Accuracy of magnetic resonance imaging for detecting meniscal tears in anterior cruciate ligament injuries.

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Disclosure

Authors have no conflicts of interest related to this study.

Introduction

- MRI is a valuable imaging modality in detecting meniscal injury. However, the MRI still has some limitations in detecting the type and location of meniscal injury.[1,2]
- And the accuracy of MRI in detecting the type and location of meniscal tears is not well investigated.

Objective

- This study aims to evaluate the accuracy of MRI in detecting specific types and locations of meniscal tears in patients with ACL injury planning for arthroscopic knee surgery.

Methods

- The authors retrospectively analyzed the patients' records of **anterior cruciate ligament knee injuries** from 2010 to 2019.
- **Intraoperative findings** of the type and location of meniscal tears were recorded by **an investigator** blinded to the MRI's results.
- **For MRI findings,** all MRIs were re-evaluated by **two radiologists** blinded to the clinical history and arthroscopic result.

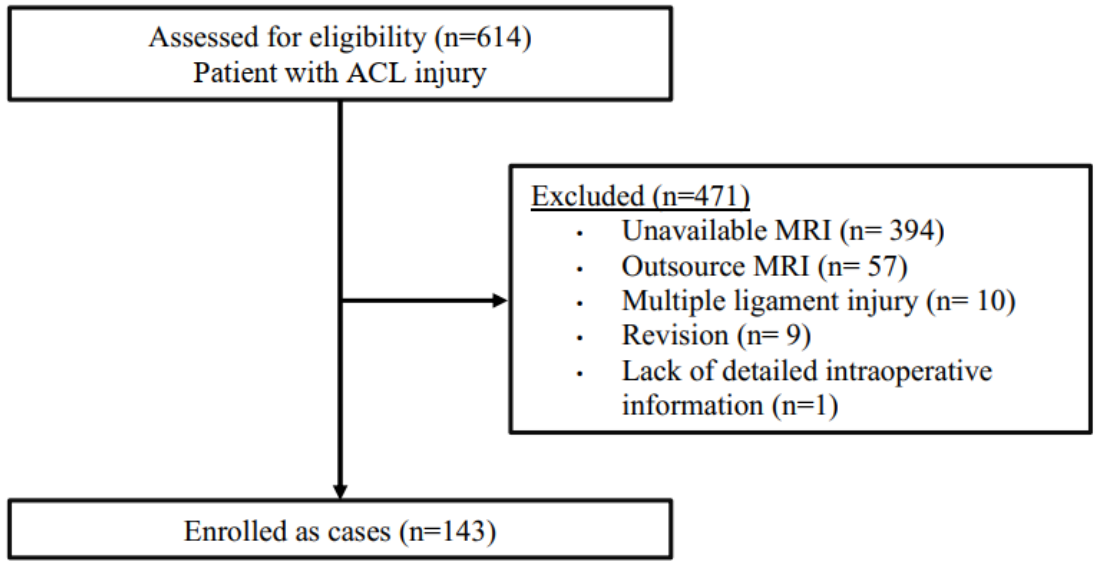

Figure 1. Flow diagram showing the process for patient inclusion and analysis in the study

Results

Characteristic	No. (%) of patients
Age (year, mean ± standard deviation)	29.3 ± 10.2
Man	130 (90.9%)
Woman	13 (9.1%)
Time injury to MRI (day, median ± interquartile range)	153 ± 334
Time MRI to Surgery (day, median ± interquartile range)	137 ± 138
Time injury to Surgery (day, median ± interquartile range)	352 ± 356
Incidence of medial meniscal tear	81 (56.6%)
Incidence of lateral meniscal tear	69 (48.3%)

Table 1. Demographics and Clinical Characteristics

Tear pattern in medial meniscus (% per all tears)	
- Radial	8.4%
- Vertical	32.5%
- Horizontal	18.1%
- Complex	25.3%
- Bucket handle tear	15.7%
Tear location in medial meniscus (% per all tears)	
- Anterior root	1.0%
- Anterior horn	5.1%
- Body	28.3%
- Posterior horn	61.6%
- Posterior root	4.0%
Tear pattern in lateral meniscus (% per all tears)	
- Radial	13.0%
- Vertical	26.1%
- Horizontal	15.9%
- Complex	39.1%
- Bucket handle tear	5.8%
Tear location in lateral meniscus (% per all tears)	
- Anterior root	0.0%
- Anterior horn	6.9%
- Body	34.7%
- Posterior horn	54.2%
- Posterior root	4.2%

Table 1. Demographics and Clinical Characteristics (Continue)

Results

Assessment		Sensitivity	Specificity	Accuracy	PPV	NPV	Agreement [a]	P-value
Medial	Detect tear	86.4 %	51.6 %	71.3 %	70.0 %	74.4%	0.395 (0.246, 0.543)	<0.001
	Tear pattern							
	- Radial	57.1 %	90.4 %	88.8 %	23.5 %	97.6 %	0.284 (0.037, 0.531)	<0.001
	- Vertical	37.0 %	69.0 %	62.9 %	21.7 %	82.5 %	0.047 (-0.111, 0.205)	0.548
	- Horizontal	20.0 %	91.4 %	83.9 %	21.4 %	90.7 %	0.118 (-0.094, 0.329)	0.160
	- Complex	47.6 %	85.2 %	79.7 %	35.7 %	90.4 %	0.289 (0.094, 0.484)	<0.001
	- Bucket handle	53.8 %	96.2 %	92.3 %	58.3 %	95.4 %	0.518 (0.269, 0.768)	<0.001
	Location	-	-	-	-	-	0.221 (0.103, 0.339)	<0.001
Lateral	Detect tear	88.4 %	56.8 %	72.0 %	65.6 %	84.0 %	0.446 (0.309, 0.584)	<0.001
	Tear pattern							
	- Radial	77.8 %	75.4 %	75.5 %	17.5 %	98.1 %	0.204 (0.053, 0.355)	<0.001
	- Vertical	22.2 %	87.2 %	79.0 %	20.0 %	88.6 %	0.090 (-0.101, 0.281)	0.281
	- Horizontal	36.4 %	85.6 %	81.8 %	17.3 %	94.2 %	0.146 (-0.051, 0.344)	0.057
	- Complex	66.7 %	87.1 %	83.2 %	54.5 %	91.8 %	0.495 (0.322-0.669)	<0.001
	- Bucket handle	50.0 %	98.6 %	97.2 %	50.0 %	98.6 %	0.486 (0.053, 0.918)	<0.001
	Location	-	-	-	-	-	0.380 (0.267, 0.493)	<0.001

Table 2. Sensitivity, specificity, accuracy, PPV, NPV, and agreement between radiologist's consensus and intraoperative finding for detecting meniscal tear

[a] Values are represented as the Cohen's Kappa value (95% confidence interval).

Results

Timing		Correlation	P-value
Medial	Injury to MRI	0.068 (-0.102, 0.234)	0.419
	MRI to surgery	0.056 (-0.114, 0.223)	0.506
	Injury to surgery	0.039 (-0.130, 0.207)	0.506
Lateral	Injury to MRI	-0.111 (-0.275, 0.059)	0.186
	MRI to surgery	-0.130 (-0.292, 0.040)	0.122
	Injury to surgery	-0.144 (-0.305, 0.026)	0.087

Table 3. Correlation between **timing on accuracy** to detect a meniscal tear in MRIs

Results

Assessment		Interobserver reliability [a]	P-value
Medial	Detect tear	0.737 (0.617, 0.858)	<0.001
	Tear pattern		
	- Radial	0.212 (-0.025, 0.449)	0.003
	- Vertical	0.456 (0.298, 0.613)	<0.001
	- Horizontal	0.385 (0.164, 0.606)	<0.001
	- Complex	0.560 (0.385, 0.736)	<0.001
	- Bucket handle	0.781 (0.595, 0.966)	<0.001
	Location	0.630 (0.523, 0.737)	<0.001
Lateral	Detect tear	0.665 (0.537, 0.793)	<0.001
	Tear pattern		
	- Radial	0.161 (0.006, 0.315)	0.002
	- Vertical	0.225 (0.028, 0.423)	0.006
	- Horizontal	0.316 (0.110, 0.523)	<0.001
	- Complex	0.370 (0.195, 0.545)	<0.001
	- Bucket handle	0.561 (0.116, 1.006)	<0.001
	Location	0.452 (0.355, 0.550)	<0.001

[a] Values are represented as the Cohen's Kappa value (95% confidence interval).

Table 4. Interobserver reliability for detect meniscal in MRIs between two radiologists.

Discussion

- This study's **meniscus injury incidence** is 56.6% for medial meniscus and 48.3% for lateral meniscus, which is like previous studies (16-82%). [1,3]
- The **accuracy of detection** is 71.3% for medial meniscus and 72.0% for lateral meniscus, which compatible with the previous range reported (45-98%).[1,2,4,5]
- MRI has a **fair to moderate agreement between intraoperative and radiologists' consensus** to identify the tear and location of the meniscus in patients with ACL injuries.

Conclusion

- We found **moderate to substantial interobserver reliability** between two radiologists to identify the tear and location of **medial meniscus injury.**
- We found **fair to moderate interobserver reliability** between two radiologists to identify the tear and location of **lateral meniscus injury.**
- Timing is not correlated with accuracy; therefore, repeated MRI is unnecessary if there is no new trauma event.

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