

Sensitivity and specificity of MRI in identifying Lateral meniscus injury associated with high grade ACL injury

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Abstract

Background: Meniscus tears are commonly observed in patients with high grade anterior cruciate ligament (ACL) injuries. The present study was conducted to assess association of the lateral meniscus tear with high grade anterior cruciate ligament. **Materials & Methods:** Patients with less than one month of trauma to knee were included. Patients were then subjected to MRI (GE Signa HDX MR Machine with 1.5tesla field strength and with Siemens 3T MAGNETOM VIDA). Patients having high grade ACL injuries (61 cases) are categorised into lateral menisci tear associated with ACL tear and isolated ACL tear / ACL tear with other combined tears (except lateral menisci tear). Comparison of findings of MRI with arthroscopic was done. Statistical analysis using Microsoft excel done. **Results:** 61 patients with high grade ACL tear (less than one month of injuries) were included in the study. Of those, 59.01 % (36 cases) had ACL tears without lateral meniscus injury, 40.98 % (25 cases) had associated the lateral meniscus tear. **Conclusion:** Most of the patients of lateral meniscus tear had associated with high grade anterior cruciate ligament injury.

Keywords: Anterior cruciate ligament, Injury, Lateral meniscus

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Introduction

Meniscus tears are commonly observed in patients with anterior cruciate ligament (ACL) injuries, with a reported prevalence of approximately 55% to 65% [1]. Several studies have shown that associated meniscal tears are strong predictors for the development and progression of knee osteoarthritis (OA) as well as worse patient reported outcomes after ACL reconstruction, especially if a partial or total meniscectomy is performed [2]. Meniscal injuries commonly occur in conjunction with anterior cruciate ligament (ACL) tears. Variability of the relative frequency of associated meniscal injuries, including sex differences and sport-specific injury patterns, have been demonstrated. The reported incidence of meniscal injury varies considerably, ranging from 16% to 82% in acute ACL tears and up to 96% in chronic ACL tears [3]. The importance of meniscus, especially the medial one, in knee stability in people with chronic ACL injury

has already been reported. lateral meniscus tears are predominately seen in acute ACL injuries [4,5]. Appropriate repair of the meniscus injury can prevent degenerative changes such as osteoarthritis. Since the complexity of meniscus tears increase in the chronic stage, and tears are less amenable to repair as time passes [6,7], particularly lateral meniscus tears identified in the early posttraumatic phase may be best suitable for repair. The present study was conducted to assess association of the lateral meniscus tear with high grade ACL injury. Thus accentuating the need of carefully examining lateral meniscus while visualizing ACL tear.

Materials & Methods

This study was conducted at department of Radiodiagnosis and Imaging, Mahatma Gandhi Medical College and Hospital, Jaipur. All the patients who were referred to our department with clinically suspected internal derangement of knee following less than one month of trauma to knee were included in the study. Patients with ferromagnetic implants, pacemakers, aneurysm clips and individuals with major injuries like liver / splenic rupture or flail chest and with unstable vital parameters especially in the setting of polytrauma were excluded in the study. All the patients were subjected to MRI 3 Tesla, using T1W and PD sequences in sagittal and coronal planes, T2W sequence in axial, coronal and sagittal planes (along the plane of

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ACL) and STIR sequences in coronal and sagittal planes. All the patients are evaluated for ACL injuries. Demographic profile such as name, age, gender etc. was recorded. Parameters such as height, weight, body mass index (BMI), type of injury, and mechanism of injury etc. was recorded. Patients with high grade ACL tear that is when acl angle >15 degree,(61 cases) are categorized into lateral

menisci tear associated with ACL tear (25 cases) and isolated ACL tear / ACL tear with other combined tears (except lateral menisci tear) (36 cases). Comparison of findings of magnetic resonance imaging with arthroscopic findings were done. Statistical analysis was done using Microsoft excel.

Results

Table 1:Distribution of patients based on gender

Groups	Patients with ACL tear without associated lateral meniscus tear	Lateral meniscus tear with ACL tear
Status	No l m tear	LM tear
M:F	5:3	3:2

Table 1 shows that group I had 25 males and 15 females, group II had 18 males and 12 females.

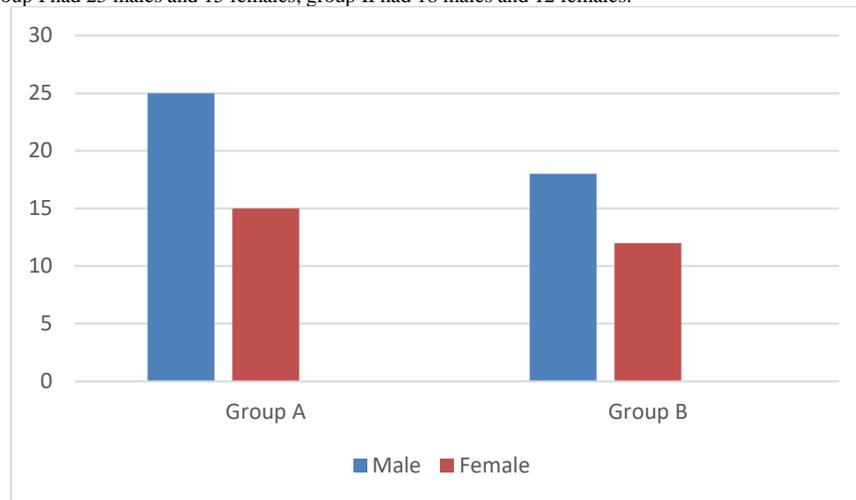


Fig1: Distribution of patients based on gender

Table 2 :Lateral meniscus injury location

Location of Tear in Lateral Menisci on MRI basis								
	Bucket Handle	Complex	Flap	Horizontal	Peripheral	Radial	Root	Total
Lateral Meniscus with ACL torn	2	3	3	4	9	4	5	30

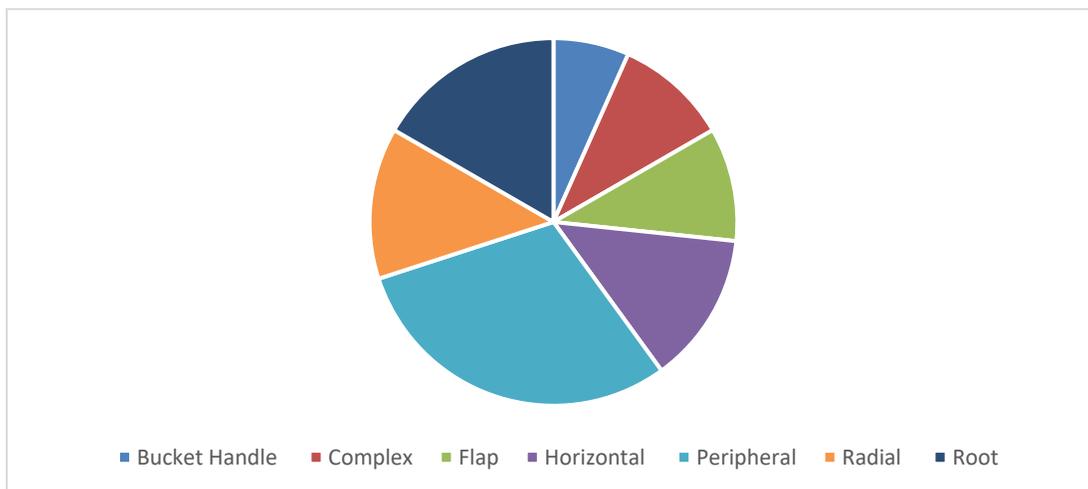


Fig 2:Location of tear in lateral menisci on MRI basis

Table 3:Correlation of MRI and arthroscopic findings

	MRI Findings	Percentage	Arthroscopic Findings
Patient with high grade ACL tear without LM Tear	40	57.14%	37
Patient with high grade ACL Tear with LM Tear	30	42.86%	33

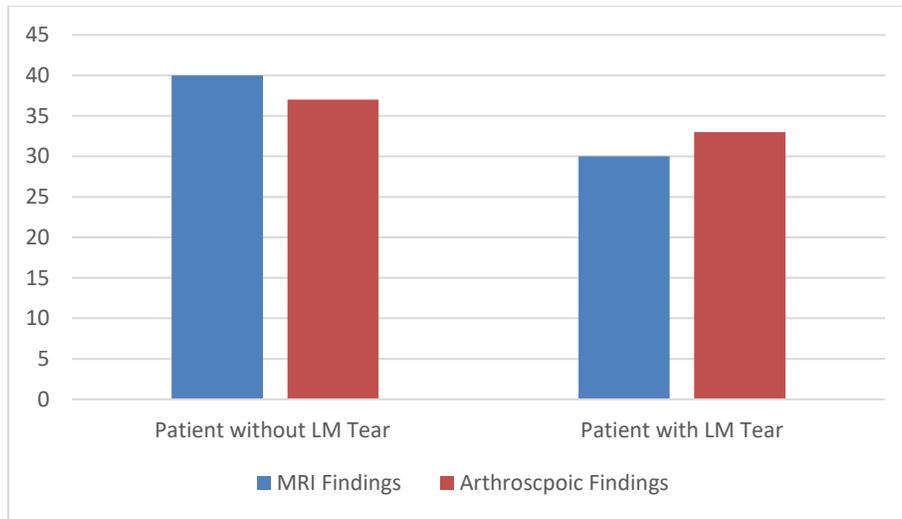


Fig 3: MRI and Arthroscopic findings

In 42% patients lateral meniscus tear is associated with high grade ACL tear

Table 4: MRI and Arthroscopic findings

MRI Findings	Arthroscopic Finding	
	LM Seen	LM Not Seen
	Test Positive	28
Test Negative	5	35

Sensitivity 84.85% ,specificity 94.6%

Table 5: Assessment of false negative patients and true positive patients according to part of lateral meniscus involved.

Location of Meniscal Tear According to arthroscopy and MRI	False-Negative	True-Positive
Anterior Horn	2	4
Body	0	5
Posterior Horn	3	6
Root	0	4
More Than one third of meniscus	0	9
Total	5	28

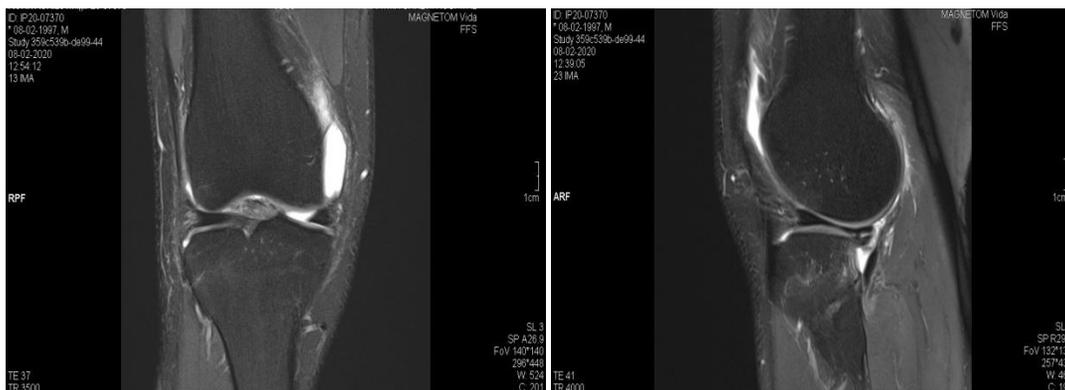


Fig 6 a,b: Lateral meniscus tear along with moderate joint effusion

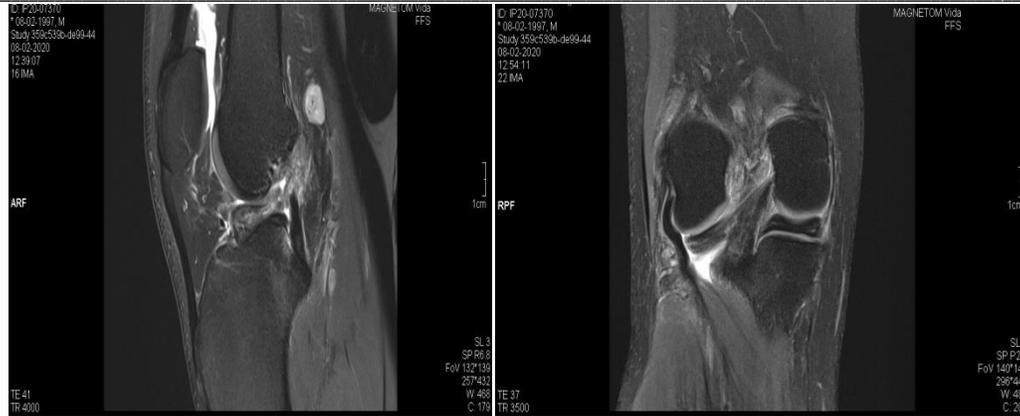


Fig 7 a,b:showing ACL injury. Bony contusion / marrow edema involving posterior aspect of lateral tibial condyle

Discussion

The pattern of lateral meniscus tears observed in ACL-injured subjects varies greatly and determines subsequent management[8]. Certain tear patterns, such as incomplete longitudinal tears or complete stable longitudinal tears have only minor consequences on knee joint health and can be left in situ[9]. In contrast, other tear patterns, such as root tears, complete radial tears, and bucket-handle tears, are associated with major biomechanical consequences and should be repaired in a timely manner to prevent rapid joint degeneration [10]. Different tear patterns of the lateral meniscus in ACL injured subjects may be associated with different demographic and historical risk factors such as gender, age, body weight, and injury mechanism. The present study was conducted to assess association of the lateral meniscus tear with high grade ACL tear. In present study, group I had 25 males and 15 females, group II had 18 males and 12 females. Feucht et al[11] in their study major tears of lateral meniscus tears were seen in male gender. We observed that LM injury associated with ACL tear seen in 30 patients out of 70 patients on MRI but on arthroscopy injury was seen in only in 28 patient. False positive result seen in two patient and 5 patients came out to be false negative. Sensitivity of MRI in detecting lateral meniscus tear associated with ACL tear is 84.85%. In 42.86% of patient both ACL and lateral meniscus injury is seen. Most commonly injury of posterior horn of lateral meniscus is seen. Peripheral vertical injury mainly the wrisberg rip is the most common type and the most commonly missed tear was seen in root of posterior horn followed by anterior aspect of anterior horn of lateral meniscus. Most common mode of injury was shear injury. The sensitivity of MRI for the detection of lateral meniscus tears in the setting of acute ACL injury in our study (84.8%) is not comparable to sensitivities observed in study done by Smet et al[12] that showed 76% sensitivity for the MR diagnosis of lateral meniscal tears in the 84 patients with an ACL. The 82% and 83% sensitivities for detecting tears in the body or root of the meniscus root, respectively, were significantly better than the sensitivity of 73% for detecting tears in the posterior horn ($p = 0.04$). Thus the most of the missed tear was seen in posterior horn of lateral meniscus but in our study mostly injuries of root of posterior horn were missed as due to its complex anatomical position. In this study 59% of patient is having lateral meniscus injury associated with ACL injury. Another study done by Oei et al shows 80% sensitivity in detecting lateral meniscus tear associated with high grade ACL tear[13]. The sensitivity of MRI for lateral meniscus tears in our study was more than the sensitivity for the diagnosis of all lateral meniscus tears (57%) in the study done by Laufer et al[14]. In this study 43% of patients were having both lateral meniscus and ACL injury. Similarly in another study done by Graf et al[15] the sensitivity in the presence of the anterior cruciate

ligament tear 0.69 ($p = .0005$) for lateral tears. In this study 145 patients with ACL tears had 51% of the 68 lateral tears in the posterior horn. Our difficulty in detecting tears in the root of posterior horn of lateral meniscus was seen followed by anterior aspect of anterior horn injuries. Missed injuries of anterior aspect of anterior horn may be related to the anatomy of meniscus and secondly not able to clearly distinguish between synovial edema and tear in anterior aspect of anterior horn of lateral meniscus. Thirdly due to misinterpretation of injury as a normal speckled appearance of anterior horn of lateral meniscus (speckled appearance is due to the insertion of ACL fibres in medial aspect of anterior horn of lateral meniscus[16]). Missed posterior horn injury (body) may be due to its anatomy or due to overlying meniscofemoral ligament. The lateral meniscus has a shorter radius of curvature than the medial meniscus does[17]. Sensitivity of MRI in detecting lateral meniscus tear associated with ACL injury is significantly more (84.8%), may be due to improved resolution as majority of the cases were done on 3T machine.

Conclusion

Authors found that sensitivity of MRI in detecting lateral meniscus tear associated with high grade ACL tear is 84% and most commonly missed tear was involving the root of posterior horn of lateral meniscus followed by anterior aspect of anterior horn of lateral meniscus. In 42.8% of patient lateral meniscus tear is associated with ACL tear.

References

1. Smith 3rd JP, Barrett GR. Medial and lateral meniscal tear patterns in anterior cruciate ligament-deficient knees. A prospective analysis of 575 tears. *Am J Sports Med.* 2001;29:415–9.
2. Slauterbeck JR, Kousa P, Clifton BC, Naud S, Tourville TW, Johnson RJ, et al. Geographic mapping of meniscus and cartilage lesions associated with anterior cruciate ligament injuries. *J Bone Joint Surg Am.* 2009;91:2094–103.
3. Ghodadra N, Mall NA, Karas V, Grumet RC, Kirk S, McNickle AG, et al. Articular and meniscal pathology associated with primary anterior cruciate ligament reconstruction. *J Knee Surg.* 2013;26:185–93.
4. Cipolla M, Scala A, Gianni E, Puddu G. Different patterns of meniscal tears in acute anterior cruciate ligament (ACL) ruptures and in chronic ACL-deficient knees. Classification, staging and timing of treatment. *Knee Surg Sports Traumatol Arthrosc.* 1995;3:130–4.
5. Nikolic DK. Lateral meniscal tears and their evolution in acute injuries of the anterior cruciate ligament of the knee. Arthroscopic analysis. *Knee Surg Sports Traumatol Arthrosc.* 1998;6:26–30.

6. Keene GC, Bickerstaff D, Rae PJ, Paterson RS. The natural history of meniscal tears in anterior cruciate ligament insufficiency. *Am J Sports Med.* 1993;21:672–9.
7. Fok AW, Yau WP. Delay in ACL reconstruction is associated with more severe and painful meniscal and chondral injuries. *Knee Surg Sports Traumatol Arthrosc.* 2013;21:928–33.
8. Shelbourne KD, Gray T. Results of anterior cruciate ligament reconstruction based on meniscus and articular cartilage status at the time of surgery. Five- to fifteen-year evaluations. *Am J Sports Med.* 2000;28:446–52.
9. Oiestad BE, Engebretsen L, Storheim K, Risberg MA. Knee osteoarthritis after anterior cruciate ligament injury: a systematic review. *Am J Sports Med.* 2009;37:1434–43.
10. Cohen M, Amaro JT, Ejnisman B, Carvalho RT, Nakano KK, Peccin MS, et al. Anterior cruciate ligament reconstruction after 10 to 15 years: association between meniscectomy and osteoarthritis. *Arthroscopy.* 2007;23:629–34.
11. Feucht MJ, Bigdon S, Bode G, Salzmänn GM, Dovi-Akue D, Südkamp NP, Niemeyer P. Associated tears of the lateral meniscus in anterior cruciate ligament injuries: risk factors for different tear patterns. *Journal of Orthopaedic Surgery and Research.* 2015 Dec;10(1):1-8.
12. Arthur A. De Smet and Rajat Mukherjee . Clinical, MRI, and Arthroscopic Findings Associated with Failure to Diagnose a Lateral Meniscal Tear on Knee MRI. *American Journal of Roentgenology.* 2008;190: 22-26. 10.2214/AJR.07.2611
13. Oei EH, Nikken JJ, Verstijnen AC, Ginai AZ, Myriam Hunink MG. MR imaging of the menisci and cruciate ligaments: a systematic review. *Radiology.* 2003;226(3):837-48.
14. Bryan J. Laundre, Mark S. Collins, Jeffrey R. Bond, Diane L. Dahm, Michael J. Stuart, and Jayawant N. Mandrekar. MRI Accuracy for Tears of the Posterior Horn of the Lateral Meniscus in Patients With Acute Anterior Cruciate Ligament Injury and the Clinical Relevance of Missed Tears. *American Journal of Roentgenology* 2009 193:2, 515-523
15. AA De Smet and B K Graf. Meniscal tears missed on MR imaging: relationship to meniscal tear patterns and anterior cruciate ligament tears. *American Journal of Roentgenology* 1994 162:4, 905-911
16. S Shankman, J Beltran, E Melamed, and Z S Rosenberg. Anterior horn of the lateral meniscus: another potential pitfall in MR imaging of the knee. *Radiology* 1997 204:1, 181-184
17. Renstrom P, Johnson RJ. Anatomy and biomechanics of the menisci. *Clin Sports Med* 1990;9:523-538

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