

Original Research Article

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Co-relation between magnetic resonance imaging and arthroscopy findings in diagnosis of meniscus injuries based on location of the meniscus tear and radial position

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ABSTRACT

Background: The objective of our study was to find the sensitivity, specificity of magnetic resonance imaging (MRI) in diagnosing meniscus tears based on its location medial or lateral and radial position namely; anterior 1/3rd, middle 1/3rd, posterior 1/3rd location of the meniscus.

Methods: All patients who have undergone arthroscopic surgeries for knee from January 2017 to July 2021 at our institute were retrospectively analyzed through hospital records comparing the MRI findings with the arthroscopy findings, taken as gold standard. Of the 68 patients found from the hospital records 14 patients were excluded as they didn't qualify as per the inclusion criteria.

Results: The sensitivity and sensitivity of MRI in diagnosis of medial meniscus tear was 100% and 50% respectively. The positive predictive value and negative predictive value for medial meniscus was 68% and 100% respectively whereas for lateral meniscus it was 50% and 100% respectively. Based on the radial location of the tear for the medial meniscus the sensitivity of MRI was maximum for middle and posterior 1/3rd medial meniscus tear (100%). For the lateral meniscus the maximum sensitivity was for the middle 1/3rd (100%) but specificity and positive predictive value was maximum (100%) for the anterior 1/3rd and posterior 1/3rd tear.

Conclusions: The MRI had similar sensitivity and specificity for both the medial and lateral meniscus diagnosis although specificity was low indicating many false positive results from MRI. Middle 1/3rd medial and lateral meniscus tears had poor predictive value.

Keywords: Meniscus, Tear, Arthroscopy, MRI, Sensitivity, Specificity

INTRODUCTION

The knees menisci are C-shaped structures composed of collagen and fibrocartilage and serve many important functions, such as shock absorption, axial load distribution, joint lubrication, and stability. The meniscus acts as a cartilaginous cushion between femur and tibia.¹ ²Meniscal injuries have become very common now days due to enhanced enthusiasm in sport activities across a varying age group. The knees menisci are C-shaped structures composed of collagen and fibrocartilage and

serve many important functions, such as shock absorption, axial load distribution, joint lubrication, and stability.^{1,2}

The predominant circumferentially and longitudinally oriented type I collagen bundles provide the meniscus with hoop strength, and the thinner radial fibres tie the collagen bundles together forming a cascade that provides an essential structural support for the menisci.^{3,4} Meniscus tears can result in clinical symptoms of pain especially in extreme range of motion, locking and joint

instability and importantly, cartilage loss and development of osteoarthritis if left untreated in the long run.⁵⁻⁷ The menisci may tear from degenerative or traumatic mechanisms, and eventually different patterns of meniscal tears can emerge namely longitudinal tear, horizontal tear, radial tear, root tears and complex tears which are combinations of various tears.⁸ Magnetic resonance imaging (MRI) has been a standard investigation done for non-invasive diagnosis of these injuries. While knee arthroscopy preceded the development of MRI, the advent of MRI in 1980 helped orthopaedic surgeons by providing an objective tool for diagnosis and further helping in decision making for surgical intervention. When surgical intervention is warranted, the orthopaedic surgeon must be able to associate the findings on the pre-operative MRI with the arthroscopic findings intra-operatively.

One of the difficulties in diagnosis is the correct interpretation of the magnetic resonance imaging scans in the process leading up to the surgery. The MRI criteria for diagnosing meniscus tear are well established; these criteria include deformity of the normal shape of the meniscus or increased intra-meniscal signal (hyperintense signals) communicating with the articular surface of the meniscus.^{9,10} Stoller et al were the first to show that increased signal within the meniscus corresponds to degenerative changes and that signal communicating with the articular surface is evidence of a tear.¹¹ It is critical to assess the meniscus in sagittal, axial and the coronal imaging planes. Low-sequence imaging T1-weighted imaging is most accurate for detecting meniscal tears, while abnormalities seen on T2-weighted images are very specific.¹²

Objectives

The objective of the study is to find the sensitivity and specificity of MRI in diagnosing meniscus tears based on medial and lateral location and radial location namely anterior 1/3rd, middle 1/3rd, and posterior 1/3rd.

METHODS

All patients who have undergone arthroscopic surgeries for meniscus or ligament injuries from January 2018 to January 2021 at our institute (Bhaktivedanta hospital and research institute, Mira Road, India) were retrospectively traced from the computerized records of the Medical records department available at our institute.

Study design

This was a cross sectional retrospective analysis. The study was cleared by the Ethics committee set up by the hospital after doing the necessary changes in the study. All the MRIs were 3-tesla MRI and were reported by a musculoskeletal radiologist. Surgeries were performed by one of the three surgeons and were not blinded of the MRI findings. The arthroscopy findings were noted in the

operative notes mentioning the location and pattern of tear. These notes were analyzed retrospectively and compared based on medial and lateral meniscus and temporal location namely anterior 1/3rd, middle 1/3rd and posterior 1/3rd of the meniscus.

Study participants

A total of 68 patients were included in the study initially but 14 of the total patients did not have only meniscus tear and had only ligament tear. A total of 54 patients were included in the study. Patients of all genders with age 16 years to 70 year, who have undergone arthroscopic meniscus surgeries from January 2018 to July 2021 at our institute, were included. Patients who have undergone any surgeries in the same knee previously or who underwent revised meniscus surgeries, patients with open injuries were excluded.

Statistical analysis

The sensitivity and specificity of MRI in diagnosis of meniscus tear based on its medial and lateral location compared to the arthroscopy findings (which is considered to be the gold standard) were calculated. Similarly the sensitivity, specificity, positive and negative predictive value of MRI in diagnosis of meniscus tear based on its radial location namely anterior 1/3rd, middle 1/3rd and posterior 1/3rd compared to arthroscopy was calculated and has been shown in the tabulated form.

RESULTS

The sensitivity and specificity of MRI in diagnosis of medial meniscus tear was 100% and 50% respectively. The positive predictive value and negative predictive value for medial meniscus was 68% and 100% respectively whereas for lateral meniscus it was 50% and 100% respectively. So the MRI had better positive predictive value in diagnosis of medial meniscus compared to lateral meniscus.

Based on the radial location of the tear for the medial meniscus the sensitivity of MRI was maximum for middle and posterior 1/3rd medial meniscus tear (100%) and anterior 1/3rd medial meniscus tear had the maximum positive predictive value which was 83%. For the lateral meniscus the maximum sensitivity was for the middle 1/3rd (100%) but specificity and positive predictive value was maximum (100%) for the anterior 1/3rd and posterior 1/3rd tear.

Table 1: Demographic characteristics of the study population in the tabulated form (n=54).

Variables	N (%)
Age (years) ^a	36 (8.4)
Sex (male)	29 (53.7)
Sex (female)	25 (46.3)

^a-represented in mean (SD).

Table 2: Sensitivity and specificity of meniscal injuries for medial and lateral meniscus.

Parameters	Sensitivity	Specificity	Positive predictive value (PPV)	Negative predictive value (NPV)
Medial meniscus	100	50	68	100
Lateral meniscus	100	50	50	100

Table 3: Sensitivity and specificity of the meniscal injuries.

Parameters	Sensitivity	Specificity	PPV	NPV
Medial meniscus				
Anterior 1/3	55	50	83	20
Middle 1/3	100	50	38	100
Posterior 1/3	100	50	69	100
Lateral meniscus				
Anterior 1/3	80	100	100	50
Middle 1/3	100	25	25	100
Posterior 1/3	83	100	100	33

DISCUSSION

Mandelbaum et al in a study of 83 knees reported that MRI was 90% accurate for detection of medial meniscal tears, 80% for lateral meniscal tears and 100% for anterior cruciate ligament (ACL) tears.¹³ In this study, the surgeons were also aware of the MRI results preoperatively. Reicher et al retrospectively studied 49 knees (only menisci) and reported that MRI was 80% accurate in detecting meniscal tears.¹⁰ The predictive value of a negative MRI was 100%. The association between ACL tears and Posterior horn lateral meniscus tear is well documented in the literature, with a longitudinal tear being most common.¹⁴ It has been proposed that the relative increased mobility of the lateral meniscus makes it more susceptible to shear or compressive injury related to twisting injury associated with ACL tears.¹⁵

Oeh et al performed a meta-analysis of 29 published articles evaluating the performance of MRI in diagnosing meniscal and cruciate ligament tears.¹⁶ In these studies, which had a pooled weighted sensitivity and specificity of 93% and 88%, respectively, for medial meniscal tears and 79% and 96% for lateral meniscal tears, the mean age of the patient populations ranged from 30 to 40 years which differs from our study population. Although the sensitivity and specificity of MRI for medial meniscal tears is excellent, MRI evaluation of the lateral meniscus is less sensitive and leaves room for diagnostic error and potentially false negative findings. As such, specifically for lateral meniscal pathology, the use of a confirmatory arthroscopic finding may be beneficial. In a study by Subash et al MRI had a sensitivity and specificity of 91% and 94%, respectively, for the medial meniscus and 73% and 91% for the lateral meniscus when only cases with definite findings for a tear (grade 5 lesions) were considered tears. If probable findings (grade 4 lesions) were also considered tears, the sensitivity increased to

96% and 88% for the medial and lateral menisci, respectively, but the specificity dropped to 76% and 80%, respectively.

Limitations

This was a retrospective study and so had the limitations of retrospective studies namely dependency on the findings recorded at the time of surgery. Also the sample size was too small.

CONCLUSION

In our study, MRI showed sensitivity (100%) and specificity (50%) for medial and lateral meniscus tears, but many are false positive too. So on MRI if meniscus tear is present, and if symptoms and clinical signs correlate too, only then must we proceed for Arthroscopy. Based on radial location for medial meniscus, MRI can predict anterior 1/3rd tears more than any other location. For lateral meniscus, MRI was able to correctly predict the posterior 1/3rd tears than any other tear. Concluding tears in anterior 1/3rd medial meniscus and posterior 1/3rd merit the arthroscopic evaluation after correlation with the clinical sign and symptoms.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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