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"A 2 YEAR PROSPECTIVE STUDY EVALUATING DIAGNOSTIC ACCURACY OF MAGNETIC RESONANCE IMAGING (MRI) IN DETECTION OF RAMP LESIONS OF MEDIAL MENISCUS"

Dr. Surya Sri karun Chintapalli[1], Dr. Pothuri Rishi Ram[2], Dr. Praveen Narayan[3], Dr. Pavith Janardhan.T[4]

1. Senior Resident, Sanjay Gandhi Institute of Trauma & Orthopaedics, Bangalore, India.
2. Fellow in Sports Medicine & Arthroscopy, Sanjay Gandhi Institute of Trauma & Orthopaedics, Bangalore, India.
3. Fellow in Advanced Orthopaedic Trauma, Sanjay Gandhi Institute of Trauma & Orthopaedics, Bangalore, India.
4. Fellow in Arthroplasty, Sanjay Gandhi Institute of Trauma & Orthopaedics, Bangalore, India.

Corresponding Author:
Dr. Pavith Janardhan. T
Email: pavithjanardhan2301@gmail.com

ABSTRACT:

Objective: The purpose of this study is to Correlate the characteristic pattern of lesions affecting posterior horn of medial meniscus in MRI with Arthroscopic findings and calculate sensitivity, specificity and accuracy in diagnosis of ramp lesions.

Methodology: It is a 2-year prospective study conducted in department of orthopedics, Rajarajeswari Medical college and Hospital, Banglore. Patients who were diagnosed with meniscal injuries were posted for arthroscopy surgery after obtaining the informed consent.

In this study we compared MRI findings with arthroscopic findings of medial meniscal ramplesions of knee. The data is prepared and sensitivity, specificity, accuracy of MRI were calculated.

Results: A total of 112 patients of knee injuries were evaluated in which the Medial meniscus was injured in 64.96% of cases. The MM tear with ramp lesion was present in 26(65%) cases, of which 5 (12.5%) cases had grade I tear, 8 (20%) cases had grade II tear and 13 (32.5%) cases had grade III tear. The sensitivity, specificity, PPV and NPV were calculated and we found Sensitivity 88.89%, Specificity 84.62%, Positive predictive value 92.31%, Negative predictive value 78.57%, Accuracy 87.50%.

Conclusions: The Meniscal Ramp lesions need to evaluation of the knee injuries accurately is very crucial for the proper management and outcome. MRI shows moderate sensitivity, specificity and accuracy in the diagnosis of ramp lesions in posterior horn of medial meniscus with more false positives and false negative values. Common causes of false positive findings in MRI is due to misinterpretation of intra meniscal signal changes (grade II signal changes) or normal anatomy as tears. The arthroscopic evaluation of ramp lesions was done using a postero-medial and trans-notch view and other accessory portals.

Keywords: Ramp lesion, Meniscus, MRI, Arthroscopy, ACL tear.

INTRODUCTION:

Menisci function as joint filler, help in joint lubrication, aids nutrition of the articular cartilage, reduce the stress on the articular cartilage[1]. The collagen fibers in the meniscus are oriented as circumferential fibers; radial fibers and perforating fibers. The arrangement ofthese collagen fibers determines to some extent the characteristic patterns of meniscal tears[2].The medial meniscus appears

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as a C-shaped structure larger than the lateral meniscus in radius. The inner border of medial meniscus is thin, concave and free. The attachment of anterior horn of medial meniscus is present in front of anterior cruciate ligament anterior to intercondylar eminence and the posterior horn is anchored posterior to the intercondylar eminence immediately in front of the posterior cruciate ligament[3]. The MRI sagittal images of medial meniscus anterior and posterior horns, appear as isosceles triangles[4]. Coronal images help in evaluating the meniscal bodies appear triangular and slightly larger laterally than medially[4]. On posterior coronal cross sections, the posterior horns appear as flat bands[5].Ram lesions are defined as peripheral vertical/longitudinal tears at medial meniscus posterior horn associated with ACL injuries[6]. These tears include menisco-capsular separation and meniscotibial ligament injuries. The Abnormal shearing forces generated during compression and rotation of femur on a fixed tibia during flexion and extension results in risk for injury[7]. Increased force on a normal meniscus, usually resulting in longitudinal or radial tears, whereas normal forces on a degenerative meniscus, usually producing horizontal tears in the medial meniscus posterior horn[8]. Tears are more common in the medial meniscus, with 56% of tears involving the posterior horn. This is because the medial meniscus is less mobile, and it bears more force during weight bearing than the lateral meniscus[9]. Ramp lesions shows variable results in sensitivity and specificity for pre-
operative diagnosis in MRI[10].

AIM:

This study aims to correlate the characteristic pattern of lesions affecting medial meniscus posterior horn in MRI with Arthroscopic findings and calculate sensitivity, specificity and accuracy in diagnosis of ramp lesions.

METHODOLOGY:

A 2-year hospital based Prospective study was conducted from 2018-2020 in Department of orthopedics, Rajarajeswari medical college and Hospital, Banglore. Source of data was obtained from 40 selective patients diagnosed with meniscal injuries. After obtaining informed consent patients diagnosed with meniscal injuries posted for arthroscopic repair were selected and data is prepared. Inclusion criteria include both male and females of age 18-45 years with history of Recent knee injury (within 2 months), both isolated meniscal injuries or multiple ligament injuries. Patients were clinically examined and evaluated for meniscal injuries. Exclusion criteria include patients contraindicated to MRI and Presence of degenerative diseases which could be inflammatory or primary (osteoarthritis), Femoro-patellar degenerative conditions excluded from the study. Imaging was performed with Siemens 1.5 Tesla MR machine with 170-mm field of view and 256 × 192 matrix, slice thickness 4 mm. The sagittal, coronal, axial images were obtained and findings were noted in selected cases. The selected patients were posted for arthroscopic surgery for meniscal repair. A diagnostic arthroscopy is performed by an experienced orthopedic surgeon to compare the findings of MRI with arthroscopy findings. A Descriptive statistical analysis with 95% confidence interval of findings of MRI and arthroscopy were obtained.

Statistical analysis:

The data was entered in a Microsoft Excel spreadsheet and Statistical Package for social sciences (SPSS) software version 17 is used for analysis of data. The socio- demographic data were expressed in terms of means and proportions. Test of significance was done using a chi-square test for association. It is considered that p-value less than 0.05 was significant.

Ethical clearance:

The study was conducted after obtaining Institutional Ethics Committee clearance and approval from the respective authorities.

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RESULTS:

A total of 112 patients of knee injuries were evaluated in which There were 68 malesand 44 female patients in the age group of 18-45 years with a mean age of 38 yrs. The ACLwas the most common ligament involved, being injured in 69.64% of cases. Medial meniscus was injured in 64.96% of cases, and Lateral meniscus was injured in 41.07% of cases.

In our study out of 58 cases of MM tear on MRI, posterior horn tears were seen more commonly, in 40 cases (68.96%), anterior horn tears were seen in 7 (12%) cases and tears inthe body were seen in 11 (18.9%) cases. The MM tear with ramp lesion was present in 26(65%) cases, of which 5 (12.5%) cases had grade I tear, 8 (20%) cases had grade II tear and 13 (32.5%) cases had grade III tear.The correlation of MRI findings with arthroscopic findings was done in 40 patients and was categorized into true positive, true negative, false positive and false negative cases. 26 cases with ramp lesions over medial meniscus posterior
horn were detected on MRI. Out of these, 24 were confirmed on arthroscopy (true positive),and 2 cases were found to be false positive. Out of the 14 cases which had no MM tear on MRI, 11 were confirmed on arthroscopy (true negative), and 3 cases were found to be false negative. The sensitivity, specificity, PPV and NPV were calculated and we found 88.89% Sensitivity, 84.62% Specificity and Accuracy 87.50% with Positive predictive value 92.31%, Negative predictive value 78.57%.

Table-1: Summary of results for MRI and Arthroscopy in diagnosing medial meniscal injuriesof knee:

	MRI MM		**Arthroscopy MM**	
Ramp Lesions posterior horn MM	**Frequency**	**Percentile%**	**Frequency**	**Percentile%**
Lesion Absent	**14**	**35.0%**	**11**	**27.5%**
Grade I tear	**5**	**12.5%**	**6**	**15%**
Grade II tear	**8**	**20%**	**10**	**25%**
Grade III tear	**13**	**32.5%**	**13**	**32.5%**
Total	**40**	**100.0%**	**40**	**100.0%**

Table-2: Medial meniscus tear with Ramp lesions – MRI correlation with arthroscopy.

	Arthroscopicallypositive	**ArthroscopicallyNegative**	**Total**
MRI positive	24	2	a + c = **26**
MRI negative	3	11	b + d = **14**
	a + b = **27**	c + d = **13**	**n = 40**

P value is 0.0001 which is significant

Table-3: The statistical correlation between MRI and arthroscopy for Medial meniscus ramplesions:

Test	**MM %**	**95% CI**
Sensitivity	88.89%	70.84% to 97.65%

Specificity	84.62%	54.55% to 98.08%
Positive predictive value	92.31%	76.91% to 97.74%
Negative predictive value	78.57%	55.51% to 91.61%
Accuracy	87.50%	73.2% to 95.81%

DISCUSSION

The Ramp lesion of medial meniscus is characterized by separation of posterior horn of medial meniscus with articular capsule or menisco-tibial ligament[11]. It is most commonly associated with anterior cruciate ligament injuries in which the increase in anterior tibial translation increases the tension over posterior horn of medial meniscus[12]. Biomechanical consequences of the ramp lesions affect the joint kinematics and loading patterns of knee leading to increase rotatory instability[13]. MRI has low sensitivity in detecting ramp lesions. The most specific sign was visualization of thin fluid signal completely interposed between medial meniscus posterior horn and posterior medial capsule[14]. The high signal irregularity of capsular margin of medial meniscus posterior horn T2 weighted images. The presence ofoedema over the tibial plateau in MRI can be used as a marker of Ramp lesions[15]. Arthroscopic evaluation is necessary for confirming diagnosis to treat intra articular pathology. The accurate diagnosis for the ramp lesion is established by using arthroscopy with intercondylar notch view for direct vision of the posteromedial compartment[16]. Ahn et al., in his study described the use of 1 or 2 accessory posteromedial portals, for sliding knot fixation by passing a curved suture passer through meniscocapsular tissue and peripheral edge of the meniscus[17].

Systemic arthroscopic exploration includes standard evaluation through Antero- lateral portal, probing meniscal tissue, exploration of postero-medial compartment, Advancement through notch and postero-medial portal is necessary to visualize hidden lesions[18]. Ramp lesions can be classified into 3 types which include I) Menisco-capsular tears, II) Partial Inferior/Superior tears and III) Complete tears. Taunat et al in his study, approached the tear pattern, direction, thickness, zone and associated menisco capsular disruption and instability[19]. Greif et al from his cadaveric studies has extended Taunat classification version integrate the recent knowledge by merging meniscocapsular and meniscotibial ligaments in the meniscal attachment of posterior horn[20].

In this study the Medial Meniscal injuries seen in 58 patients (64.96%) with Grade III injury being commonest. There is preponderance of MM tears over LM tears in our study which is well correlated with the study done by Singh JP et al, in a series of 173 cases of which they found 57 (38.23%) patients showed MM tear and 28(29.41%) patients showed LM tear[21].

Among ramp lesions were found in 26 (65%) patients, with Grade I tear in 5 (12.5%), Grade II tear in 8 (20%) and Grade III in 13 (32.5%) in both MRI and Arthroscopy.

The sensitivity, specificity and accuracy for detecting ramp lesion in posterior medial meniscal tears was 88.89%, 84.62% and 87.5% respectively, and Positive predictive value is 92.31%, Negative predictive value is 78.57% which correspond to the study conducted by Arner et al reported sensitivity of 53–84% and specificity of 92–98%[22]. DePhillipo et al in his study, reported only 50% accuracy in the diagnosis by MRI[23]. The tears of menisci demonstrated as high signal intensity were due to imbibed synovial fluid and were better demonstrated in short TE images. The interaction of synovial fluid with large macromolecules in menisci slows the rotational rate of protons and shortens T1 and T2 values as described by Stoller et al[24]. Identification of meniscal tears can be difficult to

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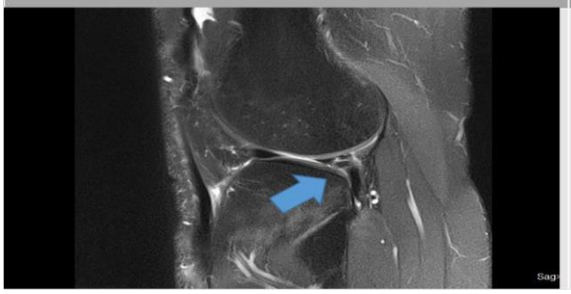
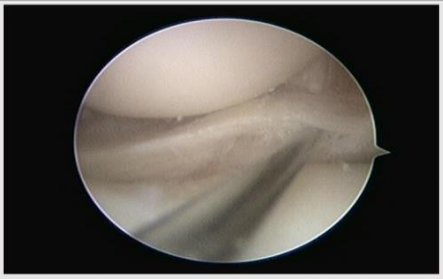
interpret and can be observer dependent, as well as depends on sensitivity of the scanner. There was 3 false negative case that had partial tear of medial meniscus as seen on arthroscopy, which were misinterpreted as normal and there are 2 false positive findings on MRI. The presence of intra-meniscal tears not communicating with the articular surface of the meniscus can be missed in arthroscopy[25]. Posterior horn tears of menisci are likely to be missed on arthroscopy especially if anterior approach is used and if the menisci are not probed[26]. Inferior surface of the meniscus is in particular vulnerable to this flaw in arthroscopy. Thus acceptance of MRI findings as false positive is controversial. In fact, through results of our study we can suggest that MRI has moderate accuracy, although arthroscopy remains as the standard of reference in diagnosis of ramp lesions.

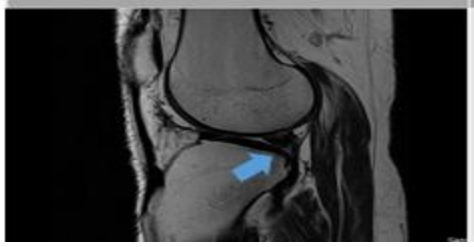
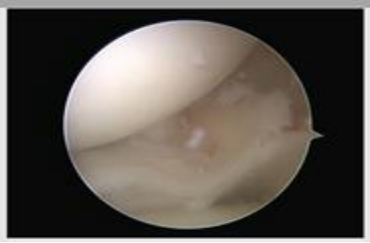
This research study has few limitations as analyses data of a relatively consists of small number of patients. The diagnostic studies have not mentioned important outcomes as sensitivity, specificity regardless of the available literature on this rare topic.

ILLUSTRATIVE CASES:

Case 1: 24 years/Male with H/o Twisting Injury Right Knee with Grade III ramp lesion

MRI FINDING	ARTHROSCOPY FINDING
There is increased signal intensity (PDFS sequence) noted in the posterior horn and body of the medial meniscus with no extension to the articular surface.	Tear in body and posterior horn of medial meniscus
	

Case 2: 30 years/Female with H/o Self Fall Left Knee with Grade II ramp lesion

MRI FINDING	ARTHROSCOPY FINDING
Increased signal intensity noted in the posterior horn of the medial meniscus with Menisco capsular tear and extension to the articular surface.	Tear in posterior horn of medial meniscus
	

CONCLUSION:

Meniscal injuries occur frequently in patients with trauma to the knee. The Meniscal Ramp lesions need to evaluation of the knee injuries accurately is very crucial for the proper management and outcome. MRI shows moderate sensitivity, specificity and accuracy in the diagnosis of ramp lesions of medial meniscus in posterior horn with more false positives and false negative values. MRI is advantageous in conditions where arthroscopy is not useful like peripheral meniscal tears and inferior surface tears[37]. MRI is also advantageous in detection of small peripheral meniscal tears that may be overlooked on arthroscopy. Common causes of false positive findings in MRI is due to

misinterpretation of intra meniscal signal changes. The sensitivity of MRI decreases in identifying meniscal tears withpresence of associated ACL injury. The arthroscopic evaluation of ramp lesions was done using a postero-medial and trans-notch view and other accessory portals. Careful inspectionof the posteromedial region at menisco-capsular junction is required as hidden menisco-capsular lesions may occur which may result in knee instability. The development of knowledge with more detailed analysis and continued interest of this topic is essential.

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Authors contribution:

- Conception and design of study: Dr. Surya Sri karun
- Acquisition of data: Dr. Surya Sri karun, Dr. Pothuri Rishi Ram
- Analysis and/or interpretation of data: Dr. Praveen Narayan
- Drafting the manuscript: Dr. Pothuri Rishi Ram, Dr. Praveen Narayan
- Revising the manuscript critically for important intellectual content: Dr. Pavith Janardhan. T, Dr. Surya Sri Karun.

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