments help in stability of knee preventing translation movements and rotatory movements and menisci helps to withstand weight bearing loads and improves the biomechanical demands of patient.[2] The intra articular ligaments of knee are more commonly injured in athletic individuals involving a sudden contact or twisting leading to sudden stress to disrupt the ligaments.[3,4] The instability from ligamentous disruption impairs a person day to day activities.[5] An Accurate and early diagnosis of the internal derangement of knee is necessary for planning the treatment.[6] It is difficult to evaluate clinically in acute scenarios due to pain and swelling in the knee. Therefore, to diagnose intra articular injuries in the acute knee injuries we use MRI as a modality of choice, but its diagnostic potential is fallible and liable to be erroneous.[6] In this study we compare the findings of MRI with gold standard diagnostic arthroscopy and evaluate the accuracy of MRI in diagnosing intra-ligament injuries of knee.

Aim

Objectives of study were to correlate findings of magnetic resonance imaging with arthroscopic findings in selected cases to determine accuracy by calculating sensitivity, specificity, positive and negative predictive value of MRI in intra articular ligament injuries of knee.

METHODS

It is a prospective study conducted in the department of orthopaedics, Raja Rajeswari medical college and hospital, Bangalore from July 2018 to May 2021. Source include 80 patients with inclusion criteria as age group 18-50 years, both males and female, knee injury within 3 months, patients presented with cruciate and meniscal injuries, selected cases indicated for arthroscopy surgery, multiple ligament injuries. Exclusion criteria consists of patients age >50 years, osteoarthritis changes, inflammatory or rheumatoid arthritis knee, femoropatellar degenerative conditions, Revision ACL injury and contraindicated to MRI are excluded. Patient history and clinical findings were documented. The MRI was obtained, MR imaging was carried out on 1.5 Tesla MR machine 18 channel by Siemens India Pvt Ltd. The fat-suppressed PD (TE 45, TR 2800), T2W (TE 80, TR 4000), T1W (TE 11, TR 495), images were obtained in axial, sagittal, coronal planes and findings were evaluated and noted and selected cases were posted for arthroscopic surgery after obtaining the informed consent. Diagnostic arthroscopy evaluation is conducted by orthopaedic surgeon at operating room. Arthroscopy was performed through the anteromedial and anterolateral portals. During the surgery, the characteristic intra-articular ligament injuries of the knee found through arthroscopy were noted. Subsequently analysis for comparison between MRI, and arthroscopic findings was undertaken. The results from comparing the findings from the MRI and arthroscopy were obtained through this database, and the sensitivity, specificity, accuracy, positive predictive value, negative predictive value were prepared. Data was entered in Microsoft excel sheet. Analysed for descriptive statistics and Chi square test done using SPSS 22 version software, $p<0.05$ was considered as statistically significant after assuming all the rules of statistical tests.

Ethical clearance

Ethical clearance has been obtained from the ethical committee of our institution to carry out the investigations and interventions on patients necessary for this study.

RESULTS

In this study 80 patients selected and data was prepared. The joint effusions were seen in 56 patients (80.2%). ACL tear is most common 90%, to be followed by the medial meniscal injuries 65%. Anterior cruciate ligament tear was seen in 72 patients (90%), 12 (15%) were partial tears and 60 (75%) were complete tears. MRI sensitivity 100%, specificity 66.67%, accuracy 95%, positive predictive value 94.44%, negative predictive value 100%. Posterior cruciate ligament injuries with complete tear 2 patients (2.5%) and partial tears in 18 patients (22.5%). MRI sensitivity 100%, specificity 96.77%, accuracy 97%, positive predictive value 90% and negative predictive value 100%. Medial meniscus tears were found in 52 (65%) patients, with grade I tear in 8 (10%), grade II tear in 14 (17.5%) and grade III in 30 (37.5%). Sensitivity 96.15%, specificity 92.86%, and accuracy 95%, positive predictive value 96.15% and negative predictive value 92.86%. Lateral meniscus tears were found in 48 (60%) patients, with grade I tear in 10 (12.5%) grade II tear in 12 (15%) and grade III in 24 (30.0%). Sensitivity 95.83%, specificity 100%, accuracy 97.50%, positive predictive value 100% and negative predictive value 94.12%.

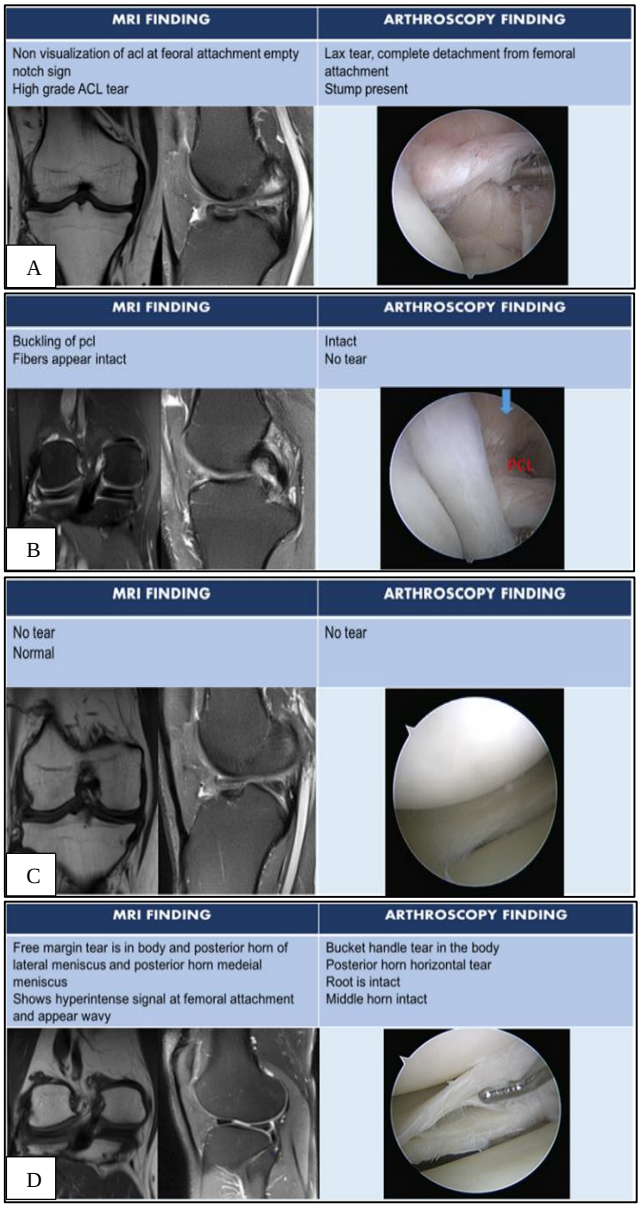

Figure 1 (A-D): Case 1: 28 years/ male with history of twisting injury of left knee-anterior cruciate ligament and posterior cruciate ligament, medial meniscus and lateral meniscus.

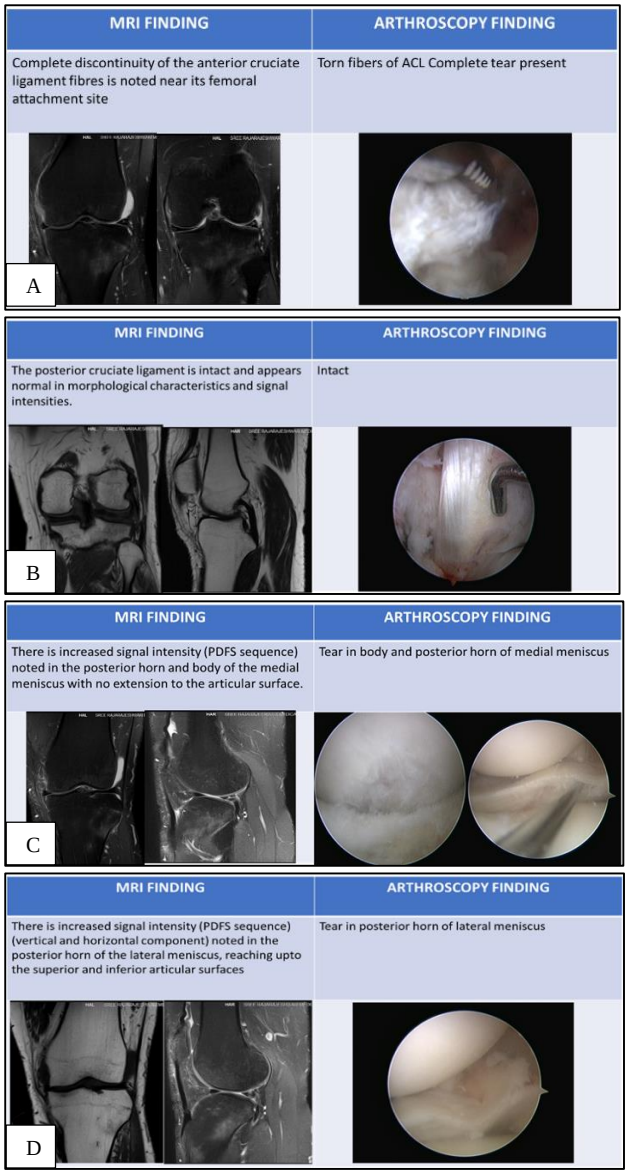

Figure 2 (A-D): Case 2: 24 years/ male with history of RTA injured right knee-anterior cruciate ligament, posterior cruciate ligament, medial meniscus and lateral meniscus.

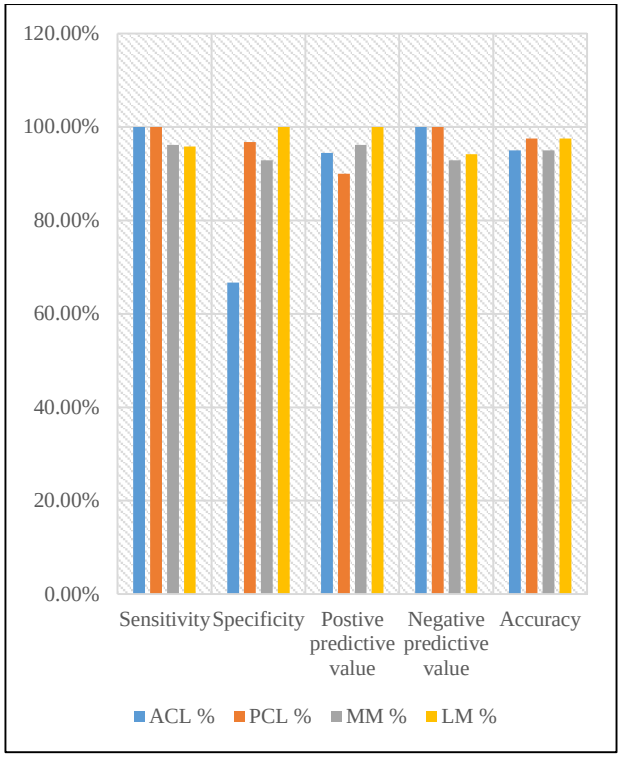

Figure 3: Presentation of correlation between MRI and arthroscopy.

Table 1: MRI showing the internal derangement of knee joint.

Variables	MRI ACL	MRI PCL	MRI MM	MRI LM
	F (%)	F (%)	F (%)	F (%)
Appear normal	8 (10)	60 (75)	28 (35)	34 (42.5)
Complete tear	60 (75)	2 (2.50)	30 (37.5)	24 (30.0)
Partial tear	12 (15)	18 (22.5)	22 (27.5)	22 (27.5)
Total	80 (100)	80 (100)	80 (100)	80 (100)

Table 2: Arthroscopy showing the internal derangement of knee joint.

Variables	Arthroscopy ACL	Arthroscopy PCL	Arthroscopy MM	Arthroscopy LM
	F (%)	F (%)	F (%)	F (%)
Appear normal	12 (15)	62 (77.5)	28 (35.0)	32 (40)
Complete tear	56 (70)	2 (2.50)	30 (37.5)	24 (30)
Partial tear	12 (15)	16 (20)	22 (27.5)	24 (30)
Total	80 (100)	80 (100)	80 (100)	80 (100)

Table 3: Correlation of MRI findings with arthroscopy using.

Variables	True positive	False positive	False negative	True negative
ACL	68	4	0	8
PCL	18	2	0	60
MM	50	2	2	26
LM	46	0	2	32

P value is 0.0001 which is significant.

Table 4: Correlation between MRI and arthroscopy findings in intra articular injuries of knee.

Test	ACL (%)	PCL (%)	MM (%)	LM (%)
Sensitivity	100	100	96.15	95.83
Specificity	66.67	96.77	92.86	100
Positive predictive value	94.44	90	96.15	100
Negative predictive value	100	100	92.86	97.50
Accuracy	95	97.50	95	95

DISCUSSION

In our study the age group ranging from 18 to 50 years. The youngest male patient was aged 18 years and the oldest female was 47 years. Joint effusions were seen in 28 patients (80.2%). Males are mostly to suffer knee injuries since they are active in sports and the right knee was more frequently injured than left.

The anterior cruciate ligament tear was most common, found in 72 patients (90%) among these 12 (15%) were partial tears and 60 (75%) were complete. We found altered signal intensity in the ligament as the most common sign which was seen in 32 patients (40%), 16 (20%) cases showed discontinuity, 12 (15%) cases show hyper intense signals and 12 (15%) cases showed non-visualization of ACL which are corresponding with Gentile et al.[6] Failure to capture complete length of ACL in true sagittal plane and physiologic ligamentous laxity are the causes for four false positive findings. There were no false negative cases, which were misinterpreted as normal. Partial tears of ACL may be identified as an altered signal alone and imaging may not be accurate due to the overlying synovial reaction. We obtained 100% sensitivity and 95% accuracy of MRI with positive predictive value is 94.44%, negative predictive value is 100%. Barronian et al in their study of 22 patients showed results similar to ours.[7] They calculated PPV and NPV of MR examination and concluded that the NPV was 92% for cruciate ligaments, whereas the PPV was 50%. The high NPV is important and indicates that a negative MRI is quite reliable for cruciate ligaments.

Posterior cruciate ligament injuries were found to be relatively uncommon, in our study a complete tear is found in two patients (2.5%) and partial tears in 18 patients (22.5%) and all the partial tears were demonstrated as thickening of the ligament with abnormal signal intensity. In a recent case series of study analysing 350 cases of knee injury, only 10 patients had PCL tear diagnosed accurately by MRI. In our study, 18 patients of PCL tears were detected accurately both by MRI and arthroscopy. Two false positive case was detected which shows abnormal signal intensity. The use of MRI to identify PCL tears has proven to be extremely accurate easily visualized as a continuous low-signal structure. We obtained 100% sensitivity and Identification of PCL tears in our study was presented with 97% accuracy, positive predictive value is 90.00%, negative predictive value is 100%. The Grover et al in his study analysed findings of 510 consecutive MRI of knee joints with PCL tear; 11 (2%) patients had different grades of tear on MRI which was confirmed correctly by arthroscopy.[8]

There are 2 false positive in MRI which involved the posterior horn of the medial meniscus. It is seen when the tears are not communicating with articular surface of meniscus. Mink et al in their study reported a total of 47 false-positive results with MRI, 70% of which were in the posterior horn tears.[9] 2 False negative cases were reported because the lesion is missed at arthroscopy as there is difficulty in visualizing the posterior compartments. The sensitivity 96.15% and accuracy 95% for diagnosing medial meniscal tears with positive predictive value 96.15%, and negative predictive value 92.86% which were corresponding to the Fischer et al.[10]

The arthroscopy shows 2 false negative cases that had partial tear of lateral meniscus, which were misinterpreted as normal in MRI. The sensitivity 95.83% and accuracy 97.50% which were corresponding to the Fischer et al.[10] The tears of menisci demonstrated as high signal intensity were due to presence of synovial fluid. Stoller et al in their study explained the interaction of synovial fluid with large macromolecules in menisci slows rotational rate of protons and shortens T1 and T2 values.[11,12] Identification of meniscal tears can be difficult to interpret and can be observer dependent, as well as depends on sensitivity of the scanner.[13]

So, from our prospective study we can rely on MRI to avoid diagnostic arthroscopy as MRI has a high sensitivity and low false-negative rate. Diagnostic accuracy of MRI in diagnosing intra-articular injuries is high in our study which corresponds to studies done by Glashow et al, Kinnunen et al and İncesu et al.[14]

However, this study has its own limitations as specific site and appearance of ligament tears were not correlated with arthroscopy to avoid complexity of results.

CONCLUSION

In our study the sensitivity and accuracy of MRI are high when compared to diagnostic arthroscopy in detecting intra articular injuries of knee. The MRI has more capable in detecting anterior horn tears, multiple tears and underneath tears that may be overlooked in arthroscopy. The anatomical variants of meniscus cause miss-interpretation of intrameniscal signal changes resulting in false positive findings. The false positive results in case of

ACL is due to intra substance signal abnormality produced by hemarthrosis in acute injuries. Powerful tomograms with appropriate sequences and images analysed in different planes will improve the diagnostic accuracy and reduce errors. However, in acute knee injuries settings the indication for MRI and decision making is based on individual's choice.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Williams Peter L, Roger W. Arthrology; In Williams and Peter L editors, Gray's Anatomy, 36th edition. Edinburg: Churchill Livingstone. 1986;482.
2. Robert HM, Frederick MA. Knee Injuries. In. Canale TS, Beaty JH, editors. Campbell's Operative Orthopaedics, 11th edition. Philadelphia: Mosby Elsevier. 2008;3:2410.
3. Brantigan OC, Voshell AF. Ligaments of the knee joint. J Bone Joint Surg. 1946;28:66.
4. Voshell AF. Ligaments of the knee joint. J Bone Joint Surg. 1941;23:44.
5. Frankel VH, Burstein AH, Brooks AB. Biomechanics of internal derangement of the knee. J Bone Joint Surg. 1971;53A:945.
6. Singh JP, Garg L, Shrimali R, Setia V, Gupta V. MR Imaging of knee with arthroscopic correlation in twisting injuries. IJRI. 2004;14:33-40.
7. Barronian AD, Zoltan JD, Bucon KA. Magnetic resonance imaging of the knee: correlation with arthroscopy. Arthroscopy. 1989;5:187-91.
8. Grover JS, Bassett LW, Seeger LL, Finerman GA. Magnetic resonance imaging of the posterior cruciate ligament. Clinical use to improve diagnostic accuracy. Am J Sports Med. 1992;20(6):732-7.
9. Mink JH. The knee. In Mink JH, Deutsch A, Eds. MRI of the musculoskeletal system. A teaching file. 1990;251-84.
10. Fischer SP, Fox JM, Del Pizzo W, Friedman MJ, Snyder SJ, Ferkel RD. Accuracy of diagnoses from magnetic resonance imaging of the knee. A multi-center analysis of one thousand and fourteen patients. J Bone Joint Surg Am. 1991;73(1):2-10.
11. David Stroller W, Dilworth Cannon Jr W, Lesley J Anderson. In: David W Stroller, editor. Magnetic Resonance Imaging in Orthopaedic and Sports Medicine. 2nd ed. Philadelphia: Lippincott-Raven. 1997;203-442.
12. Tuckman GA, Miller WJ, Remo JW, Fritts HM. Radial tears of the meniscus: MR findings. AJR 1994;163:395.
13. Singson RD, Feldman F, Staron R, Kiernan H. MR imaging of the displaced bucket handle tear of the medial meniscus. AJR. 1991;156:121.
14. Glashow JL, Katz R, Schneider M, Scott WN. Double-blind assessment of the value of MRI in the diagnosis of ACL and meniscal lesions. J Bone Joint Surg Am. 1989;71.

Cite this article as: Chintapalli SSK, Thekkada PJ. Correlation of magnetic resonance imaging findings and arthroscopy findings in diagnosis of intra articular ligament injuries of knee joint. Int J Res Orthop 2023;9:367-71.