Open Access

Pak J Med Res
Vol. 62, No. 2, 2023

Original Article

Diagnostic Value of Dynamic Ultrasonography in Detection of Meniscal Injury in Correlation with MRI Knee findings keeping it as Reference Standard

Saima Shan[1], Asim Rehman[2], Jovaria Ehsan[1]
Department of Diagnostic Radiology[1], Federal Government Polyclinic Hospital, Qamar Jahan Diagnostic Center[2], Islamabad.

Abstract

Background: MRI knee is an expensive modality for diagnosis of meniscal injury. Ultrasound can be confidently used as a diagnostic tool.
Objective: To compare the findings of high resolution dynamic ultrasonography of knee with MRI knee in evaluation of meniscal injuries.
Study type, settings & duration: This cross sectional validation study was carried out at Department of Diagnostic Radiology, Federal Government Polyclinic Hospital, Islamabad from January to June 2021.
Methodology: In this study, 72 patients referred from Orthopedics' department with clinical suspicion of meniscal injury were scanned, by using 12MHz linear probe in various knee positions. Their MRI knees were already done at outside diagnostic/ health facilities which was used as reference standard. Findings of both were compared and analysed.
Results: Ultrasound of 47 cases was positive for meniscal tear. Out of these, 37 cases (78.72 %) were positive on MRI thus regarded as true positive cases. 25 patients did not show tear on US. Out of these, 23 (92 %) were also negative on MRI, thus regarded as true negatives.
Conclusion: High resolution ultrasound is an accurate and inexpensive imaging tool and gives results comparable to MRI and it can be used equally in all patients.
Key words: High resolution ultrasound, meniscal tears, MRI.

Introduction

Knee menisci are moon shaped fibrocartilagenous anatomical structure providing lubrication and stability to knee joint.[1] Meniscal injuries account for the most common knee pathology leading to pain & disability in adult age group.[2] Approximate incidence worldwide is 61 per 100,000 individuals with male predominance. It occurs either due to sports related injury or due to age related degeneration.[2,3]

High resolution ultrasonography has been used in diagnosing meniscal tears since last two decades as it possesses several inherent advantages being an excellent, inexpensive primary diagnostic tool bearing no side effects.[4] It is readily available and can be performed at bed side, as an outdoor technique or even in the operating room if necessary.[5,6]

Ultrasonography is unique in providing vital advantage of examining the individual in variable scanning planes and modes by simple alteration of patients' position of knee and applying specific postural techniques. It has added advantage of the fact that both knees can be scanned at a time allowing comparison and evaluation[7]. It also has potential to be applied in patients with metallic prosthesis, implants, pacemakers or in patients who have claustrophobia as absolute contraindications to MRI.[7,8] Accurate and early diagnosis , thus with

Corresponding Author:
Jovaria Ehsan
Federal Government Polyclinic Hospital
Islamabad.
Email: jovaria91@gmail.com

Received: 26 February 2023, **Accepted:** 22 May 2023,
Published: 24 July 2023

Authors Contribution

SS conceptualized the project and did the data collection. SS, AR, & JE did the literature search. AR performed the statistical analysis. Drafting, revision & writing of manuscript were done by JE.

the use of ultrasound helps in management in a better way in patients with clinical suspicion of meniscal injuries of knee joints.

MR Imaging of knee joint in such patients who are clinically suspected of having meniscal tear is a worldwide accepted modality for diagnosis as it can successfully image ligaments and joint capsule. It has multiple parametric capabilities allowing evaluation of meniscal injury and is thus considered as gold standard.[8]

The objective of this particular study was to compare the findings of dynamic knee ultrasound in injuries of the menisci in adult patients with MRI thus to develop a protocol for diagnosis of meniscal tears in our set up and avoid unnecessary MR examinations.

In our country, due to lack of widespread availability of MRI and its expensive costs, diagnosis is usually made on ultrasound. Very few studies are focused on comparison of accuracy between MRI and ultrasound in identification and assessment of meniscal tears. The intent of this article is to estimate the diagnostic capability and precision of ultrasound in comparison with MRI for detection of meniscal tears.

Methodology

This cross-sectional validation study was conducted in Department of Diagnostic Radiology, Federal Government Polyclinic Hospital, Islamabad in consortium with orthopedics Department from January to June 2021. Non-probability consecutive sampling technique was employed. Sample size was calculated by utilizing WHO sample size calculator with anticipated population proportion of 86.2 % and absolute precision 8% with confidence interval at 95 percent.

The study included patients referred from Orthopedics department with history of trauma either sports related or due to road side accidents with clinical suspicion of meniscal injury e.g., pain, swelling, limitation of movement, locked knee and joint tenderness etc. All Patients of both genders who were stable with no post traumatic bony fractures were included. Post-operative patients, patients with open knee wounds and critically ill patients were excluded from the study. MRI of these patients were already advised by Orthopaedics' department.

Ultrasound of these patients were performed on Phillips machine by two senior radiologists who were unaware of the MRI knee findings ,employing high frequency linear probe (12MHz) in various knee positions and graded compression technique for articular recesses. Operator bias was thus **e**liminated. Evaluation of meniscal echogenicity was done, meniscal tears were seen as hypoechoic or anechoic clefts in the echogenic meniscal substance. Findings were later on compared with the MRI films interpreted by consultant radiologist, which were performed at an outside diagnostic/health facility.

All documentation, record maintenance and data analysis was done on SPSS version 21. Diagnostic accuracy, specificity, sensitivity, positive and negative predictive values were calculated for both ultrasound and MRI.

The ethical approval was obtained from Ethical Review Board of Federal Government Polyclinic Hospital, Islamabad vide reference FGPC.1/12/2020/Ethical committee.

Results

In this study, 72 patients of 15-50 years of age were included. Mean presenting age of the patients was 33.74±11.58 SD years. Maximum numbers of patients belonged to 15-30 years age group. Among these, 48 patients were male and number of female patients was 24. Left knee was involved in 62.5 % of patients.

Forty seven cases were ultrasound positive for meniscal tear (Table-1). Out of these, 37 cases were positive on MRI thus regarded as true positive cases. 25 patients did not show tear on ultrasound Out of these, 23 were also negative on MRI, thus regarded as true negatives.

Table-1: Meniscal tears on ultrasound with comparison to tears on MRI.

Ultrasonography	*Positive on MRI*	*Negative on MRI*
Positive 47	True positive 37 (78.7%)	False positive 10 (21.2%)
Negative 25	False negative 02 (8%)	True negative 23 (92%)

Ultrasound revealed that medial meniscus was injured in 43 patients. Of these, anterior horn of medial meniscus was involved in 01 patient only. Posterior horn of medial meniscus was affected in 42 patients. Lateral meniscal tears were seen in 4 patients in whom anterior horn was involved in 01 patient and posterior horn in 03 patients

MRI revealed similar picture that left knee was more involved than right knee. Medial meniscal injury was noticed in 36 patients of whom anterior horn involvement was seen in only 02 patients, posterior horn of medial meniscus was injured in 34 patients. Lateral meniscal tears were present in 3 patients of whom anterior horn was involved in 01 patients and posterior horn in 02 patients.

Diagnostic accuracy of ultrasound for meniscal tear keeping MRI as reference standard was found to be 83.3%, Sensitivity and specificity for Ultrasound was 94.8% and 69.69% respectively. (Table-2).

Table-2. Diagnostic Parameters of Ultrasound vs MRI.

Diagnostic Parameters	*Ultrasound*
Sensitivity= True Positive/(True Positive +False Negative)	94.8 %
Specificity= True Negative /(True Negative +False Positive)	69.69%
Positive Predictive Value= True Positive/(True Positive+ False Positive)	78.72%
Negative Predictive Value= True Negative/(True Negative +False Negative)	92.0%
Diagnostic Accuracy=(True Positive +True Negative)/All Patients	83.3%

Discussion

The menisci are two moon-shaped fibrocartilagenous entities, which are present between the femoral condyles and tibial plateaux functioning as soft tissue restraints providing stability to the knee joint.[1] Meniscal tear is the most common sports related or post degenerative knee injury found in common population.[2] Patients who come in Orthopedics' department with specific symptoms and signs of meniscal injury are evaluated either by ultrasound or MRI imaging for confirmation, each having benefits and limitations in their own regard.[3,4,8]

Usefulness of US has been studied in the past with its results compared with those of MRI as it is readily available allowing comparison with the opposite normal side.[9] High resolution ultrasonography was used in our study on patients with clinical suspicion of meniscal injury. Our study results are comparable to the study conducted by Omar MA et al, who found that ultrasound is equally sensitive to MRI in detection of meniscal tears.[9]

Park GY et al compared the results of meniscal tears on ultrasound and MRI similar to our study, where MRI was used as the reference standard.[10] They found out that the diagnosis was correct in 86.2% of patients and incorrect in 13.8% of patients who underwent ultrasound. Our study however showed that sensitivity of ultrasound is little higher as compared to Park GY et al , probably of the fact that the ultrasounds were done by qualified radiologist having experience in musculoskeletal imaging along with the usage of latest ultrasound machines having very good resolution increasing sensitivity for detection.

High resolution transducer was used in a study conducted by Najafi J et al. They used 6.5-MHz micro convex probe to scan 406 knee joints in patients who had knee discomfort and compared their results with arthroscopic findings. Comparing the results of these two methods concluded that ultrasound has 100% sensitivity in evaluating meniscal injuries.[9] We could not include arthroscopic findings in our study as it is currently not available in our institution.

Shanbhogue AK, et al. and Shetty AA, et al. studied high resolution ultrasound in the assessment of meniscal injuries and compared them with ultrasound and MRI.[11,12] It is also a fact that when sonographic diagnosis showed a normal meniscus, MRI was almost always normal in these cases. It signifies that if US used as a screening tool diagnosis a meniscus as normal, MRI examination can reliably be omitted. But on the other hand, if a meniscal injury is positive on US, MRI examination ought to be planned to confirm the findings. Sensitivity of ultrasound approaches that of MRI, so they concluded that ultrasonography can invariably be employed to confirm the clinical diagnosis of meniscal injury before proceeding for arthroscopy.[10,11,12] As arthroscopy isn't available in our institution yet and costs of MRI are high, ultrasound is still a preferable investigation as evident by our study.

Results of a study conducted by Akatsu show that US is a useful screening tool in clinically suspected cases of meniscal tears before undergoing an MRI examination.[13] Our study validates this too. Hence unnecessary MRI examinations can be avoided by using US as our first line screening tool which is readily available, inexpensive, comfortable for the patient and reliable.

The diagnostic potential of high resolution ultrasound is equally superior and comparable with that of MR imaging with particular reference in accurately recognizing.

Ultrasound is an authentic, quick, economical and widely available diagnostic tool as long as the examiner has elaborative acumen of knee anatomy, and employs a standard examination technique with in depth perception and understanding of the potential drawbacks, artifacts and risks. Thus it can be confidently used as a primary diagnostic tool.

Conflict of interest: None declared.

References

1. Fox AJ, Wanivenhaus F, Burge AJ, Warren RF, Rodeo SA. The human meniscus: a review of anatomy, function, injury, and advances in treatment. Clin Anatomy 2015; 28(2): 269-87.

2. Luvsannyam E, Jain MS, Leitao AR, Maikawa N, Leitao AE. Meniscus tear: pathology, incidence, and management. Cureus 2022 18; 14(5): .
3. Smith BE, Thacker D, Crewesmith A, Hall M. Special tests for assessing meniscal tears within the knee: a systematic review and meta-analysis. BMJ Evidence-Based Med 2015; 20(3): 88-97.
4. Dong F, Zhang L, Wang S, Dong D, Xu J, Wu H, et al. The diagnostic accuracy of B-mode ultrasound in detecting meniscal tears: a systematic review and pooled meta-analysis. Med Ultrason 2018; 20(2): 164-9.
5. Dai H, Huang ZG, Chen ZJ, Liu JX. Diagnostic accuracy of ultrasonography in assessing meniscal injury: meta-analysis of prospective studies. J Orth Sci 2015; 20(4): 675-81.
6. Mahdy NS, Sakr HM, Allam AE. The role of ultrasound in evaluation of meniscal injury. Egyptian J Hosp Med 2018; 72(10): 5490-4.
7. Ahmadi O, Motififard M, Heydari F, Golshani K, Azimi MA, Hatami S. Role of point-of-care ultrasonography (POCUS) in the diagnosing of acute medial meniscus injury of knee joint. Ultrasound J 2022; 14(1): 1-8.
8. Mostafa H, Abou EA., Alsakka M. MRI Versus Ultrasound In Diagnosis Of Meniscal Tear In Knee Joint. Egyptian J Hosp Med 2019; 74(2): 3039.
9. Omer MA, Malik SS, Anjum MN, Riaz A, Ali R. Diagnostic accuracy of ultrasound in detecting meniscal tears taking magnetic resonance imaging as gold standard. Biol Clin Sci Res J 2020; 2020(1): .
10. Park GY, Kim JM, Lee SM, Lee MY. The value of ultrasonography in the detection of meniscal tears diagnosed by magnetic resonance imaging. AmJ Phy Med Rehab 2008; 87(1): 14-20.
11. Shanbhogue AK, Sandhu MS, Singh P, Ojili V, Khandelwal N, Sen R. Real time spatial compound ultrasound in the evaluation of meniscal injuries: a comparison study with conventional ultrasound and MRI. Knee 2009; 16 (3): 191-5.
12. Shetty AA, Tindall AJ, James KD, Relwani J, Fernando KW. Accuracy of hand-held ultrasound scanning in detecting meniscal tears. J Bone Joint Surg Br 2008; 90(8): 1045-8.
13. Akatsu Y, Yamaguchi S, Mukoyama S, Morikawa T, Yamaguchi T, Tsuchiya K ,et al. Accuracy of high-resolution ultrasound in the detection of meniscal tears and determination of the visible area of menisci. JBJS 2015; 97(10): 799-806.