ORIGINAL ARTICLE

Diagnostic Accuracy of 1.5 Tesla MRI in the Diagnosis of Meniscal Tears of Knee Joint

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ABSTRACT

Aim: To determine the diagnostic accuracy of 1.5 tesla MRI in the diagnosis of meniscal tears of knee joint taking arthroscopic findings as gold standard.
Place and duration of study: From July 2011 to December 2011, at Sheikh Zayed Post graduate medical Institute, Lahore (Radiology and Orthopedic departments).
Subjects and methods: 50 patients fulfilling the selection criteria were identified, referred from outpatient department of orthopedics to Radiology department Sheikh Zayed hospital were included in the study. Their informed consent and demographic profile was obtained. 1.5-Tesla MRI was done by single technician of MRI department. Arthroscopy was done by professor of orthopedics to confirm the findings of MRI. All this information was recorded on proforma and results were evaluated.
Results: A total of 50 patients were included in the study. 48(96%) were male and 2(4%) were female. The age ranged from 15–55 years. Mean age of patients was 30.4 ±5.91 years. Our study revealed high sensitivity (97%), high specificity (94%) and accuracy (96%) for the meniscal injuries of knee joint in comparison to arthroscopy.
Conclusion: Magnetic resonance imaging is a good, accurate and non invasive modality for the assessment of meniscal injuries.
Keywords: Arthroscopy, magnetic resonance imaging, knee

INTRODUCTION

Magnetic Resonance Imaging has gained in popularity as a diagnostic tool of the musculoskeletal system since its introduction in the 1980s[1]. MRI is non-invasive and requires no exposure to ionizing radiation. Since then because of its improved signal to noise ratio, higher resolution, reduced artifacts, shorter imaging times and improved accuracy, MRI has clearly emerged as the primary imaging tool in the work up of knee joint pathology[2,3].

MRI not only depicts osseous lesions, but provides information on the cartilages, menisci, ligaments and surrounding soft-tissues. On MRI meniscal tears are characterized by linear, complex, or diffuse increased signal intensity within the meniscus which communicates with an articular surface[4]. Diagnostic arthroscopy of the knee has also been increasingly performed as it is highly accurate and can be therapeutic at the same setting However, it may be complicated by infection, haemarthrosis and adhesions, as well as complications related to anaesthesia[5,6]. The rationale of my study was to evaluate the role of 1.5-Tesla MRI as a screening technique to reduce the number of arthroscopic procedures in diagnosis of meniscal tears of knee in our local population.

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PATIENTS AND METHODS

Age group from 15 to 55 years, both sexes, Patients presenting in orthopedic OPD with complain of instability and locking of knee with suspicion of meniscal injury and referred to us for MRI were included in the study. While patients having history of tumor of knee, history of previous knee surgery**,** history of associated intra-articular fracture and confirmed on x-ray were excluded.

Data collection procedure: From July 2011 to December 2011, fifty patients with history of instability and locking of knee with suspicion of meniscal injury, referred from outpatient department of orthopedics to Radiology department were studied. After obtaining history and clinical examination by the orthopedic surgeon, these patients went through 1.5-Tesla MRI done by single technician with pre procedure informed written consent. MRI showed injury to either the medial meniscus or lateral meniscus or both. Follow up of such patients were done by gold standard knee arthroscopy done by single orthopedic surgeon to compare the findings on MRI. Exclusion criteria were history of tumor of knee, history of previous knee surgery, history of associated intra-articular fracture confirmed on x-ray and those patients who had contra indication to MRI as pregnancy and patients with metallic implants. MRI studies were performed on Visart TM series (Toshiba 1.5 Tesla unit) by single technician. The imaging protocol included Sagittal T1, T2 and T2*;

coronal and axial T2 weighted images. The imaging was performed with a dedicated extremity knee coil. The images were studied and reported by at least two trained and qualified Radiologists, who reached a consensus interpretation. A modified version of the classification system of Lotysch et al to score meniscal injuries on MR images was used. A meniscal tear on MRI was defined as being of grade 3 signal intensity (i.e. intra meniscal signal intensity unequivocally extending to an articular surface). All arthroscopic examinations were performed by an experienced orthopedic surgeon. The arthroscope, which had a 30° viewing angle, was introduced into the knee through an anterolateral or transpatellar portal. All structures were probed as well as visualized. After the diagnostic part of the examination, the arthroscopist recorded the arthroscopic diagnosis and therapeutic intervention, if any. Next, depending on the diagnostic findings, the arthroscopist terminated the procedure or continued with the therapeutic part of the procedure. The various findings at MRI and arthroscopy were noted on data collection proforma.

Data analysis: All the collected information was analysed with the help of computer software SPSS version 15. Qualitative variables i.e., sex was presented as frequency and percentage. Quantitative variables i.e. age was presented as mean and standard deviation. Sensitivity, Specificity, Positive predictive value and Negative predictive value and accuracy of MRI was calculated taking arthroscopy as gold standard. Accuracy is defined as (true-positive [TP]+true-negative [TN])/(TP+false-positive [FP]+TN+false-negative [FN]). Sensitivity is defined as TP/(TP+FN), specificity is TN/(FP+TN), PPV is TP/(TP+FP) and NPV is TN/(TN+FN).

RESULTS

The ages ranged from 15 to 55 years (average 30 years). Of these 8(16%) patients were in the age group 16-25 years, 33(66%) patients were in age groups 26-35 years, 7(14%) were found in the age group 36-45 years, 2 (4%) patients were found in the age groups 46-55 years (Table 1).

Table 1: Distribution of cases according to age group (n=50)

Age (years)	=n	%age
15	0	0
16-25	8	16.0
26-35	33	66.0
36-45	7	14.0
46-55	2	4.0

Mean±SD=30.42±5.91

According to sex distribution, 48(96%) patients were male and 2(4%) were female (Table 2).

Table 2: Distribution of cases according to sex group (n=50)

Gender	=n	%age
Male	48	96
Female	2	4

Male:Female ratio 24:1

Seventy percent of the patients were in their third and fourth decade; and of this group, only 4% were female. Left side of knee was involved in 36(72%) patients and Right side of knee was involved in 14(28%) patients (Table 3).

Table 3: Distribution of cases according to side involved (n=50)

Knee side	=n	%age
Left	36	72
Right	14	28

Medial meniscus: A total of 42 medial meniscal tears were described at arthroscopy (42/50 patients, 84%), and MRI detected 41 of them (Table 4).

Table 4: Findings of arthroscopy and MRI (n=50)

Modality	Medial Meniscus	Lateral Meniscus
Arthroscopy	42	25
MRI	41	24

One tear seen at surgery was not seen on MRI interpretation. One tear described on MRI was not seen or described at surgery. The results included 41 true-positives, one false-positive, seven true-negatives, and one false-negative (Table 5).

Table 5: Reliability of magnetic resonance imaging as determined at arthroscopy

Result	Medial Meniscus	Lateral Meniscus
True +ve	41	24
True –ve	7	24
False +ve	1	1
False -ve	1	1

Therefore, the accuracy for the detection of medial meniscal tears was 96%, the sensitivity was 97%, the specificity was 87%, the PPV was 97%, and the NPV was 87% (Table 6).

Table 6: Percentage validity of the diagnoses from MRI

Validity	Medial Meniscus	Lateral Meniscus
Accuracy	96	96
Sensitivity	97	96
Specificity	87	96
Negative predictive value	87	96
Positive predictive value	97	96

According to sex distribution, 48(96%) patients were male and 2(4%) were female (Table 2). Seventy

percent of the patients were in their third and fourth decade; and of this group, only 4% were female. Left side of knee was involved in 36(72%) patients and Right side of knee was involved in 14(28%) patients (Table 3).

Lateral meniscus: Twenty five lateral meniscal tears were described at surgery (25/50 patients, 50%). MRI detected 24 of the 25 tears (Table 4). One tear found at surgery was not seen on the MRI interpretation and one tear found on MRI was not seen at surgery. The results included 24 true-positives, one false-positive, 24 true-negatives, and one false-negative (Table 5). Therefore, the accuracy for the detection of lateral meniscal tears was 96%, the sensitivity was 96%, the specificity was 87%, the PPV was 96%, and the NPV was 96% (Table 6).

DISCUSSION

Injuries to the knee resulting from acute trauma can occasionally limit full extension of the knee[7,8], due to swelling, and muscle spasm[9] MRI has proved reliable and safe and offers advantages over diagnostic arthroscopy, which is currently regarded as the reference standard for the diagnosis of internal derangements of the knee. Arthroscopy is accepted as the 'gold standard', and in experienced hands can reach a diagnostic accuracy between 69% and 98%[10] with correspondingly high levels of specificity and sensitivity in the detection of meniscal and cruciate ligament injury.

However, arthroscopy is invasive and carries the risk of complications such as infection, pain, deep venous thrombosis, blood loss, and anesthetic problems, and discomfort for the patients[5,6,11]. It is preferably performed only for treatment purposes; provided that alternative noninvasive diagnostic modalities such as MRI are available[9].

A normal MR knee examination is highly accurate in excluding any internal derangement[12,13]. It shows meniscal, ligamentous and cartilaginous abnormalities. It is now the preferred investigation by most orthopedic surgeons[14].

In present study the diagnostic accuracy of 1.5 Tesla MRI in the diagnosis of meniscal tears of knee joint taking arthroscopic findings as gold standard was studied. 50 cases were studied with majority of cases (41 out of 50) were of medial meniscal tears and 24 out of 50 were of lateral meniscal tears. In study by Gul-e-khanda et al[3] 50 patients were studied with majority of cases 41(82%) out of 50 showed meniscal abnormalities in the medial meniscus. Eighteen patients (36%) had lateral meniscal injury. In study by Winters K et al[15] 67 patients were studied with majority of cases (31 out of 67) were of medial meniscal tear and. (13 out of 67) were of lateral meniscal tear.

In our study mean age of the patients was 30.42±5.91years (average 30 years). In study by Winters K et al[15], average age of the patients at time of procedure was 37 years. So, most of the patients in our study underwent MRI and Arthroscopy was of relatively younger age (30.42±5.91years). This age difference from other studies is the result of the fact that our younger population meet with the accidents more frequently as they are the key figures in the development of a developing nation[16]. In present study, 48 patients (96%) were males and only 2 patients (4%) were females. In study by Gul-e-khanda et al[3], 32 patients (64%) were males and 18 patients (36%) were females. In study by Winters K et al[15], 37 patients (56%) were males and 30 patients (44%) were females. Despite of the fact that female constitute about 55% of total population in our society, this male gender predominance in our study may be the results of our social setup where males are the bread winners of their families and they meet with accidents more frequently. Our duration of study was 6 months as compare to study conducted by Gul-e-khanda et al[3] of 1 year and study by Winters K et al[15], of 4 years. In a study conducted by Noble[17], he emphasized the need to avoid unnecessary arthroscopy indicating that the results of MR imaging in some patients augment the clinical judgment, leaving the arthroscope to bring about a practical solution for the patients demonstrable and verified problem. In a study Arthroscopic correlation of MRI findings conducted by Mackenzie R et al revealed overall sensitivity of MRI for menisci 88% and overall specificity 94%[13].

In a study conducted by Gul-e-khanda et al[3] the sensitivity, specificity and accuracy for MRI of the menisci were as follows: medial meniscus resulted in 100% sensitivity, 69.27% specificity, 90% PPV, 100% NPV and 92% accuracy, lateral meniscus resulted in 87.5% sensitivity, 88.23% specificity, 77% PPV, 93% NPV and 88% accuracy.

Another study conducted by Winters K et al[15] the sensitivity, specificity and accuracy for MRI of the menisci were as follows: medial meniscus resulted in 87% sensitivity, 92% specificity, 90%PPV, 89%NPV and 92% accuracy, lateral meniscus resulted in 46% sensitivity, 91% specificity, 55% PPV, 88% NPV and 82% accuracy.

Our study had 50 cases that underwent MRI and arthroscopy and showed an excellent correlation between the two modalities and results were comparable to the aforementioned studies[3,15]. Our study showed sensitivity, specificity and accuracy for MRI of the menisci as follows: medial meniscus resulted in 97% sensitivity, 87% specificity, 97%

PPV, 87% NPV and 96% accuracy; lateral meniscus resulted in 96% sensitivity, 96% specificity, 96% PPV, 96% NPV and 96% accuracy.

Meta-analysis by Oei and colleagues[18] combined 29 studies from 1991 to 2000 that evaluated the validity of MRI with respect to meniscal and ligamentous disorders of the knee. The pooled sensitivity of medial and lateral menisci was 93% and 79% while pooled specificities were 88% and 95% respectively. In most meniscal tears, the medial meniscus is involved more often than the lateral meniscus, and the posterior horn of the medial meniscus and anterior horn of lateral meniscus are most frequently involved[19]. Sensitivity, specificity and accuracy of MRI for meniscal injuries have been reported in 80-95% range[12,13]. In our study the results were the same. Quinn and Brown[20] retrospectively analyzed the arthroscopic videotapes of false-positive MR imaging results and found that the suspected area of the meniscus was never visualized in these cases. Therefore, false-negative findings at arthroscopy could potentially account for many false-positive MR imaging results.

Our study has confirmed the ability of the MRI to reliably identify internal derangement of the knee. Its multiplanar imaging capabilities, cost benefit, and non-invasiveness make MRI an important diagnostic modality.

CONCLUSION

Magnetic resonance imaging is a good, highly accurate and non invasive modality for the assessment of tears of menisci. It can be used as a first line investigation in patients with soft tissue trauma to knee.

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