



ORIGINAL RESEARCH PAPER

Radiology

Magnetic Resonance Imaging For Assessment Of Painful Knee

KEY WORDS: MRI: magnetic resonance imaging T: Tesla CI: Confidence interval

Sandhu Arshbir S.	M.B.B.S, 3 rd Year Resident, Department of Radiodiagnosis, S.A.M.C & P.G Institute
Tiwari O.P	Professor and Director Department of Radiodiagnosis, S.A.M.C & P.G Institute
Jain Yajush	M.B.B.S, 3 rd Year Resident, Department of Radio-Diagnosis and Sri Aurobindo Institute of Medical Science and Post Graduate Institute
Santeshwari	M.B.B.S, 2 nd Year Resident, Department of Radio-Diagnosis and Sri Aurobindo Institute of Medical Science and Post Graduate Institute
Kumar Ravi	M.B.B.S, 2 nd Year Resident, Department of Radio-Diagnosis and Sri Aurobindo Institute of Medical Science and Post Graduate Institute
Goyal Vipul	M.B.B.S, 1 st Year Resident, Department of Radio-Diagnosis and Sri Aurobindo Institute of Medical Science and Post Graduate Institute

ABSTRACT

Context: A plethora of pathologies can present as painful knee which may either be of traumatic origin or non-traumatic. MRI is a well-accepted imaging modality because it is non-invasive, not use ionizing radiation, it gives multi planar images, and it provides better soft-tissue delineation.

Aims: To assess the role of magnetic resonance imaging for assessment of painful knee

Methods and Material: In this prospective, nonrandomized, observational study, patients from 2014 to 2016 were assessed. 50 patients with clinical complains of painful knee were included. The patients were subjected to various pulse sequences in multiple planes on 1.5 T MRI. MRI finding were correlation with Arthroscopic were arthroscopic was done

Results: Trauma as cause of knee pain was major etiology in our study (64% of patients) and correlation of MRI findings with arthroscopic findings was performed in 25 patients (22.5%). Among which in 22 patients (88%) MRI findings are well correlated with arthroscopic findings with 95% CI. Correlation between MRI and arthroscopic findings are statistically significant with 95% CI (70.04-95.83%)

Conclusions: From the present study, we conclude that MRI is an excellent, non-invasive, radiation free imaging modality with multiplane capabilities and excellent soft tissue delineation. It can accurately detect, localize and characterize various internal derangements of the knee joint and help in arriving at a correct anatomical diagnosis thereby guiding further management of the patient.

Key Messages:

MRI has emerged as frontline investigation for evaluation of painful knee. Arthroscopy gives excellent visualization of the interior of the joint but it is invasive and can evaluate only surface abnormalities. Statistically good correlation was seen between MRI and Arthroscopic finding (88%cases showed excellent correlation)

The main obstacles to routine use of MRI in clinical practice are the limited availability of MR scanners and scanning time, and the relatively high costs involved¹. This study was therefore undertaken to analyse in our setup, the utility of magnetic resonance imaging (MRI) in assessing painful knee, evaluate the spectrum of MRI findings in patients with painful knee, Comparison of MRI findings with arthroscopic findings in selected cases.

INTRODUCTION:-

Pain and swelling of the knee joint is a significant cause of morbidity in the young, active individuals. A plethora of pathologies can present as painful knee. It may either be of traumatic origin or non-traumatic origin like infection, inflammation, degeneration and neoplasia. With the availability of improved surgical options, accurate imaging of the knee becomes all the more imperative however clinical examination by a surgeon or orthopedician is usually not conclusive to pinpoint the exact lesion causing pain. Hence optimum treatment is hampered. Therefore non- invasive imaging which can demonstrate the underlying pathology without any significant discomfort to the patient is needed. Imaging is useful to identify and confirm the clinically suspected pathologies and also to assessing its extent and gravity.

PATIENT CRITERIA:-

The present study was carried out in the Department of Radiology, Sri Aurobindo Medical College & Postgraduate Institute, Indore (M.P.) from 1st November, 2014 to 30th August, 2016.

Our study population comprised of 50 patients who came to the outpatient department of orthopaedics with complaints of pain in knee joint.

Out of 50 patients, 32 patients had history of Trauma and 18 patients who had no history of trauma. Out of the above patient group 25 patients underwent Arthroscopy in Sri Aurobindo Medical College and PG Institute. The findings of the Arthroscopy were compared with the findings of Magnetic Resonance Imaging.

MRI is a now a well-accepted imaging modality in the diagnostic workup of painful knee. MRI has largely replaced diagnostic arthroscopy for diagnosing internal derangements of knee. MRI has proved reliable, safe and offers advantage over diagnostic arthroscopy, which is currently regarded as the reference standard for the diagnosis of internal derangements of the knee. Advantages of MRI are that it is non-invasive, it does not use ionizing radiation, it gives multi planar images, and it provides better soft-tissue delineation.

After taking written informed consent, all patients were meticulously evaluated by Magnetic Resonance Imaging. The following observations were made in our study.

ETHICAL AND LEGAL CONSIDERATIONS:-

The protocol of the present study was submitted to the Ethics Committee of Sri Aurobindo Medical College & Postgraduate Institute, Indore. After getting their due approval, the study was initiated in the institute. A patient information and consent form was given to the patients in their local language which, when all

their queries were satisfactorily answered and when they were willing to participate, signature of the patient and/or his/her legally acceptable representative was obtained and then only study related procedures were initiated.

OBSERVATION AND RESULTS:-

The patients were categorized into 7 groups on basis of age. The age of the patients ranged from 18 to 75 years. In this study, most patients were in age group of 31 – 40 years (10 patients – 20 %) followed by 21 –30 years (07 patients – 14 %). Mean age of patients presenting with Painful knee was 42 years with standard deviation of 16 years. The Chi Square for trend P Value: 0.0040. (Table 1 and Graph 1)

On basis of gender patient were categorized as follows. There was male preponderance in our study with 74% of patients being male. (Table 2, Graph 2)

On basis of time interval between onset of symptoms and its radiological evaluation. Patients were categorized into 4 groups. Our study shows that out of the 32 patients of Trauma 84% patients get their radiological evaluation done within 1 week. Traumatic patients have decreasing trend in relation to their radiological evaluation. Whereas, patients suffering from non-traumatic knee pain presented uniformly over the duration under study (viz. 4 weeks). The Chi Square for trend P value = 0.0003. (Table-3, Graph-3)

According to our Perma following MRI findings were evaluated. Our study shows that out of the 32 patients who had history of trauma around 65% patients had ACL injury and around 66% patients had Joint effusion while out of 18 non-traumatic cases around 44% patients had Bursitis and 44% patients had Joint effusion. (Table 4, Graph 4)

On the basis of history, clinical findings and MRI findings five major causes of knee pain were identified. Trauma as cause of knee pain was major etiology in our study (64% of patients) followed by degenerative arthritis (24% of the patients) while 8% patients were found to have inflammatory arthritis. 2% were suffering for synovial chondromatosis and the rest 2% had isolated chondromalacia patellae. (Table-5 and Graph-5)

Type and Gender prediction of ACL tear was evaluated. Our study shows that out of the 50 patients 26 patients had ACL tear. There were 15 partial tears whereas 11 complete tears. Slight male preponderance was found in ACL tear but it is not statistically significant (p value=0.3388, RR=1.212). (Table-6 and Graph-6)

Presence or Absence of PCL tear and its gender predilection was evaluated. Our study shows that out of the 50 patients 6 patients had PCL tear. No gender preponderance was found in PCL tear. P value =0.9525, RR=1.146 (Table- 7 and Graph- 7)

On the basis of grading of MCL tear, patients with tear were grouped into three grades and gender preponderance was evaluated. Our study shows that out of the 50 patients 6 patients had MCL tear. It was found that 50% of the patients had Grade III tear. Female preponderance was found in MCL tear. P value = 0.0543, RR=0. (Table-8 and Graph-8)

On the basis of grading of LCL tear, patients with tear were grouped into three grades and their gender preponderance was evaluated. Our study shows that out of the 50 patients 2 patients had LCL tear. It was found that 50% of the patients had Grade I tear and rest had Grade II. Slight female preponderance was found in LCL tear (P Value= 0.4297, RR=0.6667), (Table-9 and Graph-9)

On the basis of grading of MM tear, patients with tear were grouped into three grades and their gender preponderance was evaluated. Our study shows that out of the 50 patients 18 patients had MM tear. It was found that 50% of the patients had Grade III

tear. Slight female preponderance was found in MM tear however it is not statistically significant (P Value: 0.5818, RR=0.8533), (Table-10 and Graph-10)

On the basis of grading of LL tear, patients with tear were grouped into three grades. Our study shows that out of the 50 patients 9 patients had LM tear. It was found that 66% of the patients had Grade III tear. No gender preponderance was found in LM tear (P =0.7754, RR=1.063) (Table-11 and Graph-11)

Twenty five patients out of fifty had arthroscopic done. MRI finding were compared to arthroscopic findings. Correlation between MRI and arthroscopic findings was statistically significant with 95% CI (70.04-95.83%), (Table -12 and Graph -12)

DISCUSSION:-

The role of magnetic resonance imaging has steadily increased and now it has become the first line investigation for most of the lesions of knee. Complete evaluation of all the internal structures of the knee was not possible with other modalities like conventional radiography, arthrography, ultrasonography and computed tomography. Even with arthroscopy lesions such as peripheral meniscal tears, inferior surface tears and osteochondritis dissecans without articular cartilage damage are most often not detected. Multiplanar MR images provide significant improvement in assessing these structures

When comparing the age group of this study, we found that Kornaat et al¹⁰ had studied the painful osteoarthritic knee to compare clinical findings with MR findings and they got patients from 43 to 73 years. Chan et al¹¹ in their study on patients with knee pain due to osteoarthritis included age group of 42-73 years. Anderson et al studied non-traumatic lateral knee pain in patients aged 38 to 46 years. Turner et al⁸ in their study included all patients aged less than 30 years.

Our study group belongs to 18-75 years. Among them traumatic knee pain group belongs to 18 to 75 years where as non-traumatic knee pain were above 35 years of age barring only one patient of age 21 years.

In the study of Chan et al¹¹ the male female ratio was 11:9. Kornaat et al¹⁰ studied a group which had male female ratio of 42:163. Turner et al had dealt with the study where male: female ratio was 10:1.

Our study has male female ratio of 2.85:1. As males are more mobile in our scenario so males are more prone for traumatic injuries and females have preponderance for degenerative changes.

In our study its observed most of traumatic patients get their radiological evaluation done within first week (84%), whereas patients suffering from non-traumatic knee pain presented uniformly over the duration of study. Chi Square for trend P value is 0.0003 which is statistically significant.

According to a case report on acute non-traumatic knee pain in adults by Fotidou et al⁹ causes of pain may be due to septic arthritis, degenerative arthritis, inflammatory arthritis, spontaneous osteonecrosis, transient osteoporosis, acute synovitis.

In our study the non-traumatic causes of pain were due to degenerative arthritis, inflammatory arthritis, isolated chondromalacia patellae and synovial chondromatosis (an extra-articular cause).

In our study joint effusions were the most common finding affecting 30 patients (60%). Among the ligamentous and meniscal injuries, ACL tear is most common, seen in 26 patients (52 %), to be followed by the Medial Meniscal injuries seen in 18 patients (36 %) with grade 3 type injury being commonest.

Singh JP et al in their series of 173 patients, 78 patients (45.08%) showed ACL tears, among these 52 (66.67%), are partial, 16(20.51%) are complete and 10 (12.82%) cases showed non visualization of ACL. The authors concluded that ACL tears are more common than other ligamentous injuries with partial tears being commoner¹².

However in our study ACL tear was found in 26 patients (52%) among these 15(57.7%) were partial tears and 11(42.3%) were complete.

Posterior cruciate ligament injuries were found to be relatively uncommon, in our study found in only 6 patients (12 %) and all the tears were demonstrated as thickening of the ligament with abnormal signal intensity (partial tear). Sonnin et al found the incidence of PCL tear to be 3 percent; in a series of study analysing 350 case of knee injury only 10 patients had PCL tear².

In a study by Grover et al where they analysed findings of 510 consecutive MRI of knee joints with an emphasis on PCL tear; 11 (2%) patients had different grades of tear on MRI which was confirmed correctly by arthroscopy. Of the other 202 patients who had undergone MRI as well as arthroscopy for internal derangement of knee none of the patients had any PCL injury as predicted correctly by MRI³.

In our study, MCL tears (6 patients -9.9 %) were found to be more common than the LCL tear (2 patients -2.7 %). Almost all of these cases had history of trauma and were associated with multiple injuries. This suggests presence of a single injury should prompt the examiner to look for other subtle associated injuries, which was further confirmed by Mink JH et al⁴. They observed on MRI and arthroscopy of 11 patients who had tear of ACL, 7 patients had tear of MCL, 4 patients had tear of lateral meniscus and 1 patient had tear of medial meniscus.

In our study grade 3 tear (50 %) of MCL was more common. We also found the MCL tear is more common in females 4 out of 13 females while in males only 2 out of 35 males had MCL tear. No gender preponderance was found in LCL tears

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. Out of 173 patients, Grade 3 tear of MM was seen in 57(32.95%) patients, Grade 2 in 16(9.25%) patients & Grade 1 in 20(11.56%). In LM, Grade 3 tears were seen in 28(16.18%) patients, Gr 2 in 12 (6.94%) patients & Gr I in 14(8.1%) patients¹².

In our study, MM tears were found in 18 (36%) with Grade I tear in 3 patients (16.6%), Grade 2 tear in 6 (33.4 %) and Grade 3 in 9 (50 %) and LM tear in 20 (18.1%) with Grade I tear in 3 (15%) Grade 2 tear in 5(25.0%) and Grade 3 in 12 (60.0%). No statistically significant gender preponderance was found in both meniscal tears.

Lateral Discoid meniscus with appearance of bow tie configuration in more than three contiguous slices on sagittal images was found in one patient.

In our study Osseous/Osteochondral lesions were seen in 20 patients (40%). Most of these were bony contusions involving the femoral and tibial condyles. Osteochondral lesions are seen in 14 patients. These findings were correlated with findings described by Thomas H. Berquist.⁵

The findings of a partial tear of proximal fibers of medial head of Gastrocnemius muscle were seen in two patients in our study. These findings were correlated with findings described by Thomas H. Berquist⁵

In our study, a correlation of MRI findings with arthroscopic findings was performed in 25 patients (22.5%). Among which in 22 patients (88%) MRI findings are well correlated with arthroscopic findings with 95% Confidence interval. Correlation between MRI and arthroscopic findings are statistically significant with 95% CI (70.04-95.83%)^{6,7}

SUMMARY AND CONCLUSIONS:-

Traumatic knee pain although seems to be more common in youngsters, It is also seen in elderly patients. Leading cause of non-traumatic knee pain is degenerative arthritis in middle aged patients. Inflammatory arthritis can also cause acute knee pain without any history of prior trauma.

Degenerative knee disease is often associated with damage to medial meniscus, joint cartilage and anterior cruciate ligament. Medial and lateral collateral ligaments are usually spared. Subsequent to trauma, insult to anterior cruciate ligament and risk of medial meniscus damage is high.

Chondromalacia patellae is frequently and almost exclusively associated with degenerative painful knee disease. Cartilaginous damage of knee joint is more common in degenerative arthritis than traumatic injury. Contrarily, hemarthrosis is frequently and exclusively detected in post-traumatic scenarios. Extra-articular cause like synovial chondromatosis can be responsible for non-traumatic knee pain.

Most common injury in traumatic knee pain group was ACL tear of which complete tears were more common. Posterior cruciate ligament tears were less common. Among the meniscal injuries, medial meniscal tears are more common than lateral meniscus and grade 3 tears were more common in both. Medial collateral ligament tears outnumbered lateral ligament tears and grade 3 tears were more common in MCL. Osseous/Osteochondral lesions were seen in 20 patients (40%). Most of these were bony contusions involving the femoral and tibial condyles.

Statistically good co-relation was seen between MRI findings and arthroscopic findings in our study.

MRI because of its inherent qualities of multiplanar imaging and excellent soft tissue delineation now has emerged as modality of choice in diagnosing internal derangements in cases of painful knee. It can accurately detect, localize and characterize various internal derangements of the knee joint and help in arriving at a correct anatomical diagnosis thereby guiding further management of the patient.

Table 1 : Age-wise distribution of patients

S. No.	Age group (in years)	No. of patients with h/o trauma	No. of patients with no h/o trauma
1.	18-21	5	0
2.	21-30	7	1
3.	31-40	10	2
4.	41-50	5	6
5.	51-60	1	6
6.	61-70	2	2
7.	>70	2	1
	TOTAL	32	18

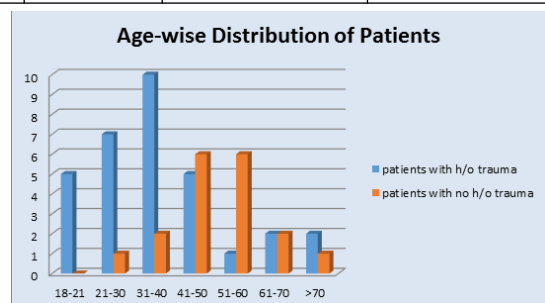


Table 2 : Distribution of patients on basis of gender

S. No.	Gender	No. of patients	% of patients
1.	Male	37	74.0
2.	Female	13	26.0
	Total	50	100.0

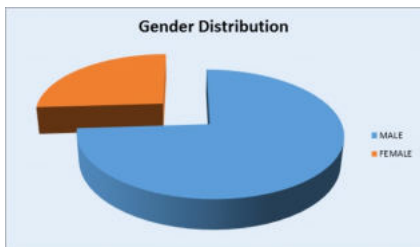


Table 03. Distribution of patients according to time gap between onset of symptoms and its radiological evaluation

S. No.	Time duration	Traumatic	Non-traumatic	Total
1.	Within 1 WEEK	27	5	32
2.	1-2 WEEKS	2	4	6
3.	2-3 WEEKS	1	4	5
4.	3-4 WEEKS	2	5	7

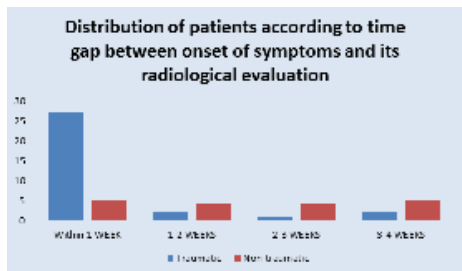


TABLE 04: Spectrum of MRI findings in patients with and without history of Trauma.

MRI FINDINGS	POSITIVE FINDINGS IN TRAUMATIC CASES (N=32)	POSITIVE FINDINGS IN NON-TRAUMATIC CASES (N=18)	POSITIVE FINDINGS DETECTED ON MRI (TOTAL) (N=50)
MEDIAL MENISCUS INJURY	13	5	18
LATERAL MENISCUS INJURY	5	4	9
ANTERIOR CRUCIATE LIGAMENT INJURY	21	5	26
POSTERIOR CRUCIATE LIGAMENT INJURY	2	0	2
MEDIAL COLLATERAL LIGAMENT INJURY	5	1	6
LATERAL COLLATERAL LIGAMENT INJURY	2	0	2
CARTILAGE INJURY	7	7	14
OSSEOUS LESIONS	14	6	20
BURSITIS	12	8	20
JOINT EFFUSION	22	8	30

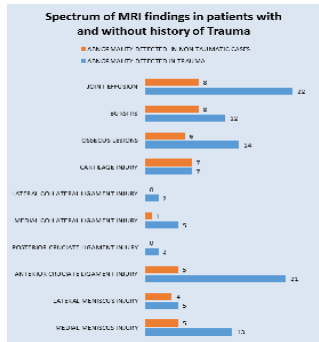


Table 05. : Distribution of patients on basis of causes of knee pain

S.No	Cause of Pain	No. of patients
1	TRAUMATIC KNEE PAIN	32
2	DEGENERATIVE ARTHRITIS	12
3	INFLAMMATORY ARTHRITIS	4
4	SYNOVIAL CHONDROMATOSIS	1
5	ISOLATED CHONDROMALACIA PATELLAE	1

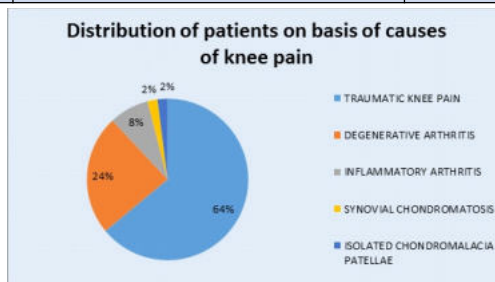


Table 6: Spectrum of ACL tear and its relation to Gender

ACL tear	Number (50)	Male (37)	Female (13)
No	24	16	8
Yes	26	21	5
Partial	15	11	4
Complete	11	10	1

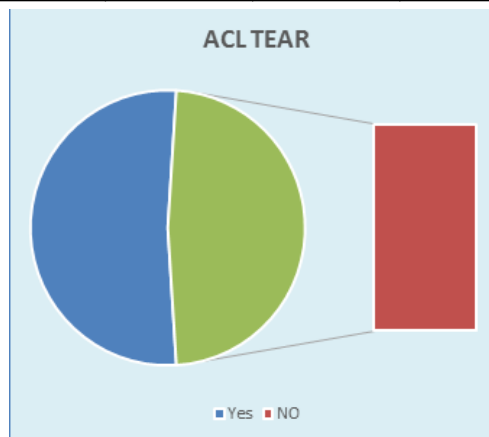


Table 7: Spectrum of PCL tear and its relation to Gender.

PCL tear	Number (50)	Male (37)	Female (13)
No	44	32 (86.4%)	12 (92.3%)
Yes	6	5 (13.6%)	1 (7.7%)

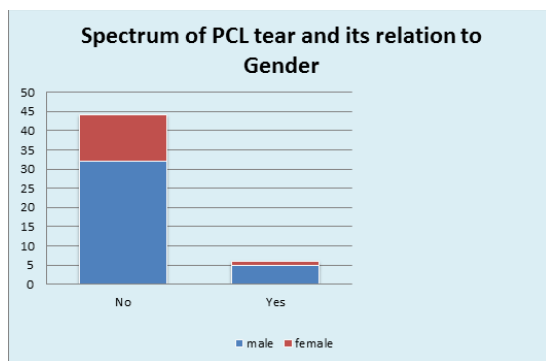


Table 8: Spectrum of MCL tear and its relation to Gender.

MCL tear	Number (50)	Male (37)	Female (13)
No	44	35	9
Yes	6	2	4
Grade I	2	1	1
Grade II	1	0	1
Grade III	3	1	2

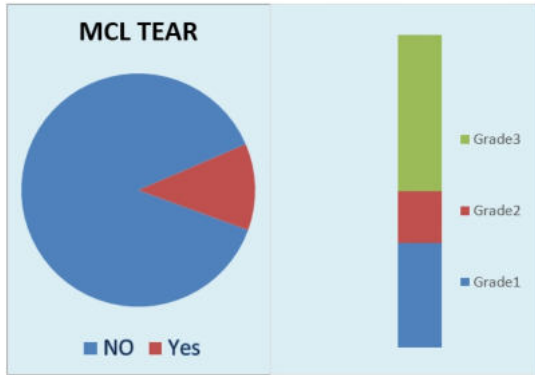


Table 9: Spectrum of LCL tear and its relation to Gender.

LCL tear	Number 50	Male (37)	Female (13)
No	48	36	12
Yes	2	1	1
Grade I	1	0	1
Grade II	1	1	0
Grade III	0	0	0

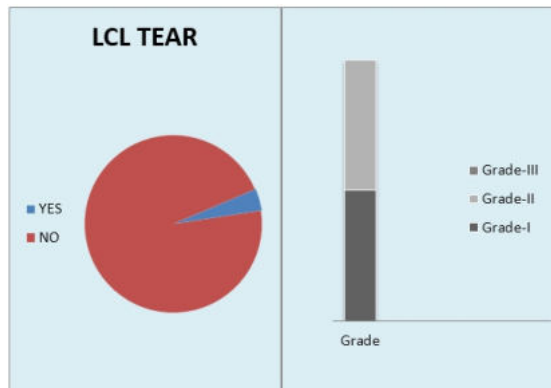


Table 10: Spectrum of MM tear and its relation to Gender.

MM tear	Number (50)	Male (37)	Female (13)
No	32	25	7
Yes	18	12	6
Grade I	3	2	1
Grade II	6	4	2
Grade III	9	6	3

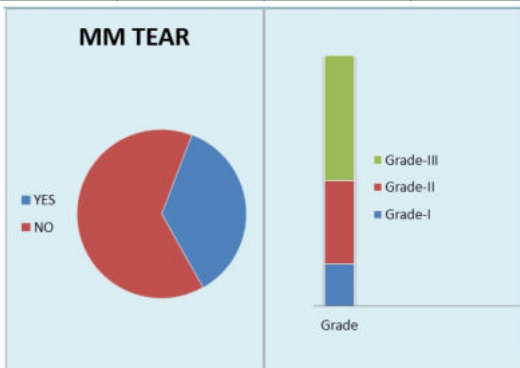


Table 11: Spectrum of LM tear and its relation to Gender.

LM tear	Number (50)	Male (37)	Female (13)
No	41	30	11
Yes	9	7	2
Grade I	1	1	0
Grade II	2	1	1
Grade III	6	5	1

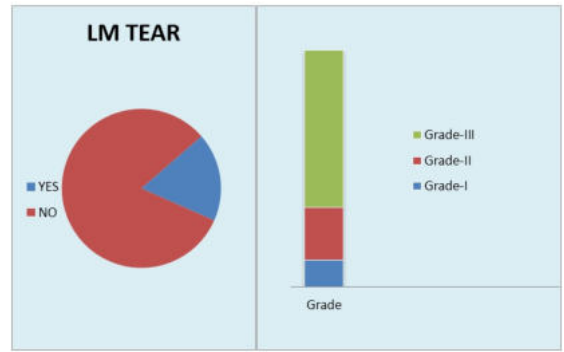
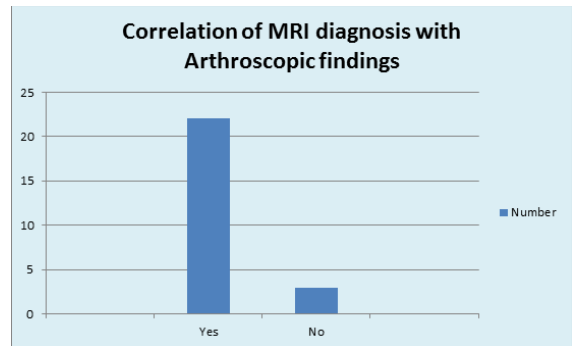


Table 12: Correlation of MRI diagnosis with Arthroscopic findings

Correlation	Number (n=25)	%
Yes	22	88.0
No	3	12.0



REFERENCES:

- Smith HJ. Contrast-Enhanced MRI of Rheumatic Joint Disease. *Brit J Rheumatol.* 1996; 35(suppl. 3): 45-47
- Sonin AH, Fitzgerald SW, Friedman H: MR imaging of Posterior cruciate ligament; normal, abnormal and associated injury pattern. *Radiographics* 1995; 15: 551-561.
- Grover JS, Bassett LW, Gross ML. Posterior cruciate ligament: MR imaging. *Radiology* 1990; 174:527-530.
- Mink JH: The cruciate and collateral ligaments, in Mink JH, Reicher MA, Crues JV III, (eds): *MRI of the Knee* (ed 2). New York, NY, Raven, 1993, pp 141-188.
- Thomas H. Berquist. Osseous and Myotendinous Injuries About the Knee. *Radiolclin N Am* 2007;45: 955-968.
- Bernard Rosner, *Fundamentals of Biostatistics*. In: Bernard Rosner, editor. *Fundamentals of Biostatistics*. 5th ed. Duxbury: Blackwell, 2000; 80-240.
- M. Venkataswamy Reddy, *Statistics for Mental Health Care Research*. In: Subba Rao, S Jingar editors, NIMHANS, INDIA 2002.
- Turner AD, Chadwick CP, Jerry PP, John WC. Acute injury of the ligaments of knee: MRI Evaluation. *Radiology* 1985; 154:717-722.
- Fotidou AN and Karantanas AH. Acute Non-Traumatic Knee Pain in Adults – The Role of Magnetic Resonance Imaging. *European Medical Imaging Review* 2008; 62-64.
- Kornaat PR, Bloem JL, Ceulemans RYT, Riyazi N, Rosendaal FR, Nelissen RG, Carter WO, Le Graver and MPH, Kloppenburg M. Osteoarthritis of the Knee: Association between Clinical Features and MR Findings. *Radiology*, 2006 June, Volume 239, Number 3, 811-817.
- Chan WP, Lang P, Stevens MP, Sack K, Majumdar S, Stoller DW, Basch C, Genant HK. Osteoarthritis of the Knee: Comparison of Radiography, CT, and MR Imaging to Assess Extent and severity. *AJR* 1991 October, 157:799-806
- Singh JP, Garg L, Shrivallari R, Setia V, Gupta V. MR Imaging of knee with arthroscopic correlation in twisting injuries. *Indian J Radiol Imaging* 2004;14: 33-40.