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Research Article

Association between Overhang of the Posterior Horn of Lateral Meniscus and ACL Injuries

Noor Yousif Abed[1]*, Bashar Talib Huweidy[1], Rajaa Abdullah Mohammed[1], Maysam Yousif Abed[2]
[1]*College of Medicine, University of Fallujah, Al-Anbar, Iraq;* [2]*Ibn Al-Bitar Tertiary Center for Cardiac Surgery, Baghdad, Iraq*

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Abstract

Background: The anterior cruciate ligament (ACL) tear is one of the most common injuries among young athletes. Posterior displacement of the posterior horn of the lateral meniscus caused by anterior translation of the tibia has been recorded as a secondary finding of the anterior cruciate ligament (ACL) injury. ***Objective***: to discriminate the association between the overhang of the posterior horn of the lateral meniscus and the anterior cruciate ligament tear. ***Methods***: A specialist radiologist performed a comparative cross-sectional study at Al Ramadi Teaching Hospital, diagnosing 60 patients with ACL tears based on MRI findings, measuring the lateral meniscus overhang value, percentage meniscus diameter, and lateral tibial plateau diameter. ***Results***: A significant difference between studied groups regarding the presence of LMO was higher in group 1 than in group 2, with a mean value of 1.85±0.74 mm for group 1 and 0.80±0.16 mm for group 2, which are also significantly different. The meniscal overhang percentage and the lateral meniscus diameter were higher in the ACL tears group than in other subjects; however, the lateral tibial plateau was significantly higher in the latter group. ***Conclusions***: A significant association has been reported between the overhang of the posterior horn of the lateral meniscus and the anterior cruciate ligament tear; we recommend further studies to display the clinical value of this finding.

Keywords: Anterior cruciate ligament, Lateral meniscus, Overhang, Tear.

الارتباط بين الجزء المتدلي من القرن الخلفي للهلالة الجانبية وإصابات الرباط الصليبي الأمامي

الخلاصة

الخلفية: تمزق الرباط الصليبي الأمامي (ACL) هو واحد من أكثر الإصابات شيوعا بين الرياضيين الشباب. تم تسجيل الإزاحة الخلفية للقرن الخلفي للغضروف المفصلي الجانبي الناجم عن الأمامي للساق كنتيجة ثانوية لإصابة الرباط الصليبي الأمامي (ACL). **الهدف**: التمييز بين العلاقة بين الجزء المتدلي من القرن الخلفي للهلالة الجانبية وتمزق الرباط الصليبي الأمامي. **الطريقة**: أجرى أخصائي أشعة دراسة مقطعية مقارنة في مستشفى الرمادي التعليمي، حيث قام بتشخيص 60 مريضا يعانون من تمزق الرباط الصليبي الأمامي بناء على نتائج التصوير بالرنين المغناطيسي، وقياس قيمة تدلي الغضروف المفصلي الجانبي، والنسب، وقطر الغضروف المفصلي، وقطر الهضبة الظنبوبية الجانبية. **النتائج**: كان الفرق الكبير بين المجموعات المدروسة فيما يتعلق بوجود قيمة تدلي غضروف أعلى في المجموعة 1 منه في المجموعة 2، بمتوسط قيمة 1.85±0.74 ملم للمجموعة 1 و0.80±0.16 ملم للمجموعة 2، والتي تختلف اختلافا كبيرا أيضا. كانت نسبة الغضروف المفصلي وقطر الغضروف المفصلي الجانبي أعلى بوجود تمزق الرباط الصليبي الأمامي مقارنة بالموضوعات الأخرى. ومع ذلك ، كانت الهضبة الظنبوبية الجانبية أعلى بكثير في المجموعة الأخيرة. **الاستنتاجات**: تم تسجيل وجود ارتباط كبير بين تدلي القرن الخلفي للهلالة الجانبية وتمزق الرباط الصليبي الأمامي ؛ نوصي بإجراء مزيد من الدراسات لعرض القيمة السريرية لهذه النتيجة.

* ***Corresponding author***: Noor Y. Abed, College of Medicine, University of Fallujah, Al-Anbar, Iraq; Email: noor.yousif@uofallujah.edu.iq

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INTRODUCTION

One of the most common injuries among outstanding young athletes is the anterior cruciate ligament (ACL) tear, with approximately 200 thousand cases reported annually [1]. Orthopedic surgeons generally recommend the precise characterization of the shape and fiber integrity of the ACLs by magnetic resonance imaging (MRI) for surgical decisions [2]. Researchers have described variability in sensitivity, specificity, and diagnostic accuracy (from 82% to 100%) of MRI in detecting ACL tears. Surprisingly, recent studies have shown that the application of higher-field MRI machines has not significantly increased diagnostic accuracy, with the accuracy increasing from 93% with 0.2 tesla machines to 95% with 3.0 tesla machines [3]. On MRI scans looking for problems with other knee structures, especially before surgery, researchers found that 68% of people with ACL tears had a torn meniscus and bone marrow edema, and 18% had torn medial collateral ligaments [4]. Anterior tibial translation has recorded posterior displacement of the lateral meniscus's

posterior horn as a secondary finding of anterior cruciate ligament (ACL) injury [5]. Researchers have observed that the displaced meniscus, which leaves part of the tibial articular surface uncovered [6], leads to lateral meniscal dysfunction, increasing tibio-femoral contact pressure, and decreasing contact area in the lateral knee compartment [7]. The displaced meniscus itself is not considered a pathology; however, it may reflect certain abnormalities or other injuries. Protruding medial meniscus is caused by joint effusion or medial joint-line osteophytes, while protruding posterior horn of the lateral meniscus is linked to an ACL tear and happens when the tibia moves forward. Also, displaced anterior horn of the lateral meniscus and lateral protrusion of the body part of the lateral meniscus are normal findings and not linked to internal instability, effusion, or signs of degeneration [5]. A meniscus extrusion can happen along with meniscus damage, cartilage damage, bone contusions, subchondral cysts, and changes in the tibiofemoral joint osteoarthritis [8]. This study aims to recognize the association between the overhang of the posterior horn of the lateral meniscus and the anterior cruciate ligament tear.

METHODS

Study design and setting

This is a comparative cross-sectional study carried out from January 2023 to August 2024. During the study period, 60 patients diagnosed with ACL tears by a specialist radiologist based on MRI findings were included with the other 60 subjects having intact ACL. The age range for group 1 was 18-67 years, while group 2 had an age distribution of 18-65 years. Group 1 included 44 males and 16 females, while group 2 included 34 males and 26 females.

Exclusion criteria

We excluded patients with tears in the posterior horn of the lateral meniscus and those with a history of surgery on the affected knees from our study.

Ethical consideration

The study was registered and approved by the Research Ethics Committee of the College of Medicine, University of Fallujah, and informed consents were obtained from the participants.

Intervention and outcome measurements

The study was carried out using a superconductive 1.5 Tesla MRI scanner (Magnetom Aera, Siemens Healthineers, Germany) with an extremities coil. The usual knee examination methodology for examined participants consists of a sagittal fat-saturated proton density sequence, axial fat-saturated proton density pictures, coronal T1- and STIR-weighted sequences, and 3 mm slice thicknesses with no intersection gaps. To define the LMO, cross-sagittal pictures were taken laterally until the maximum point of the posterior overhang of the lateral meniscus was identified. In the same frame, a vertical line was drawn tracing the posterior cortex of the tibia and referencing the meniscus bisector (Figure 1).

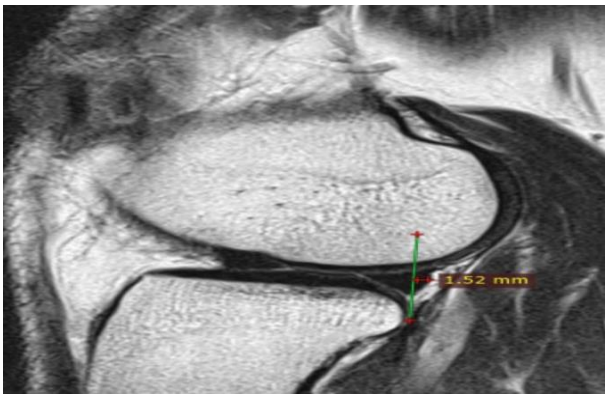

Figure 1: LMO measurement.

To assess meniscal height, another line was drawn that crossed from the superior to inferior levels of the meniscus; this line was then divided by two to determine the meniscus central line. A line was then drawn across the center of the lateral meniscus, from its posterior-most vertical point to the tibia's posterior cortical line. This was recorded as a lateral LMO. The antero-posterior dimension of the posterior horn of the lateral meniscus was measured in the sagittal frame through the meniscal center, correlated with axial and coronal images, and recorded as lateral meniscus posterior horn diameter (Figure 2).

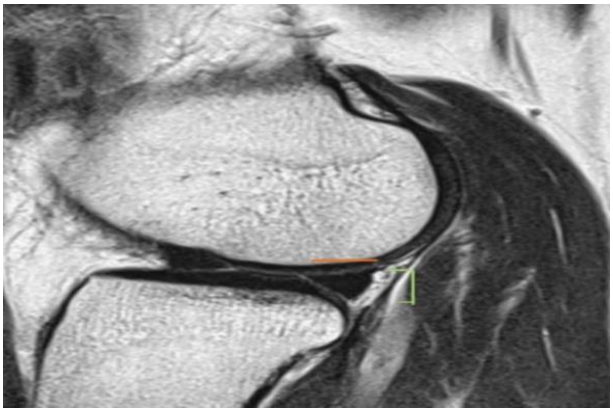

Figure 2: Meniscal height (green line) and diameter (orange line).

The diameter of the tibial plateau was measured via the superior subchondral bone from anterior to posterior places at the same level as the meniscal overhang (Figure 3). The meniscal overhang percentage was computed by dividing the LMO value by lateral meniscal diameter ∗100.

Figure 3: Lateral tibial plateau diameter.

Statistical analysis

The collected data was coded and analyzed by computer using the statistical package of IBM SPSS-29 software. Independent sample t-test, Fishers, exact test, and Chi square test are utilized for statistical analysis. Values with $p<0.05$ are considered significantly different.

RESULTS

A professional radiologist analyzed the knee MRI studies of two age- and gender-matched comparison groups. Group 1 contained 60 patients with ACL injuries, while group 2 had intact ACLs. Group 1 had a mean age of 36.3±13.8 (range 18-67 years), whereas group 2 had a mean age of 39.1±14.7 (range 18-65 years). 73.3% (44 patients) of group 1 and 56.7% (34) of group 2 were male (Table 1).

Table 1: The demographic distribution of the groups studied

Character		ACL tear	without ACL tear	*p*-value
Age (year)	<20	2(3.3)	6(10)	0.087
	20-29	22(36.7)	18(30)	
	30-39	16(26.7)	6(10)	
	40-49	6(10)	11(18.3)	
	50-59	8(13.3)	13(21.7)	
	≥60	6(10)	6(10)	
	Mean±SD	36.3±13.8	39.1±14.7	0.279
Gender	Male	44(73.3)	34(56.7)	0.056
	Female	16(26.7)	26(43.3)	

Values are expressed as frequencies, percentages, and mean±SD.

Group 1 had a considerably larger presence of LMO compared to group 2, with 56.7% (34) and 8.3% (5), respectively, with a mean value of 1.85±0.74 mm for group 1 and 0.80±0.16 mm for group 2. More than half of the patients in group 1 had a meniscal overhang of 15% or more, while all cases in group 2 had a meniscal overhang of less than 10%. The mean values for both groups were 15.19±5.22% and 7.00±1.58%, respectively (Table 2 and Figure 4).

Table 2: Characteristics of the participants

Parameters		Group1 (with ACL tear)	Group 2 (no ACL tear)	*p*-value
Presence of LMO	Yes	34(56.7)	5(8.3)	0.0001
	No	26(43.3)	55(91.7)	
Meniscal overhang percentage (%)	Mean±SD	1.85±0.74	0.80±0.16	0.0001
	<10	4(11.8)	5(100)	0.0001
	10-14	10(29.4)	-	
	≥15	20(58.8)	-	
	Mean±SD	15.19±5.22	7.00±1.58	0.001
	Meniscal diameter (mm)	11.46±1.56	9.89±0.88	0.0001
	Lateral tibial plateau diameter (cm)	3.59±0.26	3.95±0.32	0.0001

Values are expressed as frequencies, percentages, and mean±SD.

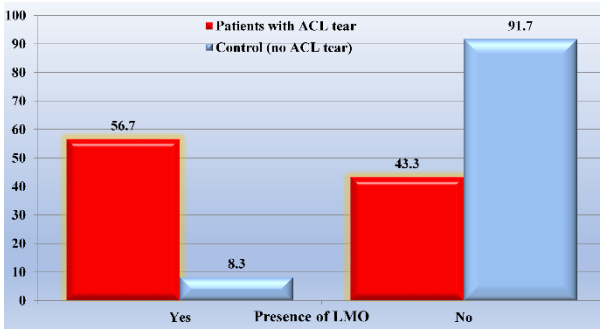

Figure 4: Presence of LMO in studied groups.

In group 1, meniscal diameter was significantly higher at 11.46±1.56 mm compared to 9.89±0.88 mm in other participants. Group 2 with intact ACLs had a higher lateral tibial plateau diameter of 3.95±0.32 cm compared to 3.59±0.26 cm in group 1 (Table 2 and Figure 5).

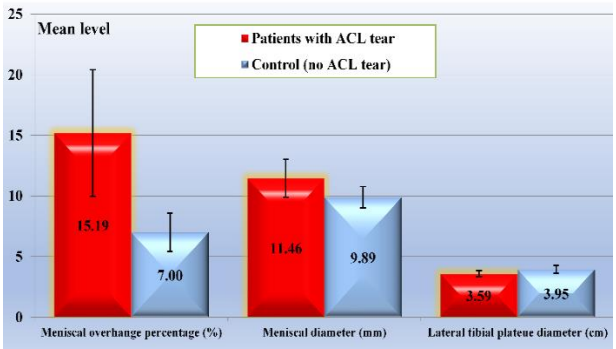

Figure 5: LMO, meniscal diameter and lateral tibial diameter in the included participants.

The LMO has a significant correlation with meniscus diameter ($r > 0.5$) (Table 3).

Table 3: The correlation between different measured parameters

		Patients with ACL tear			
		Presence of LMO (mm)	Meniscal overhang (%)	Meniscal diameter (mm)	Lateral tibial plateau diameter (cm)
Age (year)	*r*	-0.250	-0.319	0.013	-0.134
	P	0.154	0.066	0.921	0.306
Presence of LMO (mm)	*r*	-	0.944	0.553	-0.011
	P		0.0001	0.001	0.951
Meniscal overhang (%)	*r*	0.944	-	0.342	-0.026
	P	0.0001	-	0.048	0.883
Meniscal diameter (mm)	*r*	0.553	0.342	-	0.166
	P	0.001	0.048	-	0.204
Lateral tibial plateau diameter (cm)	*r*	-0.011	-0.026	0.166	-
	P	0.951	0.883	0.204	-

DISCUSSION

Anterior cruciate ligament (ACL) injury is one of the most common traumatic injuries to the knee joint and is often associated with other concurrent tears of the ligaments, meniscus, and cartilage [9]. Researchers have discussed a significant difference in LMO rate between patients with an ACL tear and those with an intact ACL, which we confirmed. We can explain this as a function of anterior tibial translation associated with ACL tear, which reduces the contact between the tibial plateau and femoral condyle. One of the indirect MRI signs of ACL tear is anterior tibial translation, which suggests the antero-posterior and rotational instabilities resulting from the ACL tear. These findings commonly have supportive diagnostic values [10]. This appears on sagittal images under the middle part of the lateral condyle of the femur, as described by Guenoun *et al*. [11] Researchers have reported that anterior tibial translation, where the line from the posterior cortex of the upper lateral tibial plateau splits the posterior horn of the lateral meniscus, determines posterior displacement, or the exposure of the posterior horn of the lateral meniscus [11]. After excluding previously operated Knees patients, we included 120 MRI studies. Of these, 60 patients had ACL tears, while the remaining patients had intact ACLs. We observed a significantly higher rate of LMO in association with AACL: 56.7% (34 patients) versus 8.3% (5 patients) in the second group. The over-hang percentage was also significantly higher in group 1. DeBell *et al*. [12] described similar results in their research, which involved 117 patients with ACL tears and a control group of 89. 42.7% of the injured ACL group recorded LMO, compared to 4.5% of the intact ACL subjects. Miller *et al*. [5] included 132 MRI studies of the knee, 111 with different knee pathologies, and 21 knee MRI studies as a control. Of the patient group, 18 reported ACL tears; two-thirds of them had complete ACL tears. From this group, 6 patients (50%) have associated posterior lateral meniscal overhang, which aligns with our current study. However, Miller et al. included a variety of knee pathologies, of which only a small percentage had ACL tears. Tung et al. [13] investigated a higher number of ACL tears by examining the primary and secondary findings of ACL injury in 50 patients with ACL tears and 53 uninjured knees. They reported bone bruises, PCL curvature, and anterior translation of the tibia as secondary signs of ACL tears. Tung et al. [13] reported that the uncovered lateral meniscus, a function of anterior tibial translation, was positive in 9 (18%) patients with ACL tears and nil in all cases where the ACL was intact. The average LMO value in our study was 1.85±0.74 mm for the ACL tear group and 0.80±0.16 mm for the second group. These values are very different from each other. Also, the meniscus diameter was 11.46±1.56 mm in group 1 compared to 9.89±0.88 mm in the other groups. Miller *et al*. [12] reported a smaller average value of LMO in comparison with our study (0.95 mm *vs*. 1.8 mm) in ACL injury patients and (0.08 vs. 0.8 mm) in ACL intact subjects. While their results display greater meniscal diameter in the ACL tear group, they record a smaller value in comparison with our work, with a mean value of 9.64 mm in ACL tear patients and a mean of 8.85 mm in the control group. In contrast, Gentili *et al*. [14] found that the posterior horn displacement of the lateral meniscus was longer on average than in our study. The mean value in the ACL tear group was 3.05 mm, while it was only 0.54 mm in the ACL intact group. Differences in the sample size studied and in the included and excluded criteria, particularly the presence of concomitant ligamentous injuries, can account for these differences.

Conclusion

A substantial correlation has been established between the overhang of the posterior horn of the lateral meniscus and anterior cruciate ligament tears; we advocate for this as a corroborative diagnostic indicator for radiologists in identifying ACL tears, and additional research is necessary to validate the clinical applicability of this observation.

Conflict of interests

No conflict of interest was declared by the authors.

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The authors did not receive any source of funds.

Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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