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Presence Of Antero Lateral Ligament In Knees With And Without Anterior Cruciate Ligament Tear

[1] Manoj Kumar , [2] Bijender Kumar , [3] Himanshu Jain , [4]* Angad Singh Johal , [5] Nirat Tiwari , [6] Jitin Singla, [7] Prasad Sakhare , [8] Dwarika Nitish Sahu , [9] Shubham Yadav

[1,2]Assistant Professor, [3]Associate Professor, [4,5,6,7,8,9]Junior Resident,
Department of Orthopedics,
MM Institute of Medical Sciences and Research, Mullana (Ambala)l, Haryana, India

***Corresponding Author:**
Angad Singh Johal
Junior Resident, Department of Orthopedics, MM Institute of Medical Sciences and Research, Mullana (Ambala)l, Haryana, India

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Abstract

Background: The anterolateral ligament (ALL) of the knee has been a topic of anatomical and clinical debate. This study aims to assess the prevalence of ALL and its anatomical components (femoral, meniscal, tibial) in knees with and without anterior cruciate ligament (ACL) tears.

Methodology: A cross-sectional study was conducted involving 96 patients undergoing knee MRI for clinically suspected ACL injury or chronic knee pain. Patients were categorized into two groups: Group A (n=48) with ACL tear and Group B (n=48) without ACL tear. Clinical and demographic data were recorded. Data analysis was performed using SPSS® version 21.0. Categorical variables were analyzed using the Chi-square test and continuous variables with the t-test. A p-value <0.05 was considered statistically significant.

Results: The ALL was visualized in 65% of patients. The femoral, tibial, and meniscal components were seen in 56%, 63%, and 57% respectively, while all three components were visualized together in 30%. A significant association was found between ACL tear and ALL visualization ($p < 0.001$), with ALL identified in 81% of knees with ACL tear versus 48% without the tear. Among patients with a visible ALL, 24 had medial meniscal tears, 7 had lateral, and 3 had both—indicating a significant link between ALL presence and meniscal injury. No association was found with age, gender, or side of involvement.

Conclusion: MRI findings support the anatomical presence of the ALL and its strong association with ACL and meniscal injuries, underlining its possible clinical relevance.

Keywords: Anterolateral ligament, Anterior Cruciate Ligament, MRI, Meniscus tear

Introduction

The knee joint is the largest and one of the most mechanically loaded joints in the human body. It is a modified hinge joint that primarily allows flexion and extension, along with limited varus-valgus and internal-external rotational movements. Additionally, minor translational motions occur, with anteromedial translation being the most prominent. The stability of the knee joint is maintained by four major ligaments: the medial collateral ligament (MCL) and lateral collateral ligament (LCL) on either side, and the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) located centrally within the joint.

Among these structures, the existence, anatomical definition, and functional significance of the anterolateral ligament (ALL) have been subjects of ongoing debate within the orthopedic community.

Interest in the ALL was reignited following the landmark study by Claes et al. in 2013, which explored the anterolateral anatomy of the knee [1]. Since then, multiple studies have attempted to correlate historical anatomical descriptions with modern imaging and biomechanical data. Despite extensive research, consensus remains elusive regarding the presence and role of the ALL.

A consensus meeting held in Lyon, France in November 2015 concluded that the ALL is a distinct ligament located on the anterolateral aspect of the knee [2]. However, some researchers dispute this, suggesting that the observed structure may instead represent components of the anterolateral capsule or the deep fibers of the iliotibial band (ITB) [3].

According to the ALL Expert Group, the ligament is located deep to the ITB, with its femoral origin just posterior and proximal to the lateral epicondyle, and a tibial insertion between Gerdy's tubercle and the fibular head, including a consistent attachment to the lateral meniscus [2]. Several anatomical studies report its incidence in cadaveric specimens to range between 50% and 100%. Daggett et al. described a method for identifying the ALL by reflecting the ITB distally after a transverse incision 6–8 cm proximal to the lateral epicondyle. With the knee flexed between 30° and 60° and applying internal rotation, the ALL can be visualized as oblique, fan-shaped fibers extending from the lateral femur to the proximal tibia. Additional dissection of the fibular attachment of the biceps femoris and the adjacent capsule allows clearer visualization of the ALL and its meniscal connections [4].

Although there is general agreement on the ALL's anatomical path—from just proximal and posterior to the lateral epicondyle to its tibial insertion between the fibular head and Gerdy's tubercle—studies have noted structural variations. The ALL typically measures 34–59 mm in length and varies in thickness, often being nearly twice as thick in males compared to females. It becomes taut during internal rotation of the tibia. Ingham et al. performed knee dissections on 58 specimens from 24 different animal species and did not find the ALL in any of the specimens[5].The anterolateral ligament (ALL) has been identified as a distinct anatomical structure in 12% to 100% of human specimens [6]. These varied findings have led to increasing interest in the detailed anatomical study of the anterolateral structures of the knee [7]. Some researchers propose that, with meticulous dissection and precise anatomical knowledge of the ALL's insertions, the ligament can be consistently identified in all human knees [8].

Multiple studies have explored the biomechanical characteristics of the ALL. Reported values include a mean ultimate load to failure ranging between 50 and 205 N, mean stiffness between 20 and 42 N/mm, and a mean ultimate strain of approximately 36% [9]. Biomechanical investigations have shown that the ALL may fail via several mechanisms, including tears at the femoral or tibial insertions, intrasubstance tears, or avulsion fractures at the tibial insertion site, commonly referred to as Segond fractures.

Although no study has exclusively evaluated the biomechanical function of the ALL or its role in overall knee kinematics, evidence supports its contribution as a lateral stabilizer of the knee [10]. Due to its relatively anterior femoral insertion compared to the lateral collateral ligament (LCL), the ALL is believed to play a role in both anterior and rotational stability. Dodds et al. demonstrated an increase in the length of the ALL when an internal rotation torque of 5 Nm was applied, indicating its resistance to internal tibial rotation. This length change varied with the degree of knee flexion, whereas no significant change was observed during external or neutral rotation across the flexion-extension spectrum.

Recent findings by Claes et al. support the role of the ALL in controlling tibial rotation, reporting a high incidence of ALL injuries at its distal insertion [11]. Additionally, they observed that up to 78.7% of patients who had undergone ACL reconstruction presented with associated ALL injuries. However, the exact relationship between ALL injury and ACL pathology remains unclear. Further research is necessary to define the ALL's contribution to tibiofemoral stability throughout the range of knee motion, the biomechanical consequences of ALL deficiency, and its involvement in other soft tissue injuries.

Studies suggest that ALL deficiency is associated with a higher-grade pivot shift compared to isolated ACL injuries [12]. One study, however, reported not an increase in internal rotation but rather an increased acceleration of the lateral tibial compartment, which has been linked to pivot shift phenomena [13].

Furthermore, MRI-based studies have indicated increased pivot shifts in the presence of injuries to the anterolateral capsule, medial meniscus, and lateral meniscus [1].

There is a lack of Indian studies evaluating the anatomical presence of the ALL [14]. Emerging evidence suggests that combining ALL repair or reconstruction with ACL surgery enhances rotational knee stability [15]. Thus, comprehensive anatomical understanding of the ALL is essential for orthopedic surgeons aiming to perform functionally effective reconstructions involving both the ACL and ALL. The present study was undertaken with the primary objective of determining and comparing the prevalence of the anterolateral ligament and its three anatomical components—femoral, meniscal, and tibial—in knees with and without ACL tears.

Methodology

A cross-sectional study was conducted at Bhagat Phool Singh Government Medical College for Women, Khanpur Kalan, Sonepat. Prior approval was obtained from the Institutional Scientific and Ethical Committee before initiating the study.

Inclusion Criteria:

Patients undergoing magnetic resonance imaging (MRI) of the knee either due to:

1. Clinically suspected anterior cruciate ligament (ACL) injury.
2. History of chronic knee pain.

Exclusion Criteria:

Patients presenting with associated bony fractures involving the tibial plateau or femur, congenital lower limb deformities, or clinically evident posterior cruciate ligament (PCL) injuries.

Sampling And Study Design:

The sample size (Total-96) was calculated using the nMaster 2.0 software, based on a previous study by C.P. Helito et al. [17], assuming an expected proportion of 33.3%, with a 95% confidence interval and 5% precision for a finite population.

Of the 96 patients, 48 were diagnosed with ACL tears and were categorized into Group A, while the remaining 48 patients without ACL tears comprised Group B. All participants were provided with a detailed explanation of the study's purpose and procedures, and written informed consent was obtained prior to inclusion in the study. All the participants in this study underwent an MRI of the knee using 1.5T Philips MRI machine.

MR Imaging protocol

MR images were performed on GE Signa Horozon LX 1T scanner (GE Medical Systems,US). The following MR sequences were acquired in the knees included in the study.

1. Sagittal T1-weighted fast spin-echo sequences (TR/TE 575/min; section thickness 3 mm; field of view 180 x 135 mm; matrix 384 x 224).

2. Sagittal intermediate-weighted (3600/min full).

3. T2-weighted (3600/102).

4. FSE sequences (section thickness 3 mm; field of view 180 x 135 mm; matrix 512 x 224)

5. Coronal gradient-echo T2 (325/min; flip angle 30; section thickness 3mm; FOV 180 x 135 mm; matric 256 x 192).

6. T2-weighted fat suppressed sequences (12/3700/fatsat, section thickness 3 mm; FOV 180 x 135 mm; matrix 385 x 224).

7. Axial intermediate-weighted FSE sequences (3500/20; section thickness 3 mm; FOV 170 x 127, 5mm; matrix 320 x 256).

Certainly! Here's a rephrased version of the MR Imaging Results section, aligned with the formal tone and structure appropriate for the *International Journal of Medical Science and Current Research (IJMSCR)

MR Imaging Evaluation

1. The anterolateral ligament (ALL) was considered visualized on MRI when low-signal-intensity fibers were identified originating from the lateral epicondyle of the distal femur, extending obliquely towards the anterolateral border of the proximal tibia, and running lateral to the lateral inferior geniculate vessels.

2. The ALL was classified as abnormal when one or more of the following findings were observed: complete disruption of the ligament with discontinuity of all fibers, marked irregularity in the contour (e.g., bending), or the presence of intra- or peri-ligamentous edema. A combination of these features was also considered indicative of ALL abnormality.

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3. The ALL was deemed non-visualized if no distinct fibers were discernible at its expected anatomical location and there was no surrounding edema suggestive of pathology.

4. In accordance with prior anatomical studies, the ALL was segmented into three parts:

1. Femoral part: from the origin to the bifurcation point,
2. Meniscal part: from the bifurcation point to the meniscal insertion
3. Tibial part: from the bifurcation point to the tibial insertion.

Visibility was assessed separately for each part, and the entire ligament was considered visualized only if all three components were visible. If any segment was not visible in both coronal and axial MRI planes, it was considered non-visualized.

5. The presence of focal or diffuse thickening, high signal intensity on proton density-weighted (PDW) images, disruption, or irregular contour of the ligament was interpreted as evidence of ALL injury.

6. ACL rupture was diagnosed based on the following primary MRI findings: ligament thickening, increased signal intensity on PDW images, fiber discontinuity, and abnormal course or orientation of the ACL. Normally, the ACL course should be as steep or steeper than the intercondylar roof, with its apex pointing posteriorly and less steep than Blumensaat's line.

7. In addition to primary signs, secondary signs of ACL injury were evaluated, including: bone contusions of the posterolateral tibial plateau and lateral femoral condyle, presence of a Segond fracture, anterior tibial translocation, reduction in the posterior cruciate ligament (PCL) angle, a positive PCL line, and an uncovered posterior horn of the lateral meniscus.

Data Collection and Statistical Analysis

Patient-related data were collected using a pre-designed, semi-structured format. Demographic details including age, gender, and residential address were recorded for all participants. Relevant clinical information such as mechanism of injury, presence of comorbidities, past surgical history, and ambulatory status was also documented.

Quantitative variables were summarized using mean and standard deviation (SD), while qualitative variables were expressed as frequencies and percentages. Data entry was performed using Microsoft Excel, and statistical analysis was carried out using SPSS® version 21.0 (SPSS Inc., USA). For continuous variables, mean and SD were computed, and for categorical data, proportions and percentages were calculated. The Chi-square test was applied for analyzing categorical variables, while the independent t-test was used for comparison of means in normally distributed data. A p-value of <0.05 was considered statistically significant.

Results

Mean age of the patients was 29.75 ± 10.17 years, ranging between 11 to 60 years. The most common age group was 21 to 30 years. (Table 1).

Table 1: Distribution of patients according to their age

Age (in years)	N	%
Less than 21	25	26%
21 to 30	28	29%
30 to 35	19	20%
More than 35	24	25%

Females comprised only 19% while males were 81% of the study population in the present study. The right side was affected in 51% of the patients and the rest had left side affected. All patients underwent MRI assessment.

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Reasons for undergoing MRI were road traffic accident in 65% of the patients, sports injury in 29%, chronic knee pain in 5% and fall on ground for one patient. (Table 2)

Table 2: Distribution of patients according to the reason for undergoing MRI

Reason for MRI	N	%
Road side accident	62	65%
Sports injury	28	29%
Chronic knee pain	5	5%
Fall on ground	1	1%

ALL was visualized in 65% of the patients included in the study. Its femoral component was visualized in 56%, tibial component in 63% and meniscal component in 57% of the patients.The three components were viewed together in 30% of the patients. (Table 3). Associated medial meniscal tear was present in 35% of the patients, lateral meniscal tear in 18%, both medial and lateral meniscal tear in 9% of the patients. No meniscal tear was observed in 38% of the patients. (Table 4)

Table 3: Distribution of patients according to ALL visualization on MRI

ALL visualised	N	%
Any type	62	65
Femoral	54	56
Meniscal	55	57
Tibial	60	63

Table 4: Distribution of patients according to associated meniscal injuries

Associated meniscal injury	N	%
Medial	34	35
Lateral	17	18
Both	9	9
None	6	38

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ALL was visualized in a total of 62 patients, of which 19 were aged less than 21 years, 18 were aged between 21 to 30 years, 11 were aged between 30 to 35 and 14 were aged above 35 years. We did not find any significant association between age and the presence of ALL (Table 5). The ligament was visualized in a total of 62 patients, of which 10 were females and rest were males. We did not find any significant association between gender and the presence of ALL (Table 6).

Table 5: Association of age with the presence of ALL

	ALL present		**Total**
Age in group (in years)	No	Yes	
Less than 21	6	19	25
21-30	10	18	28
30-35	8	11	19
More than 35	10	14	24
	34	62	96
p value 0.53*			

Table 6: Association of gender with the presence of ALL

	ALL Present		**Total**
Gender	No	Yes	
Female	8	10	18
Male	26	52	78
	34	62	96
p value 0.34*			

The anterolateral ligament was visualized in a total of 62 patients, of which 23 had an ACL tear and rest did not. We found a significant association between ACL tear and the presence of ALL (p <0.001). Out of 48 without ACL tear patients ALL was found in 39 patients that means almost 81%, this is significant relation between intact ACL and ALL visualization in comparison to 48 patients with ACL tear where ALL visualization was found in

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only 23 patients that means 48%. (Table 7). Meniscal tears were significantly associated with the presence of ALL as out of the 62 patients in which ALL was visualized, 24 had an associated medial meniscal tear, 7 had lateral and 3 had tear in both the menisci. (Table 8)

Table 7: Association between presence of ALL and ACL injury

	ALL Present		**Total**
ACL Tear	No	Yes	
Not present	9	39	48
Present	25	23	48
	34	62	96
p value <0.001*			

Table 8: Association of meniscal tear with the presence of ALL

	ALL Present		**Total**
Meniscal Tear	No	Yes	
Both	6	3	9
Lateral	10	7	17
Medial	10	24	34
No	8	28	36
	34	62	96
p value <0.001*			

Following MRI findings were present in our study

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Fig 1: All 3 portions (femoral, meniscal and tibial) of ALL are seen

Fig 2: ACL and MM tear is present and ALL is not visualised

Fig 3: ACL tear present and only femoral portion of ALL is visualized

Fig 4: only femoral portion of ALL is visualized

Fig 5: Femoral and tibial portion of ALL is visualised

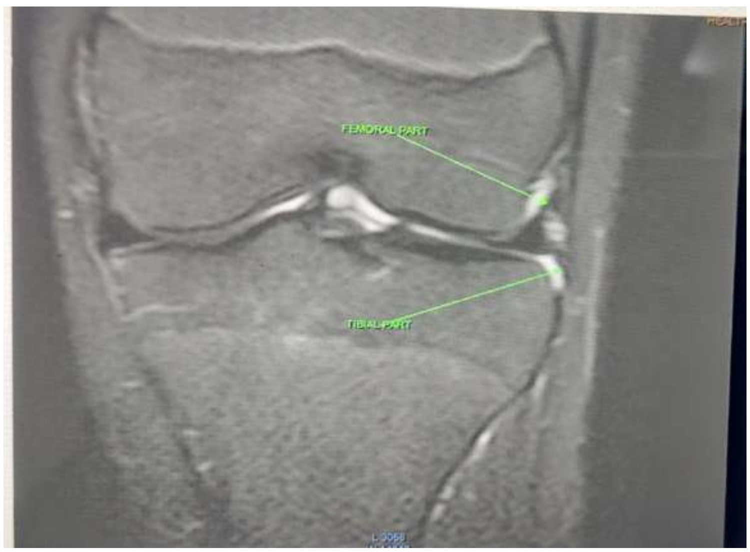

Fig 5: Only tibial portion of ALL is visualised

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Discussion

The present study was conducted with the objective of evaluating the presence of the anterolateral ligament (ALL) by separately assessing its femoral, meniscal, and tibial components in knees with and without anterior cruciate ligament (ACL) tears. The study population comprised patients presenting with knee injuries or chronic knee pain who underwent magnetic resonance imaging (MRI) of the knee in the Department of Orthopedics at BPS Government Medical College for Women, Khanpur Kalan, Sonepat, Haryana, during the DNB training period. Ethical clearance for the study was obtained from the Institutional Ethics Committee of the same institution.

Although the ALL was initially identified by Paul Segond in 1879 in association with the Segond fracture, it was formally named and anatomically characterized much later by Vincent et al. in 2012 [16]. The ALL originates from the lateral epicondyle of the distal femur and inserts on the proximal tibia near Gerdy's tubercle. Biomechanical studies have demonstrated its role as a secondary stabilizer to the ACL, primarily contributing to the control of anterior tibial translation and internal tibial rotation.

In the current study, the ALL was visualized on MRI in 65% of the total cases, indicating its identifiable presence in the majority of patients. The femoral component of the ALL was visualized in 56% of patients, the meniscal component in 57%, and the tibial component in 63%. Complete visualization of all three anatomical components of the ALL was achieved in 30% of patients. These findings highlight the variable visualization rates of the ALL on MRI and reinforce the importance of detailed anatomical understanding and optimized imaging protocols for accurate assessment.In the present study, the anterolateral ligament (ALL) was visualized in 39 out of 48 patients without ACL tear, corresponding to a visibility rate of approximately 81%. In contrast, among the 48 patients with ACL tear, the ALL was visualized in only 23 patients (48%). This difference suggests a significant association between the presence of an intact ACL and the visibility of the ALL on MRI.

When compared with previous literature, these findings are consistent with the results of Helito et al. (2014), who conducted a study to assess the visualization of the ALL using magnetic resonance imaging [17]. In their study, 33 MRI scans of knees performed for reasons unrelated to ligament instability or trauma were analyzed. The ALL demonstrated signal characteristics similar to other ligamentous structures—hypointense on T2-weighted images with fat saturation—and was best visualized in the coronal plane. The ALL was partially visualized in 27 knees (81.8%). The meniscal portion was identified in 25 knees (75.7%), the femoral portion in 23 (69.6%), and the tibial portion in 13 knees (39.3%). All three portions were visualized together in 11 cases (33.3%). The authors concluded that the coronal plane offers the best visualization of the ALL, with the meniscal portion being most consistently identifiable and the tibial portion the least.

Debate continues regarding the anatomical presence and prevalence of the ALL, to the extent that some researchers have questioned its existence altogether [18]. Ingham et al. examined 58 knee specimens from 24 different animal species and did not identify the presence of an ALL in any of them. Studies on human specimens have reported a wide variation in the incidence of the ALL, ranging from 12% to 100% [19, 20]. Vincent et al. evaluated 30 patients undergoing total knee arthroplasty and successfully identified the ALL in all cases [21]. In a separate anatomical study involving dissection of 10 fresh cadaveric knees, the ALL was identified in 100% of specimens. Similarly, Helito et al. conducted a dissection-based study on 21 human cadaveric knees (mean age 61.5 years) and clearly identified the ALL in 20 of the 21 specimens [18]. In a subsequent study involving radiographic and anatomical analysis of 10 unpaired cadaveric knees (mean age 62.8 years), the ALL was visualized in all cases [22].

The variability in the reported incidence of the ALL is likely attributable to differences in the defined anatomical attachment sites. While some studies describe the ALL as an integral part of the joint capsule, others have defined it as a structure superficial to the lateral collateral ligament (LCL) and not directly attached to the meniscus. Dodds et al. described the tibial insertion of the ALL as being inferior to the meniscus, a feature not clearly specified in earlier literature [23]. Such anatomical distinctions likely account for the variation in reported visualization rates, including the 83% incidence noted in Dodds' study. Additionally, the femoral attachment site of the ALL has also been variably described. Claes

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et al. [24] noted its origin as superior and anterior to the LCL at the lateral epicondyle, while Dodds et al. described it as approximately 8 mm proximal and 4 mm posterior to the epicondyle, contributing further to inconsistencies in reported prevalence.

In the present study, ACL tears were identified in 50% of patients, and a statistically significant association was observed between ALL visualization and ACL injury ($p < 0.001$). Previous studies have shown that associated lesions in ACL injury often correlate with the mechanism of trauma [25]. Various mechanisms have been proposed for ACL injury, including both contact and non-contact causes. Most ACL injuries are believed to result from pivot-shift-like movements involving a combination of sudden anterior tibial translation and internal tibial rotation. These injuries frequently occur alongside damage to the posterolateral corner of the knee (including osseous lesions) and lateral meniscus tears [26].

In the current study population, meniscal tears were found to be significantly associated with the presence of ALL ($p < 0.01$), further supporting the hypothesis that the ALL plays a role in rotational stability and may be concurrently affected in complex knee injuries.

In the current study, associated medial meniscal tears were observed in 35% of patients, lateral meniscal tears in 18%, and combined medial and lateral meniscal tears in 9%. No meniscal pathology was found in 38% of patients. These findings align with existing biomechanical literature that emphasizes the role of the anterolateral ligament (ALL) in providing rotatory stability during pivot-shift movements [27]. However, the extent of this contribution remains debated. Some studies have reported no significant increase or only a minimal increase in anterior tibial translation and internal tibial rotation following sectioning of the ALL in ACL-deficient knees [28]. Furthermore, Noyes et al. observed that a significant increase in pivot shift was only evident after combined sectioning of the ALL and the iliotibial band (ITB)[29].

This raises ongoing debate about whether simultaneous ALL reconstruction should be performed during ACL reconstruction to enhance rotatory stability and reduce stress on the reconstructed graft. While some support the concept of reconstructing the ALL to enhance biomechanical outcomes, others have questioned its practical benefits. Spencer et al., in a cadaveric biomechanical study, reported no significant improvement in rotatory stability or anterior tibial translation following ALL reconstruction in an ALL-deficient state [30]. Similarly, Tavlo et al. found that detaching the ALL had a significant impact on knee instability only in ACL-deficient knees, and this instability was effectively neutralized after ACL reconstruction alone [31].

Claes et al. examined 206 patients and reported that when the ALL was identifiable, over 75% had a concomitant ALL injury, with the tibial insertion site being the most common location of injury [11]. Hartigan et al. noted that although the ALL could be identified in 100% of acutely injured ACL knees, radiologists were often unable to reliably classify the ligament as intact or injured when using 1.5T MRI with a slice thickness of 4.0 mm [32]. The use of 3.0T MRI with improved imaging protocols and interpretation criteria has been suggested to enhance visualization and diagnostic accuracy. The authors concluded that standardized identification techniques are essential to accurately detect ALL injuries and understand their clinical relevance.

In the present study, the mean age of patients was 29.75 ± 10.17 years, with a range from 11 to 60 years. The 21 to 30 years age group was the most commonly affected. Females comprised 19% of the study population. The right knee was involved in 51% of cases, while the left knee was involved in the remaining. The ALL was visualized in a total of 62 patients: 19 were aged below 21 years, 18 between 21–30 years, 11 between 30–35 years, and 14 above 35 years. No statistically significant association was found between age and ALL visualization ($p = 0.53$).

Similarly, there was no significant association between gender and visualization of the ALL ($p = 0.34$). Although not assessed in the present study, prior anatomical investigations have demonstrated sex-based differences in ALL morphology. Daggett et al., in a cadaveric study involving 157 knees, confirmed the presence of the ALL in all specimens, supporting its existence as a constant anatomical structure in the anterolateral aspect of the knee [33]. Their findings showed that the ALL was significantly thicker in males than in females, with an average difference of 1.04 mmin thickness at the level of the lateral

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meniscus. While no significant differences were observed in width, male ligaments were more than twice as thick as those in females. This anatomical difference may partly explain the higher incidence of ACL injuries in females, who are known to exhibit greater rotational laxity, predisposing them to ligamentous injuries during pivot-shift-type movements. In such cases, external forces are initially absorbed by peripheral structures, including the ALL, before being transmitted to the ACL.

Evidence from various cadaveric studies suggests that combined ACL and ALL reconstruction may result in superior rotatory stability compared to ACL reconstruction alone. Nitri et al. demonstrated improved rotational control when both ligaments were reconstructed simultaneously [34], supporting the notion that addressing secondary stabilizers may enhance surgical outcomes in select patient populations.

Further studies are warranted to compare the outcomes of autograft, allograft, and synthetic grafts in the reconstruction of the anterolateral ligament (ALL). Historically, lateral extra-articular tenodesis (LET) was used as an adjunct to ACL reconstruction to enhance rotational stability of the knee. However, concerns regarding over-constraint of the lateral compartment led to its decline in use, as such constraints have been associated with restricted range of motion, joint stiffness, and potential development of lateral compartment osteoarthritis [35]. These same concerns persist with ALL reconstruction, regardless of the fixation angle used during surgery. For instance, Sonnett utilized a traction force of 88 N, which may have contributed to the observed constraint. Nevertheless, the degree of constraint reported (1°–2°) may not have clinical significance.

It is important to recognize that cadaveric studies have inherent limitations, including absence of graft incorporation, lack of soft tissue adaptation, and exclusion of complex capsule-ligamentous injuries commonly associated with ACL ruptures. While a retrospective clinical study involving combined ACL and ALL reconstruction found no postoperative range of motion limitations [36], there is a clear need for prospective clinical studies in living subjects to validate these findings and assess long-term functional outcomes.

ALL injuries are most commonly associated with ACL tears [11]. Ferretti et al., in a clinical case series of 60 patients undergoing surgical management for ACL rupture, identified several patterns of ALL injury upon exposure of the lateral knee compartment. These included: macroscopic hemorrhage extending from the ALL to the anterolateral capsule(32%), macroscopic hemorrhage extending to the posterolateral capsule (27%), complete transverse tear near the tibial insertion of the ALL (22%), and bony avulsion (Segond fracture) near the lateral tibial plateau (10%).

MRI findings, particularly bony contusions, may assist in diagnosing ALL injuries in the context of ACL tears. In a retrospective analysis of 193 MRIs from ACL-injured patients, Song et al. found that contusions of the lateral femoral condyle and lateral tibial plateau were significantly associated with ALL injuries, while medial-sided contusions were not [37]. The Segond fracture, a classic radiologic sign, is strongly associated with ALL rupture and ACL tears. In another study, Porrino et al. examined 20 MRIs of knees with Segond fractures and found the ALL to be attached to the avulsed bone fragment in all but one case, where anatomic distortion limited visualization.

This study acknowledges several limitations. Firstly, there is no standardized reference for characterizing and comparing the ALL on MRI, making it challenging to draw definitive conclusions. Although MRI has shown considerable promise in visualizing the ALL, lack of consensus regarding its anatomical and radiological definitions has resulted in inconsistent reporting among studies. Additionally, biomechanical analyses were not performed in the current study. Incorporating such evaluations would be ideal to better understand the functional role of the ALL. Finally, the relatively small sample size represents a limitation in the generalizability of the findings.

Conclusion

The present study provides radiological evidence supporting the presence of the anterolateral ligament (ALL) in the human knee. A distinct portion of the ALL was clearly visualized in 65% of the patients evaluated. Specifically, the femoral component was identified in 56% of cases, the meniscal component in 57%, and the tibial component in 63%. All three components were simultaneously visualized in 30% of the subjects. Additionally, the presence of the ALL

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showed a significant association with anterior cruciate ligament (ACL) injuries and meniscal tears. However, no statistically significant correlation was observed between the presence of the ALL and patient age, gender, or the laterality of the affected knee.

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