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Role of Magnetic Resonance Imaging in Evaluation of Traumatic Meniscal Injuries

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A B S T R A C T

Background*:** Knee pain and swelling are the common complaints affecting approximately 26.9% of population. In recent time meniscal injury is on rise, 9 out of 1000 men and 4.2 out of 1000 women are affected approximately. Of these, traumatic tears account for 68 to 75%, causing lower quality of life. MRI has become most important diagnostic tool for evaluating meniscal injuries replacing arthroscopy.Aims*:** To determine the morphology and signs of knee meniscal injuries using MRI and also to assess yield in patients with suspected meniscal tear.***Methods and Material*:** A prospective longitudinal study was conducted between July 2022 to June 2023 of individuals with traumatic knee injury referred for MRI, to department of radio-diagnosis. MRI was obtained with 1.5 T (Siemens Sempra XA12 platform). Intra meniscal signals were graded as described by Stoller and Colleagues. Also part of meniscus involved and type of tear was noted. ***Statistical methods used*:** Descriptive method of statistics are being used to portray the baseline profile. The chi-square and Fischer exact test are being used for comparing categorical variables and to compare means student-t test is being used.***Results*:** Out of 53 individuals presented with knee injury, 47 individuals had changes on MRI. A total of 60 abnormalities were identified. Lateral meniscus (34) was most commonly involved than medial meniscus (26). In lateral meniscus, anterior horn was significantly involved (20) as compared to (12) of posterior horn. In medial meniscus, posterior horn was significantly involved, that is (19) compared to (3) of anterior horn (p value<0.000914). Of these, 43 had meniscal tears. Complex tears were commonly seen in lateral meniscus.***Conclusion***: These findings compel radiologists to focus on those specific regions, while looking into meniscal injuries and minimize the possibility of missing crucial findings, for patient management.

Keywords: Meniscal injury, MRI, yield, traumatic.

INTRODUCTION

Knee pain and swelling is one of the common complaints affecting people of all ages and have substantially contributed to significant visits to health care centers [1, 2]. Overall it is seen to affect 26.9% of the general population [3]. The highest burden of all sports injuries is attributed to trauma to the knee causing a lower quality of life [4].

Previously knee meniscus was considered to be vestigial structure which is of no functional significance and was described as the functionless remains of a leg muscle [5, 6]. Now it is known that the meniscus plays a vital role in the complex biomechanics of the knee [7]. In recent times meniscus injury has become one of the important reasons for consultations pertaining to knee problems. Sports injuries are the leading cause of it and an overall incidence of approximately 9/1000 in men and 4.2/1000 in women [8]. Out of these traumatic tears of the meniscus, are the most

common lesions (68 to 75%) which occur in the young population with healthy meniscus, which can be distinguished from degenerative micro traumatic fissures occurring in the older population [9, 10].

Since the time when magnetic resonance imaging was introduced in 1980, it has become the most important diagnostic tool for evaluating disorders of the musculoskeletal system, and arthroscopy now entirely is sought for therapeutic purposes [11]. It is safe as patients are not exposed to harmful ionizing radiation [12]. Currently, MRI of the knee has an accuracy rate of more than 90% for detecting any internal derangements [13]. When MRIs of the knee were first introduced they were requested mainly by secondary care orthopedic surgeons to determine the requirement of surgical intervention. However, in recent times it is observed that even in primary care, MRIs of the knee are now the second most commonly requested investigation [14].

Meniscal tears area common pathology in individuals with knee disorders whose diagnosis depends on a well-extracted detailed case history and in depth clinical evaluation, with magnetic resonance imaging (MRI) being the gold standard diagnostic tool. Few meniscal tears like horizontal or oblique are often encountered in asymptomatic knees without any significant clinical symptoms, hence it is seen that these meniscal tears are exclusively diagnosed based on MRI in up to one-third of patients [15]. It is also noted that the anatomical distribution of meniscal tears alters between the medial and the lateral meniscus, and knowledge about these variations could guide clinicians in providing better outcomes to the patients [16]. Through this study, we tried to determine the morphology and signs of knee meniscal injuries using MRI and also to assess yield of MRI in patients with knee complaints.

Aims and objectives:

1. To assess the importance of MRI in patients with trauma in whom meniscal injury is suspected.
2. To determine the morphology and signs of meniscal injuries of knee using MRI.

Materials and methods:

A prospective longitudinal study was conducted in a medical college hospital in the state of Karnataka between July 2022 to June 2023. We included all the individuals who were sent for an MRI of the knee with a history of traumatic knee injury, to the department of radiodiagnosis. We excluded those who were previously diagnosed with knee pathology and post-operative patients. After taking informed consent the individuals were subjected to knee MRI.

The MRI was obtained with 1.5 T (Siemens Sempra). The patient was made to lie in a supine position with the knee in slight external rotation. MRI was done with a field of view 14-16cm (small) and thickness of 4 mm slice.

Protocols of MRI used for the evaluation wereT2-weighted images (T2W), T2-weighted fat-suppressed (T2FS), proton density-weighted (PDW), PDW fat suppressed (PDFS) and T1-weighted (T1W) imaging. All three orthogonal imaging planes of section (axial, coronal, and sagittal) were used.

Intra meniscal signals have three grades on MRI which were first described by Stoller and Colleagues [17]. Grade I: Small focal area of hyperintensity not extending up till the articular surface of the joint; Grade II: hyper intensive linear areas not reaching to the articular sur faces; Grade III: Abnormal hyper intensive lesions extending to at least one of the surface of articulation.

Ethical issue- ethics committee of the institute gave approval for the study.

Statistical Analysis

The data analysis was performed using the software STATA (14.2). Descriptive statistics using Mean (Standard Deviation) and Frequency (percentage) were applied to portray the baseline information of the study participants and diagnostic outcomes. The chi-square and Fischer exact test are being used for comparing categorical variables and to compare means student-t test is being used.

RESULTS

A total of 53 individuals presented with knee complaints met the eligibility criteria during our period of study, 37(69.81%) being male and 16(30.19%) being female. The baseline data of the participants in study is displayed in Table 1. The average age of the study participants is depicted in Table 2.

Table 1: Baseline data of the participants in the study

Characteristics		**Frequency (%)**
Gender	Male	37 (69.81%)

	Female	16 (30.19%)
Symptoms	Pain	5 (9.43%)
	Swelling	2 (3.77%)
	Both	46 (86.79%)

Table 2: Age of the study population

Gender	Mean age in years [SD]	P value*
Male	34.621 [±11.265]	0.1655
Female	39.5 [±12.334]	

*- student t-test is used for p-value calculation

Out of the 53 individuals with suspected meniscal involvement, 47(88.68%) individuals had changes on MRI, and 6(11.32%) individuals did not have any abnormalities. A total of 60 abnormalities were identified, as 11 individuals had findings at multiple sites.

These 60 meniscal abnormalities were further divided according to the site of involvement. Lateral meniscus (34 cases) was most commonly involved as compared to medial meniscus (26 cases). In the lateral meniscus, the anterior horn was commonly involved with 20 compared to 12 posterior horn cases and 2 involving the body. In the medial meniscus, posterior horn was most commonly involved, that is 19 compared to 3 involving anterior horn and 4 of body. Thus posterior horn being commonly involved in medial meniscus injuries, whereas the anterior horn is commonly involved in lateral meniscus injuries. This difference was statistically significant as the value was <0.05 (Table 3).

Table 3: Site of involvement of meniscus

Site	Medial meniscus	Lateral meniscus	P value*
Anterior horn	3	20	0.000914
Posterior horn	19	12	
Body	4	2	

*- p-value calculated using Fischer exact test.

The abnormalities were graded using the grading system given by Stoller and colleagues. Out of 60 involvements, 43 had meniscal tears [grade III]. Complex tears were more common among lateral meniscus injuries (13), compared to (5) in the case of medial meniscus injury. However, this difference was not statistically significant. Whereas other types of tears were almost similar among both the groups (Table 4).

Table 4: Various grades of meniscal involvement

Grades	Definition	Medial meniscus	Lateral meniscus
Grade I [Figure 1]	Small focal hyper intensive area not extending up till the articular surface of the joint	8	6
Grade II [Figure 2]	Hyper intensive linear areas not reaching to the articular sur faces	2	1
Grade III [Figure 3]	Abnormal hyper intensive lesions extending to at least one of the surface of articulation	16	27

The abnormalities were classified depending on the morphology of meniscal tear into horizontal(6) (Figure 4), vertical(7) (Figure 5), oblique(9) [Figure 6], radial(3) (Figure 7) and complex(18) (Figure 8) tears. Of which complex tear was found be the most common morphology of tear.

Table 5: Various types of meniscal tear

Type of tear	Medial meniscus	Lateral meniscus	P value
Vertical	4	3	0.7108*
Horizontal	2	4	
Oblique	4	5	
Radial	1	2	
Complex	5	13	

*- Fischer exact test is used for p-value calculation

GRADESOFMENISCAL INJURY
GRADEIMENISCAL INJURY

Figure 1: Proton density (PD) imaging sagittal section showing small focal area of hyper intensity not extending to the articular surface involving the posterior horn of left Lateral meniscus as indicated by arrow. Represents grade I meniscal injury

GRADEIIMENISCAL INJURY

Figure 2: T2 fat suppressed (T2FS) image sagittal section showing linear areas of hyper intensity not extending to the articular surfaces involving posterior horn of right medial meniscus as indicated by arrow. Represents grade II meniscal injury

GRADE IIIMENISCALINJURY

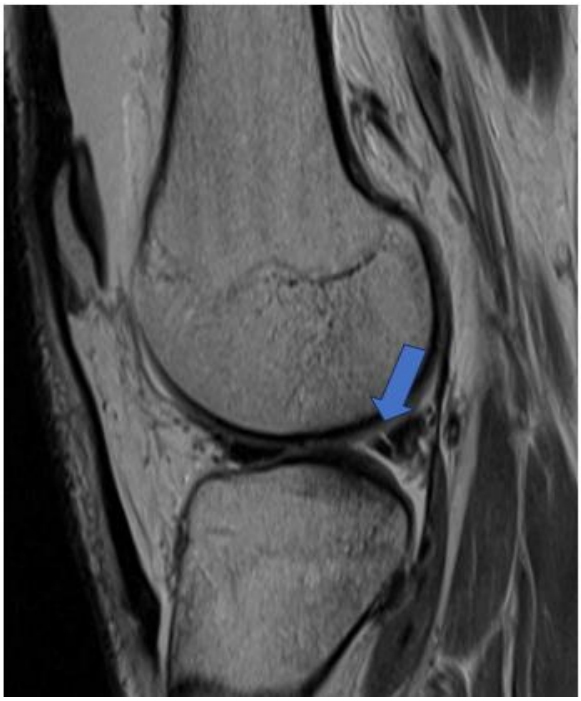

Figure 3: Proton density (PD) imaging sagittal section showing hyper intensity extending to superior articular surface of posterior horn of left lateral meniscus as indicated by arrow. Represents grade III meniscal injury as indicated by arrow

Types of meniscal tear
Horizontal tear

Figure 4: Proton density (PD) imaging sagittal section showing hyper intensity parallel to articular surface in the posterior horn of right lateral meniscus as indicated by arrow. Represents horizontal tear

Vertical tear

Figure 5: T2 fat suppressed (T2FS) image sagittal section showing hyper intensity perpendicular to articular surface in the anterior horn of left lateral meniscus as indicated by arrow. Represents vertical tear

Oblique tear

Figure 6: Proton density (PD) imaging sagittal section showing oblique tear in the posterior horn of left lateral meniscus as indicated by arrow

Radial tear

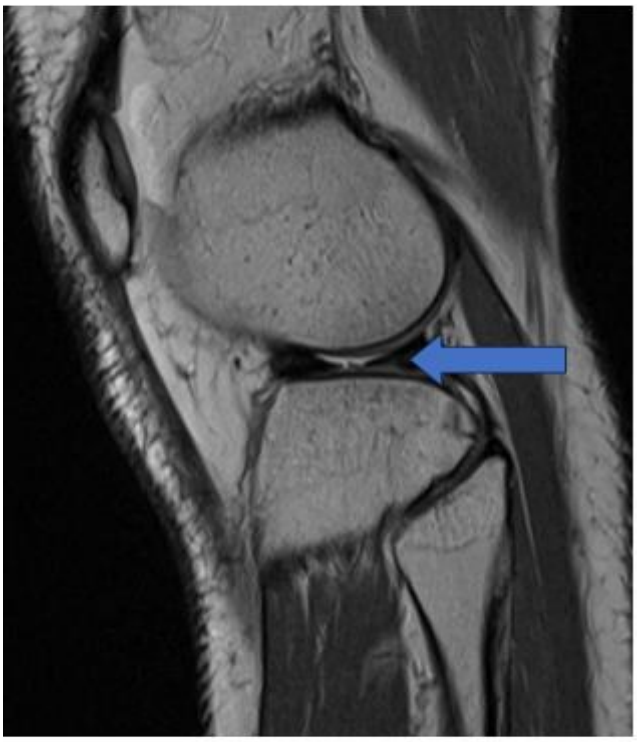

Figure 7: Proton density (PD) imaging sagittal section showing radial tear in the posterior horn of left lateral meniscus as indicated by arrow

Complex tear

Figure 8: Proton density (PD) imaging sagittal section showing complex tear in the posterior horn of left medial meniscus as indicated by arrow

DISCUSSION

In our study, MRI knee was performed on 53 patients who were referred from various departments with traumatic knee injury. Of which 47 individuals showed meniscal involvement.

It was noted that males were predominant among study participants who represented 69.81% of the total and females were 31.19%. These findings were in agreement with other studies by Hasiba Muahmed Shukri and Saleem Khadir Musalah [18], where 72.5% were male, and Magee and Williams [19], which also showed male preponderance (73%).

Out of 60 meniscal involvements on MRI, medial meniscus (43.44%) and lateral meniscus (56.66%) were almost equally involved. This was contrary to findings seen in another study where a significantly higher proportion of medial meniscus tear (80%) was noted than that of the lateral meniscus (20%) [18].

Among the meniscal involvement (60), the individual anterior horn involvement was significantly more in lateral meniscus (20) than in the medial (3) while, isolated involvement of posterior horn being frequent finding in medial meniscus (19) than lateral (12). This was similar to findings from another study where isolated anterior horn tear was significantly more common in the lateral meniscus (12.5%) than the medial meniscus (1.25%) while isolated posterior horn tear was more common in the medial meniscus (66.25%) than the lateral meniscus (7.5%) [18].

The involvements were further graded and it was seen that grade 3 [tears] were more commonly seen 43 (71.6%) compared to grade 1 & 2 involvement. These tears were further classified into various types. Horizontal, vertical, oblique, and radial tears were noted in similar numbers across lateral and medial meniscal tear groups. However, complex tears (18/43) 41.86%weremore commonly seen as meniscal tears, and the lateral meniscus group (13) was more commonly involved compared to the medial meniscus group (5). These findings were in agreement with the results found in a study by Englund *et al*., [20].

Another study showed that horizontal tear was the most common tear and more commonly occurred at the medial meniscus and the vertical longitudinal tear occurred most commonly at the lateral meniscus, while, Bucket handle tear was much more common in the medial meniscus [18], these results were comparable to a study done by Wright *et al*., [21]. However, our study did not show such findings.

CONCLUSION

From this study, it was noted that meniscal involvement is the most common finding in people presenting with knee complaints and trauma is the major cause for it and males are more often involved. In the medial meniscus, the posterior horn is most affected and in the lateral meniscus, the anterior horn is most affected. Complex tears are commonest among the tears of meniscus, with lateral meniscus being commonly involved. These findings aid radiologists to focus more on those specific regions of the meniscus while looking into meniscal injuries on knee MRI and minimize the possibility of missing crucial findings, which play a vital role in patient management.

Conflict of Interest: None

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REFERENCES

1. Jinks, C., Jordan, K., & Croft, P. (2002). Measuring the population impact of knee pain and disability with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). *Pain*, *100*(1–2), 55–64. doi: https://doi.org/10.1016/s0304-3959(02)00239-7.
2. Symmons, D. P. (2001). Knee pain in older adults: the latest musculoskeletal ‘‘epidemic”. *Ann Rheum Dis*, *60*(2), 89–90. doi: https://doi.org/10.1136/ard.60.2.89.
3. Fernandes, G. S., Parekh, S. M., Moses, J., Fuller, C., Scammell, B., Batt, M. E., ... & Doherty, M. (2018). Prevalence of knee pain, radiographic osteoarthritis and arthroplasty in retired professional footballers compared with men in the general population: a cross-sectional study. *British journal of sports medicine*, *52*(10), 678-683. doi: https://doi.org/10.1136/bjsports-2017-097503.
4. Wagemakers, H. P., Luijsterburg, P. A., Heintjes, E. M., Berger, M. Y., Verhaar, J., Koes, B. W., & Bierma-Zeinstra, S. M. (2010). Outcome of knee injuries in general practice: 1-year follow-up. *British journal of general practice*, *60*(571), e56-e63. doi: https://doi.org/10.3399/bjgp10X483157.
5. Lento, P. H., &Akuthota, V. (2000). Meniscal injuries: a critical review. *J Back MusculoskeletRehabil*, *15*(2), 55-62.
6. Amendola, A., & Bonasia, D. E. (2012). The menisci: anatomy, healing response, and biomechanics. In: Bonnin, M., Amendola, N. A., Bellemans, J., MacDonald, S. J., &Menetrey, J. (eds.). the knee joint: surgical techniques and strategies. Paris: Springer, pp.5-9.
7. Thornton, D., & Rubin, D. (2000). Magnetic resonance imaging of the knee menisci. *Seminars in Roentgenology*, *35*(3), 217-230.
8. Hede, A., Jensen, D. B., Blyme, P., & Sonne-Holm, S. (1990). Epidemiology of meniscal lesions in the knee, 1215 open operations in Copenhagen 1982—84. *Acta Orthop Scand*, 61, 435-437.

9. De Smet, A. A., Blankenbaker, D. G., Kijowski, R., Graf B. K., &Shinki, K. (2009). MR diagnosis of posterior root tears of the lateral meniscus using arthroscopy as the reference standard. *AJR Am J Roentgenol*, 192, 480-486.
10. Drapé, J. L., Godefroy, D., & Dupont, A. M. (1997.). Les limites de l'RMdans la pathologieméniscale. In: Le genoutraumatiqueetdégénératif. GETROA OPUS XXIV. Montpellier: Sauramps Medi-cal; p. 379-409.
11. Avcu, S., Altun, E., Akpinar, I., Bulut, M. D., Eresov, K., & Biren, T. (2010). Knee joint examinations by magnetic resonance imaging: the correlation of pathology, age, and sex. *NAJMS, 2*(4), 202-204.
12. Jackson, D., Jennings, L., Maywood, R., & Berger, P. (1988). Magnetic resonance imaging of the knee. *AJSM,16*(1), 29-38
13. Barnett, M. (1993). MR diagnosis of internal derangements of the knee: effected of field strength on efficacy. *AJR, 161*(1), 115-118.
14. Van Oudenaarde, K., Swart, N. M., Bloem, J. L., Bierma-Zeinstra, S. M., Algra, P. R., Koes, B., ... &Reijnierse, M. (2017). Post-traumatic knee MRI findings and associations with patient, trauma, and clinical characteristics: a subgroup analysis in primary care in the Netherlands. *British Journal of General Practice*, *67*(665), e851-e858. doi: https://doi.org/10.3399/bjgp17X693653.
15. Zanetti, M., Pfirrmann, C. W., Schmid, M. R., Romero, J., Seifert, B., &Hodler, J. (2003). Patients with suspected meniscal tears: prevalence of abnormalities seen on MRI of 100 symptomatic and 100 contralateral asymptomatic knees. *American Journal of Roentgenology*, *181*(3), 635-641.
16. De Smet, A. A. (2012). How I diagnose meniscal tears on knee MRI. *AJR Am J Roentgenol 199*(3), 481-499.
17. Stoller, D. W., Martin, C., Crues, J. V., Kaplan, I., & Mink, J. H. (1987). Meniscal tears: pathologic correlation with MR imaging. *Radiology*, 163, 731-735.
18. Shukri, H. M., &Musalah, S. K. (2017). MRI assessment of clinically suspected meniscal tears. *Duhok Medical Journal*, *11*(1), 33-38.
19. Magee, T., & Williams, D. (2006). 3.0-T MRI of meniscal tears. *American journal of roentgenology*, *187*(2), 371-375.
20. Guermazi, A., Niu, J., Hayashi, D., Roemer, F. W., Englund, M., Neogi, T., Aliabadi, P., McLennan, C. E., & Felson, D. T. (2012). Prevalence of abnormalities in knees detected by MRI in adults without knee osteoarthritis: population based observational study (Framingham Osteoarthritis Study). *Bmj*, 345.
21. Wright, D. H., DeSmet, A. A., & Norris, M. (1995). Bucket-handle tears of the medial and lateral menisci of the knee., the value of MR imaging in detecting displaced fragments. *AJR, 165*(3), 621-625.