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CORRELATION BETWEEN CLINICAL EXAMINATIONS, MAGNETIC RESONANCE IMAGING AND ARTHROSCOPY FOR MENISCUS AND LIGAMENT INJURIES OF KNEE.

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Abstract

Objective: The aim of this study was to compare accuracy of clinical examination and MRI taking Arthroscopy as Standard in knee injuries. **Materials and Methods:** We evaluated 198 patients retrospectively in 1.5-year period from January 2013 to June 2014 with a meniscal tears and ligament tears. The participants were subjected to clinical examination, MRI and then Arthroscopy. The results were compared and analyzed using various statistical tests. **Results**: Diagnostic accuracy of MRI was 62.62% for medial meniscus and 89.89% for lateral meniscus. Grade 1 and 2 meniscal tears have low sensitivity 50% as compared to Grade 3 and 4 with 88.13%. In the case of ACL tears, diagnostic accuracy for clinical examination and MRI examination came out to be 88.38% and 89.39% respectively. **Conclusion:** We can avoid diagnostic arthroscopy in patients with ACL and PCL injuries having equivocal clinical and MRI examination and go on for therapeutic modality. In case of meniscal injuries graded as 1 and 2 on MRI, are rarely seen on arthroscopy hence arthroscopy is not requiredfor these meniscal injuries.

Key-words: arthroscopy, meniscus, magnetic resonance imaging, ligaments

INTRODUCTION:

The knee is one of the most frequently injured joints because of its anatomical structure, its exposure to external forces and the functional demands placed on it.[1] Orthopedic surgeons relied completely on clinical examination in the late 1960 & early 70's till numerous reports suggested the role of arthroscopy in diagnosis and treatment of various knee disorders.[2] The traumatic or degenerative internal derangement of the knee is a common entity and may require certain studies for the establishment of diagnosis, in addition to clinical history and a thorough physical examination. The use of arthrography

and arthroscopy improves the accuracy of the diagnosis; but both of these interventions are invasive and can cause complications.[3]

The reported accuracy of arthrography has widely from 67 to 97%, and the technique requires a person who is skilled in reporting and interpreting the results.[3] It also involves exposure to ionizing radiation. Diagnostic arthroscopy is an important advance, improving diagnostic accuracy 64 to 94 per cent.[4-7] However, it is an invasive procedure, with the possible attendant complications of infection, hemarthrosis, adhesions, reflex sympathetic dystrophy.

The introduction of MRI had revolutionary impact on medical diagnosis, allowing for comparison of the findings of MRI with surgical/clinical findings.[8] It is non-invasive intervention, poses minimal risk if any, produces minimal patient discomfort and posterior cruciate ligament is easily seen on MRI. Many factors affect the accuracy of MRI in detecting meniscal lesions like experience of radiologist in interpreting studies. Many pitfalls occur in interpretation of MRI findings e.g in studying the central portion of menisci, the menisco-femoral ligament and transverse meniscal ligament, elderly patients often exhibit increased intra-meniscal signal that can be mistaken for tear. In case of ACL tears, MRI often is not helpful in differentiating partial from complete tears. In case of medial collateral ligament injury, mild degrees of injury correlate well; imaging is less accurate in grading more severe injuries.[9]

In the acute phase of knee injury, the indication of MR imaging depends upon severity of pain and/or swelling of knee joint. Although, clinical examination has vital role in the diagnosis of ligament injury. Painful stress examinations are not always accurate in the acute phase of injury. Hence, MR imaging is indicated for early diagnosis of the acutely injures knee.

The aim of this study was to find the correlation between clinical examination and the magnetic resonance imaging (MRI) with arthroscopic findings in knee injury "everyday" clinical situations, to Evaluate and correlate clinical, MRI and arthroscopic findings of meniscal injuries and ligament injuries of knee at first peoples hospital affiliated to medical school of Yangtze university and to encourage others to perform more detailed research in future so that the proper diagnosis is made and the morbidity and disability is reduced to minimum.

Methodology:

This retrospective, study was conducted on the patients who attended the first peoples hospital affiliated to medical school of Yangtze university with knee pain and related symptom from January 2013 to June 2014. A total of 210 patients aged above 20 years with knee pain consented for the study but only 198 fulfilled the inclusion criteria and were eligible for study as 12 patients had knee synovitis. All these patients had clinical examination, MRI followed by arthroscopy. Diagnosis with Arthroscopy was taken as the final diagnosis. Meanwhile, all the patients with knee joint infection along with the candidates of TKA were excluded from the study. On clinical examination various tests were done after taking thorough history. In case of meniscal tears McMurray test and Apley grinding test were done. In case of ACL and PCL disruption Lachman test and drawer test were done. In case of collateral ligament injury varus or valgus stress test were done to evaluate it.

MRI was performed using the MR protocol of 1.5 Tesla imaging system [Signa Exite 1.5-T HD,GE]. T1 & T2 weighed sequences were done on coronal and sagital planes by well-trained radiographers.MR films were be read by a senior radiologist. The status of menisci, cruciate ligament, cartilage and subchondral bone were registered. A meniscal tear was classified accordingto MAYO 2000 classification.[10]

Grade I tear: Meniscal lesion globular in nature, not communicating with articular surface.

Grade II tear: Linear in nature and remain within the substance of meniscus, there is no evidenceof communication with the articular surface of meniscus.
Grade III tear: Increased signal intensity within the meniscus that extends to the articular surface.
Grade IV tear: Distorted tears in addition to findings of grade III tears.
Arthroscopy was performed under regional or general anesthesia with patient in supine position with lateral post around proximal thigh. Proximal thigh tourniquet was used in each case. To classify the location of meniscal tear arthroscopically each meniscus was divided into three equal segments:
The anterior 1/3 or anterior horn
The middle 1/3 or body
Posterior 1/3 or posterior horn
The collateral ligaments, ACL and PCL were classified as partial disruption or complete ligament injury. The results were compared and analyzed using various statistical tests. Data was entered and analyzed using statistical package of social sciences (SPSS) version 16 andMicrosoft Excel 2010.

RESULTS

Out of 198 patients, 64 showed lateral meniscus tear, 92 medial meniscus tear, 30 ACL tear and 12 PCL tear.

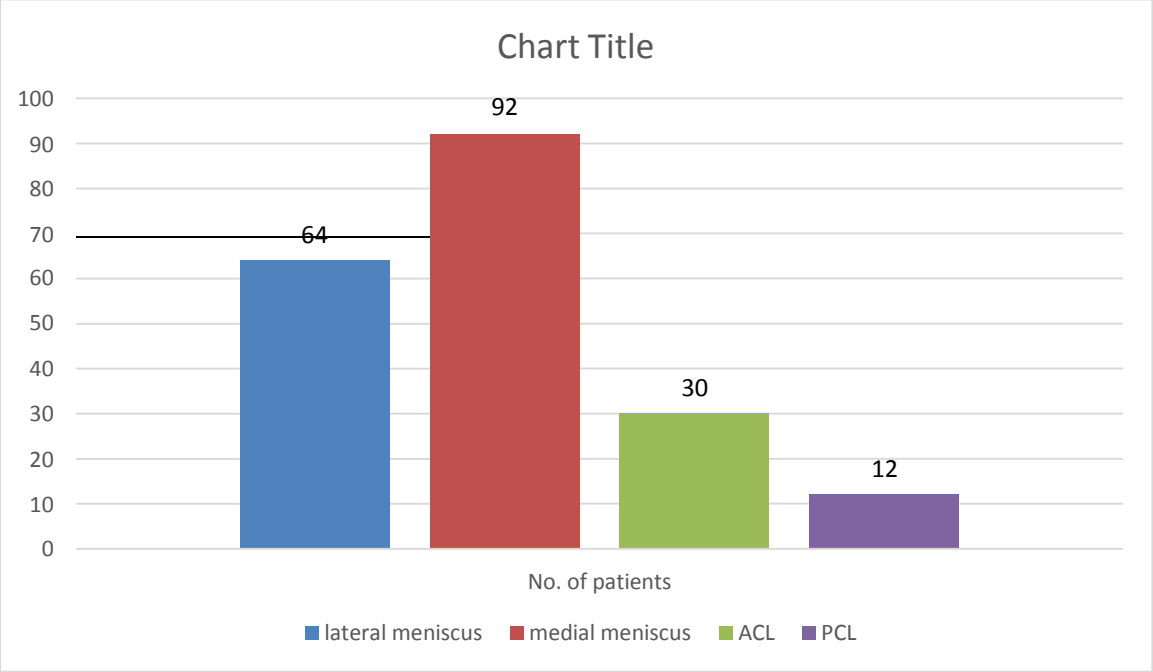

Figure 1: Frequency distribution of knee pathology

We chose a set-up with arthroscopy as the key reference point because it is widely accepted as the gold standard in validation of other diagnostic tools in knee joint disorders. Arthroscopy has an accuracy of up to 98 %.[4]
Reviewing our results, accuracy, specificity, sensitivity, positive- (PPV) and negative predictive values (NPV) were set up using specific equations:

ISSN 2515-8260 Volume 10, Issue 05, 2023

Accuracy = (true-positive + true-negative) / total examined knees x 100
Sensitivity = true-positive / (true-positive + false-negative) x 100
Specificity = true-negative / (true-negative + false-positive) x 100
Positive Predictive Value (PPV*)* = true-positive / (true-positive + false-positive) x 100
Negative Predictive Value (NPV) = true-negative / (true-negative + false-negative) x 100
The clinical examination, MRI findings and arthroscopic examination of these patients have beengiven in the table below

Table-1 Lateral meniscus findings in clinical examination, MRI and arthroscopy examination

Clinical (McMURRAYand Apley grinding positive)		MRI	Arthroscopy
Number	56	64	64
Site			
Anterior 1/3		0	0
Middle 1/3		47	47
Posterior 1/3		17	17
Other findings / MRIgrading		Grade I – 0	
		Grade II – 29	
		Grade III – 31	
		Grade IV – 4	

Table-2 Medial meniscus findings in clinical examination, MRI and arthroscopy examination

Clinical (McMURRAYand Apley grinding positive)		MRI	Arthroscopy
Number	62	92	92
Site			
Anterior 1/3		0	0
Middle 1/3		47	47
Posterior 1/3		45	45
Other findings / MRIgrading		Grade I – 0	
		Grade II – 32	
		Grade III – 54	
		Grade IV – 6	

Table-3 ACL and PCL findings in clinical examination, MRI and arthroscopy examination

Clinical (Drawer testand Lachman test)		MRI	Arthroscopy
ACL complete tear	30	30	30
PCL complete tear	12	12	12

ISSN 2515-8260 Volume 10, Issue 05, 2023

Table-4 Statistical analysis in clinical examination for meniscus and ligament injury

Modality	True positive	True negative	False positive	False negative	Sensitivity	Specificity	PPV	NPV	Accuracy
Joint line Tenderness	158	32	8	0	100%	80%	95.18 %	100 %	95.95%
McMURRAY	62	98	30	8	88.57%	76.56%	67.39 %	92.45 %	80.80%
Anterior Drawer	85	90	15	8	91.39%	85.71%	85 %	95.83 %	88.38%
Posterior Drawer	36	162	0	0	100%	100%	100 %	100 %	100%
Lachman	48	127	12	11	81.35%	91.36%	80 %	92.02 %	88.38%
Apleysgrinding	56	90	46	6	90.32%	66.17%	54.90 %	93.75 %	73.73%

Table-5 Statistical analysis in MRI examination for meniscus and ligament injury.

Modality	True positive	True negative	False positive	False negative	Sensitivity	Specificity	PPV	NPV	Accuracy
Medialmeniscus	32	92	65	9	78.04 %	58.59 %	32.98 %	91.08 %	62.62%
Lateralmeniscus	33	145	12	8	80.48 %	92.35 %	73.33 %	94.77 %	89.89%
Grade I + II	6	136	50	6	50.00 %	73.11 %	10.71 %	95.77 %	71.71%
GradeIII + IV	52	98	41	7	88.13 %	70.50 %	55.91 %	93.33 %	75.75%
ACL	53	124	15	6	89.83 %	89.20 %	77.94 %	95.38 %	89.39%
PCL	21	177	0	0	100 %	100 %	100 %	100 %	100%

DISCUSSION

The analysis of age distribution in the study showed a range of 20-50 years. The youngest subject was 20 years of age and oldest subject was of 50 years of age. On analyzing sex distribution of the subjects with knee injuries it was found that 136 were male and 62 were female. So males outnumbered the females. Similar results have been shown by Clayton et al[11] with mean age varying from 24-36 years.

In case of ACL tears diagnostic accuracy for clinical examination and MRI examination came out to be 88.38% and 89.39%.The sensitivity of MRI and clinical examination were 89.83% and 91.39% respectively while the specificity was 89.20% and 85.71% in diagnosing ACL lesions which made us interpret that in hands of a good clinician MRI does not give any advantage over clinical examination. This finding is similar to that off Yavuz Kocabey[12] who found that there was no statistical difference between MRI and clinical examination in diagnosing ACL tears (P >.05). The accuracy of the clinical examination and MRI evaluation were almost equal for diagnosing ACL

ISSN 2515-8260 Volume 10, Issue 05, 2023

ruptures.

There were 15 false positive examinations by MRI. These might be explained by the presence of partial tears which are missed on arthroscopy. Dowdy et al[13] concluded that a positive MRI for an ACL tear combined with a normal arthroscopy did not represent a false positive MRI and that an intra-substance tear may be present that is difficult to detect with arthroscopy.

In a study done by Winters et al[14] of 63 patients MRI showed a tendency to over diagnose tears with five false positive giving an overall predictive value of only 76%. This probably reflects the difficulty in distinguishing between complete and partial tears on MRI and the fact that arthroscopy is not the best tool for diagnosing cruciate ligament tears.

Specificity of MRI and clinical examination was 89.20% and 85.71%. Thus whenever there was a clinical suspicion of ACL tear on clinical examination like on Anterior drawer and Lachman test and was suspected on MRI the patient invariably had a ACL tear on arthroscopy.

Overall in case of ACL tears we suggest that in the patients where MRI and clinical examination is nearly equivocal; we might prevent the patient from undergoing an invasive diagnostic procedure. We can take up the patient for therapeutic procedure.

Barronian et al[15] in their study of 22 patients showed results similar to ours. They calculated positive predictive value and negative predictive value and concluded that negative predictive value was 92% (ours is 95.38%). The negative predictive value is very important and indicates that negative MRI is quite reliable for cruciate ligaments. In this study PPV was calculated as 50% and in our study it was 77.94%. Two possible reasons explain the low PPV. First arthroscopy has a high false negative rate. Pathology missed at the time of surgery but visualized with MRI would constitute a false positive.

Diagnostic accuracy of MRI was 62.62% for medial meniscus and 89.89% for lateral meniscus which corresponds to study done by Glashow et al[16] (74% for medial and 94% for lateral meniscus), Rappepor et al[17] (77% for medial and 91% for lateral meniscs), Kinnuen et al[18] (82 % for medial and 88 % for lateral), Incesu et al[19] (86% accuracy for meniscus).

Grade 1 and 2 tears have low sensitivity 50% as compared to Grade 3 and 4; 88.13% as tears in Grade 1 and 2 do not extend to articular surface and are difficult to detect on Arthroscopy. Diagnostic accuracy of clinical examination was relatively similar to previous studies done by Rose et al[20], Miller et al[21] that showed accuracy of 75 to 80%.

There is a high negative predictive value of MR examination in diagnosing meniscal tear as was case with ACL tear; whereas PPV was low. In study by Barronian et al[15] the negative predictive value was 91% for meniscus whereas PPV was 65%.

In our study there have been high number of false positive results that have led to decrease in the PPV. The reason that is possible is MRI seems to overdiagnose tears of menisciresulting in a low predictive value. Mink et al[22] reported a total of 47 false positive results with MRI. The degenerative changes that tend to increase the signal intensity are also a major cause of having high false positive results.

In our study we achieved a high accuracy with both clinical and MR examination in PCL injuries with accuracy of 100% in either of them. However, only 12 patients with PCL deficiency was part of the study.

CONCLUSION

An accurately performed clinical examination by an experienced examiner with positive signs alone will be justified for arthroscopy. We can avoid diagnostic arthroscopy in patients with ACL and PCL injuries having equivocal clinical and MRI examination and go on for therapeutic modality. In case of meniscal injuries graded as 1 and 2 on MRI, are rarely seen on arthroscopy hence diagnostic arthroscopy is not required for these meniscal injuries. In case of meniscal injuries graded as 3 and 4 on MRI, arthroscopy should be carried out.

ISSN 2515-8260 Volume 10, Issue 05, 2023

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