ORIGINAL ARTICLE

DIAGNOSTIC ACCURACY OF MAGNETIC RESONANCE IMAGING IN MENISCAL INJURIES OF KNEE JOINT AND ITS ROLE IN SELECTION OF PATIENTS FOR ARTHROSCOPY

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Background: Magnetic Resonance Imaging (MRI) is frequently advised to evaluate clinically suspected cases of meniscal injuries in our setup. The objective was to determine the diagnostic accuracy of MRI in meniscal injuries of knee joint and its effectiveness in selection of patients for arthroscopy. **Methods:** A Cross-sectional comparative study was conducted at Radiology Department Military Hospital (MH) Rawalpindi in collaboration with Orthopaedic Department Combined Military Hospital (CMH) Rawalpindi from 31 Jan 2007 to 1 Aug 2007. Fifty-seven patients with clinical suspicion of meniscal injuries were subjected to MRI. Arthroscopy was done only in 34 patients while 23 were excluded on the basis of MRI findings. MRI findings were compared with arthroscopic findings. Medial and lateral menisci were considered separately in each case. **Results:** Among 57 patients only 30 showed significant tear on MRI. Arthroscopy was done in these cases. Arthroscopy was considered on clinical grounds only in 4 patients who did not show significant tear on MRI. MRI showed Medial Meniscus (MM) injury in 23 patients and Lateral Meniscus (LM) injury in 10 patients. Arthroscopy confirmed MM injury in 17 patients and LM injury in 7 patients. MRI missed two MM and one LM injuries. This showed that MRI has sensitivity of 89.4% and specificity of 62% in diagnosing injuries of MM, while sensitivity of 87% and specificity of 88% in diagnosing injuries of LM. Diagnostic accuracy of MRI in MM and LM injuries was 76.4% and 88.2% respectively. **Conclusion:** MRI is accurate in diagnosing meniscal injuries of knee joint and is effective in selection of patients for arthroscopy.

Keywords: Magnetic Resonance Imaging, Meniscal injuries, Arthroscopy

INTRODUCTION

The knee meniscus was once thought to be a vestigial structure that served no function. In 1887, Sutton described meniscus as 'the functionless remains of a leg muscle'. This lack of appreciation for its function formed the basis for total meniscectomy.[1] Fairbanks in 1948 described that meniscectomy is not wholly innocuous in his classic report of post-menisectomy radiographic changes.[2] Much has been learnt in the last 30 years through laboratory investigations, clinical experience, and radiological imaging. The meniscus is now known to play an important role in the complex biomechanics of the knee.[3,4]

Menisci are commonly injured in knee trauma especially in road traffic accidents and amongst young males in the sports field.[3,5] Medial Meniscus is more commonly injured than Lateral Meniscus.[5–7] Individuals who experience a meniscus tear usually complain of pain and swelling as their primary symptoms. Although symptoms and signs are helpful in diagnosis however, sometime they may be confusing and delay in diagnosis may result in a worse prognosis, therefore, confirmation of meniscal injuries requires further evaluation by arthroscopy or MRI.[6,8,9]

Arthroscopy of the knee has been used since 1970s as a diagnostic and therapeutic tool in the management of meniscal injuries. Arthroscopy is considered as 'the gold standard' for diagnosing intra-articular knee problems. However, arthroscopy is an invasive procedure that requires hospitalization, general or local anaesthesia and has certain risks and discomfort for the patient. Arthroscopy should preferably be performed only for treatment purposes, provided that alternative non-invasive diagnostic modalities such as MRI are available.[3,6,10]

The potential of MRI in assessing the knee joint was first described by Kean and Moon in 1983. No imaging modality has had as great an impact on the current practice of orthopaedics as MRI. With the availability of the specialised extremity coil, the knee has become the most frequently studied articulation.[11] In the past 20 years, MRI of the knee has become available as an alternative to diagnostic arthroscopy.[6, 11] It has developed into a reliable tool in detecting intra-articular knee pathology. Injuries to intra-articular structures like menisci and cruciate ligaments are diagnosed with high sensitivity and specificity compared with arthroscopy, which is still regarded as the reference standard. The MRI is non invasive, gives much better soft tissue contrast and has shorter imaging time with reduced artefacts. Moreover; it allows imaging in multiple planes and incurs no radiation dose to the patient. The clinical relevance of preoperative MRI is also determined by its value to select patients for therapeutic arthroscopy.[11,12]

Unnecessary diagnostic arthroscopies can be prevented by MRI. In cases where surgery is considered necessary information provided by MRI will help the Orthopaedic Surgeon by reducing the procedure time and the patient by reducing tourniquet time.[11,13]

The MRI is frequently advised to evaluate clinically suspected cases of meniscal injuries in our setup. However, its accuracy has never been studied before locally. Most of the data available to date has been taken from western studies. This study would help us to see diagnostic accuracy of MRI in our own setup.

The objectives of this study were to determine the diagnostic accuracy of MRI in meniscal injuries of knee joint and its effectiveness in selection of patients for arthroscopy. This would not only help us to reduce the number of pure diagnostic arthroscopies in suspected cases of meniscal injuries but also in the selection of proper treatment option.

PATIENTS AND METHODS

This was a cross-sectional comparative study with non probability convenience sampling conducted at Department of Radiology, MH Rawalpindi in collaboration with Department of Orthopaedics, CMH Rawalpindi from 31st Jan 2007 to 6th Aug2007. 57 patients of all ages and either gender with clinically suspected meniscal injuries were referred from Department of Orthopaedics, CMH Rawalpindi to Department of Radiology, MH Rawalpindi for MRI of the knee joint in the duration of this study. MRI of the affected knee joint was performed using extremity coil with Siemens, 1.5 tesla Magnetom Symphony machine after taking informed consent in all of them. T1and STIR sequences were taken in Axial, Sagittal and Coronal planes. Slice thickness was 4mm. The findings of each MRI scan were substantiated by opinion of a consultant radiologist.

Thirty patients having grade 3 or 4 meniscal injuries suspected on MRI were subjected to arthroscopy after taking informed consent. Informed consent was taken after explaining benefits and risks of arthroscopy to the selected patients. The diagnostic criteria of grade 3 and 4 meniscal injuries on MRI was the presence of abnormal signal intensity within the meniscus extending to one or both articular surfaces or complete fragmentation of the meniscus respectively. Time interval between MRI and arthroscopy in each case was less than 4 weeks. Arthroscopy was also performed by Orthopaedic surgeon in 4 cases on clinical grounds, in whom MRI was normal. These cases were also included. The findings of MRI were compared with arthroscopic findings in theses 34 cases. We considered arthroscopy to be the standard for the accurate diagnosis of meniscal injuries; hence for this study the sensitivity, specificity, and accuracy of MRI was based on the findings of arthroscopy. Arthroscopy was not performed in remaining 23 cases as they did not show significant injury on MRI. These patients were advised follow up and most of them showed improvement with conservative treatment. Data was entered into computer package SPSS version 11 for statistical analysis. Sensitivity, specificity, positive predictive, negative predictive values and accuracy was calculated using the 2×2 table.

RESULTS

The MRI was followed by arthroscopy under GA in 34 patients in the duration of this study between 1-02-2007 and 6-08-2007. Findings of MRI were matched against the arthroscopic findings in each case. MM and LM in each patient were considered separately. There were 31 (91%) males and 3 (9%) females. The age of the patients ranged from 22–66 yrs with mean age of 37 yrs. 23 (67%) patients were diagnosed to have MM injury on MRI while 11 (33%) patients showed normal MM on MRI. 10 (30%) patients were diagnosed to have LM injury on MRI while 23 (70%) patients showed normal LM on MRI. Arthroscopy of affected knee joint confirmed our initial diagnosis of MM injuries in 17 (74%) but did not show any tear in 6 (26%) patients who were diagnosed to have MM injury on MRI. Arthroscopy of affected knee joint confirmed our initial diagnosis of LM injuries in 7 (74%) but did not show any tear in 3 (26%) patients who were diagnosed to have LM injury on MRI. MRI ruled out arthroscopy in 23 patients who were advised follow up and most of them showed improvement with conservative treatment. Out of those 11 patients who did not show MM injury on MRI, 2 (18%) patients were found to have grade 3 meniscal injury on arthroscopy, thus making false negative results of MM in our study. Out of those 24 patients who did not show LM injury on MRI, one (4%) patient was found to have grade 3b tear on arthroscopy, thus making this a false negative result of LM in our study.

Arthroscopy was also performed by Orthopaedic surgeon in 4 cases on clinical grounds, in whom MRI was normal. Arthroscopy showed grade 3b tear of MM of right knee in 1 of these 4 cases (False negative). Statistical analysis of our study revealed results for MM and LM as given in Table-1.

Table-1: Accuracy of MRI in diagnosing MM and LM injuries

	Medial Meniscus	Lateral Meniscus
Sensitivity	89.4	87.5
Specificity	62.0	88.0
Positive predictive value	70.0	70.0
Negative predictive value	81.66	95.0
Diagnostic accuracy	76.4	88.2

Figure-1: Sagittal STIR image of left knee showing Grade 3 a tear of posterior horn of MM.

Figure-2: Sagittal STIR image showing grade 4 tear of posterior horn of LM of left knee joint

DISCUSSION

Until the last decade, diagnostic arthroscopy was the only possible way to clarify a doubtful diagnosis. Unfortunately, it is an invasive and expensive procedure, and its overuse has produced unnecessary complications, such as infection, neurovascular lesions and damaged intra-articular materials. With the evolution of the materials and surgical techniques, arthroscopy has become more of a surgical method than a diagnostic tool, and MRI being non invasive has become an important modality in the assessment of meniscal injuries of knee joint.[13,14]

Our study showed that patients having meniscal injuries of knee joint were mostly males (91%) with 70 % patients ranging between ages of 21–40.This indicated that meniscal injuries prevail mostly in young males. This is in accordance with international studies which favour young male predilection for meniscal injuries.[3,5,6,12] Other studies have shown MM injury to be more common than LM injury.[6,8,12] This study also showed MM injury (70%) to be more common than LM injury (30%) thus favouring other studies.

In this study negative predictive value of MRI is 81.66% and 95% for MM and LM tears respectively. This shows the effective role of MRI in selecting patients for arthroscopy. In this study MRI initially ruled out arthroscopy in 27 out of 57 referred patients. Only 4 out of these 27 patients were considered for arthroscopy on clinical grounds after 3-4 months. This shows that a preoperative MRI scan can prevent unnecessary diagnostic arthroscopy in a significant number of patients.

The results of the present study demonstrate that meniscal injuries can be accurately diagnosed by MRI and support the findings of other studies. Williams performed a study in which MRI scans were performed on 69 patients waiting for knee arthroscopy. All patients had a clinical diagnosis of traumatic intra-articular knee lesion. Of the patients scanned, MRI ruled out lesions in 24 patients, who were removed from the waiting list. After 9 months, only 1 of them had been re-listed for therapeutic arthroscopy because of continued symptoms.[15] Vincken PWJ *et al* also conducted a study to see the effectiveness of MRI in selection of patients for arthroscopy of the knee and concluded that MRI is an effective tool in the selection of patients for arthroscopy from among a general population.[16]

MRI system used in this study had 1.5-T field strength which was sufficient for producing accurate diagnostic images for identifying meniscal abnormalities. Magee and colleagues concluded that MRI of the knee performed at 3.0-T compares favourably in sensitivity and specificity with studies performed at 1.5-T field strength or lower.[17] Only extremity coil was used in this study to optimise the signal-to-noise ratio; however Antonio *et al* showed that surface coil may be used for better detail in evaluating subtle lesions or suspicious areas.[18]

T1WS and STIR sequences were used in this study because they are routinely used in our department for imaging the knee joint and are also internationally acceptable.[3,5,6] Helms *et al* postulated that with fat suppression, the dynamic range signal of the menisci is increased, making meniscal tears more conspicuous.[4] In this study STIR sequences were used in all patients. Meniscal tears were more conspicuous on STIR sequences favouring Helms postulation.

Rubin *et al* have stated that virtually all meniscal tears are detected and characterised on

sagittal plane imaging only.[19] Magee *et al* concluded that coronal MR images of the knee allowed better detection and characterisation of some meniscal tears than sagittal images alone.[1]We did coronal images in all patients and found them necessary in accurately diagnosing meniscal injuries.

Some studies contradict the routine use of MRI in meniscal injuries. Brooks *et al*, in a prospective study, assessed the agreement between preoperative clinical/arthroscopic and MRI/ arthroscopic findings (79% versus 77% agreement, respectively) and concluded that MRI did not reduce the number of negative arthroscopic procedures.[20] However Bryan *et al*, reported contradictory findings to Brooks *et al*. They demonstrated that MRI could decrease the rate of surgery in chronic knee problems, especially in those in whom surgery was already planned; furthermore, they found that it did not increase the overall cost.[21]

Although knee MRI is still considered an expensive tool, the total cost of arthroscopy is far greater. Bui-Mansfield performed a study to ascertain whether there would be a significant economy if preoperative MRI is done. They observed that if the results of the MRI had been taken into account before the performance of the arthroscopy, there would have been an economy of US$ 680 for each case.[22]

In this study MRI ruled out significant number of cases having clinical suspicion of meniscal injuries from diagnostic arthroscopy hence proving its utility. Our study has certain clinical applications. Firstly, despite of the higher cost of MRI at present, it must be used whenever there is suspicion of meniscal injuries with equivocal findings and this should be performed earlier without delaying as these injuries can lead to complications. This will definitely reduce the negative diagnostic arthroscopy rates and reduce burden on hospital resources. Secondly, there is need to improve level of skill of radiologists in interpreting MRI images and if possible radiologists must have another opinion so as to reduce the inter-observer variability. Thirdly, we need to conduct a study on larger scale using different MRI protocols in patient groups so as to find out the best technique which can be used as a standard protocol for the diagnosis of meniscal injuries.

There are certain limitations to our study. The number of patients in this study was small, so the results cannot be generalised to the general population. This study was conducted in military tertiary care hospital and patients presenting here may not be representative of the general population.

Ideally, all patients regardless of MRI findings should be subjected to arthroscopy to get accurate results. However, because arthroscopy is an invasive and expensive procedure only 34 patients were subjected to arthroscopy in this study while 23 were excluded from arthroscopy. In most of these patients arthroscopy was done for therapeutic purposes. Ideally, orthopaedic surgeon should not be aware of MRI findings before arthroscopy to reduce the bias; however in this study orthopaedic surgeon was not blind about the results of MRI.

CONCLUSION

The MRI has dramatically improved our ability to detect meniscal injuries of knee joints. MRI is highly sensitive and accurate in diagnosing meniscal injuries of knee joints. MRI in clinically suspected cases of meniscal injuries would reduce the number of unnecessary diagnostic arthroscopies. Preoperative MRI will help orthopaedic surgeons in selecting proper therapy for their patients.

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