OPINION REVIEW

Effects of glucocorticoids on leukocytes: Genomic and non-genomic mechanisms
Jia WY, Zhang JJ

MINIREVIEWS

Apheresis: A cell-based therapeutic tool for the inflammatory bowel disease
Yasmin F, Najeeb H, Naem U, Moeed A, Koritala T, Surani S

Helicobacter pylori infection and small intestinal bacterial overgrowth—more than what meets the eye
Dharan M, Wozny D

Anatomy of the anterolateral ligament of the knee joint
Park JG, Han SB, Rhim HC, Jeon OH, Jang KM

ORIGINAL ARTICLE

Molecular mechanisms of Biyu decoction as treatment for psoriasis: A network pharmacology and molecular docking study
Wang Z, Zhang HM, Guo YR, Li LL

Expression of hepatocyte nuclear factor 4 alpha, wingless-related integration site, and β-catenin in clinical gastric cancer
Hu Q, Li LL, Peng Z, Yi P

Case Control Study

Improved Pittsburgh Sleep Quality Index scores on first postoperative night achieved by propofol anesthesia in patients undergoing ambulatory gynecologic surgery
Hu CH, Chou WY

Efficacy of Guhong injection versus Butylphthalide injection for mild ischemic stroke: A multicenter controlled study
Zhang WW, Xin J, Zhang GY, Zhai QJ, Zhang HM, Wu CS

Retrospective Study

Clinical values of Barcelona Clinic Liver Cancer subgroup and up-to-7 criteria in intermediate stage hepatocellular carcinoma with transcatheter arterial chemoembolization
Lee SW, Peng YC, Lien HC, Ko CW, Tung CF, Chang CS

Intervention effect of encouraging mental and programmed nursing of patients in interventional operating room on their compliance and bad moods
Chi RB, Cai YY, Mao HP
## Contents

**Thrice Monthly Volume 10 Number 21 July 26, 2022**

<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>7293</td>
<td>Preoperative neoadjuvant chemotherapy in patients with breast cancer evaluated using strain ultrasonic elastography</td>
<td>Pan HY, Zhang Q, Wu WJ, Li X</td>
</tr>
<tr>
<td>7302</td>
<td>Risk factors for delayed intracranial hemorrhage secondary to ventriculoperitoneal shunt: A retrospective study</td>
<td>Chen JC, Duan SX, Xue ZB, Yang SY, Li Y, Lai RL, Tan DH</td>
</tr>
<tr>
<td>7314</td>
<td>Sequential treatment of severe pneumonia with respiratory failure and its influence on respiratory mechanical parameters and hemodynamics</td>
<td>Niu BY, Wang G, Li B, Zhen GS, Weng YB</td>
</tr>
<tr>
<td>7324</td>
<td>Effects of alendronate sodium combined with InterTan on osteoporotic femoral intertrochanteric fractures and fracture recurrence</td>
<td>Wang KM, Wei SP, Yin XY, Meng QJ, Kong YM</td>
</tr>
<tr>
<td>7333</td>
<td>Correlation of magnetic resonance imaging quantitative parameters and apparent diffusion coefficient value with pathological breast cancer</td>
<td>Wang Z, Ren GY, Yin Q, Wang Q</td>
</tr>
<tr>
<td>7341</td>
<td>Risk factors for delirium after surgery for craniocerebral injury in the neurosurgical intensive care unit</td>
<td>Chen RY, Zhong CH, Chen W, Lin M, Feng CF, Chen CN</td>
</tr>
</tbody>
</table>

**Observational Study**

<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>7348</td>
<td>Effect of osteoarthritic knee flexion deformity correction by total knee arthroplasty on sagittal spinopelvic alignment in Indian population</td>
<td>Puthiyapura LK, Jain M, Tripathy SK, Puliappadamb HM</td>
</tr>
</tbody>
</table>

**Randomized Controlled Trial**

<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>7365</td>
<td>Comparison of involved-field intensity-modulated radiotherapy combined with S-1 vs radiotherapy alone for elderly patients with esophageal cancer</td>
<td>Liu LH, Yan MH, Di YP, Fu ZG, Zhang XD, Li HQ</td>
</tr>
</tbody>
</table>

**Randomized Clinical Trial**

<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
</table>

**META-ANALYSIS**

<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>7386</td>
<td>Impact of cancer on mortality rates in patients with sepsis: A meta-analysis and meta-regression of current studies</td>
<td>Xiang MJ, Chen GL</td>
</tr>
</tbody>
</table>
CASE REPORT

7397 Updated clinical and glycomic features of mannosyl-oligosaccharide glucosidase deficiency: Two case reports  

7409 Solitary necrotic nodules of the liver with “ring”-like calcification: A case report  

7415 Corticosteroid-induced bradycardia in multiple sclerosis and maturity-onset diabetes of the young due to hepatocyte nuclear factor 4-alpha mutation: A case report  
Sohn SY, Kim SY, Joo IS

7422 Essential thrombocythemia with non-ST-segment elevation myocardial infarction as the first manifestation: A case report  
Wang ZM, Chen WH, Wu YM, Wang LQ, Ye FL, Yin RL

7429 Extranasopharyngeal angiofibroma in children: A case report  
Yan YY, Lai C, Wu L, Fu Y

7438 Deep Sylvian fissure meningiomas: A case report  

7445 Acute pulmonary embolism originating from upper limb venous thrombosis following breast cancer surgery: Two case reports  
Duan Y, Wang GL, Guo X, Yang LL, Tian FG

7451 Managing spondylitis tuberculosis in a patient with underlying diabetes and hypothyroidism: A case report  
Novita BD, Muliono AC, Wijaya S, Theodora I, Tjahjono Y, Supit VD, Willianto VM

7459 Ovarian mucinous tumor with mural nodules of anaplastic carcinoma: Three case reports  

7467 Transcatheter arterial infusion chemotherapy and embolization for primary lacrimal sac squamous cell carcinoma: A case report  
Sun MH, Yi WD, Shen L, Zhou L, Lu JX

7474 Programmed cell death-1 inhibitor combination treatment for recurrent proficient mismatch repair/ microsatellite-stable type endometrial cancer: A case report  
Zhai CY, Yin LX, Han WD

7483 Novel compound heterozygous mutation of SLC12A3 in Gitelman syndrome co-existent with hyperthyroidism: A case report and literature review  
Qin YZ, Liu YM, Wang Y, You C, Li LN, Zhou XY, Lv WM, Hong SH, Xiao LX

7495 Successful treatment of hyperglycemia with liraglutide in a hospitalized 27-year-old patient with schizophrenia: A case report  
Zhang L, Yu WJ, Zhu H, Li HF, Qiao J
Refractory lymphoma treated with chimeric antigen receptor T cells combined with programmed cell death-1 inhibitor: A case report
Zhang CJ, Zhang JY, Li LJ, Xu NW

Median arcuate ligament syndrome with retroperitoneal haemorrhage: A case report
Lu XC, Pei JG, Xie GH, Li YY, Han HM

Novel frameshift mutation in the AHDC1 gene in a Chinese global developmental delay patient: A case report
Lin SZ, Xie HY, Qu YL, Gao W, Wang WQ, Li JY, Feng XC, Jin CQ

Selective nerve block for the treatment of neuralgia in Kummell’s disease: A case report
Zhang X, Li ZX, Yin LJ, Chen H

Traditional Chinese medicine manipulative reduction combined with percutaneous vertebroplasty for treating type III Kummell’s disease: A case report
Hao SS, Zhang RJ, Dong SL, Li HK, Liu S, Li RF, Ren HH, Zhang LY

Differential diagnosis and treatment of foot drop caused by an extraneural ganglion cyst above the knee: A case report
Won KH, Kang EY

Effect of hydrogen intervention on refractory wounds after radiotherapy: A case report

Chronic urticaria associated with lung adenocarcinoma — a paraneoplastic manifestation: A case report and literature review
Jiménez LF, Castellón EA, Marenco JD, Mejía JM, Rojas CA, Jiménez FT, Coronell L, Osorio-Llanes E, Mendoza-Torres E

Spinal giant cell-rich osteosarcoma-diagnostic dilemma and treatment strategy: A case report
Tseng CS, Wong CE, Huang CC, Hsu HH, Lee JS, Lee PH

Primary clear cell sarcoma of soft tissue in the posterior cervical spine invading the medulla oblongata: A case report
Liu CC, Huang WP, Gao JB

Pseudomonas aeruginosa-related effusive-constrictive pericarditis diagnosed with echocardiography: A case report
Chen JL, Mei DE, Yu CG, Zhao ZY

Maternal peripartum bacteremia caused by intrauterine infection with Comamonas kerstersii: A case report
Qu H, Zhao YH, Zhu WM, Liu L, Zhu M

Considerations of single-lung ventilation in neonatal thoracoscopic surgery with cardiac arrest caused by bilateral pneumothorax: A case report
Zhang X, Song HC, Wang KL, Ren YY
Contents

Thrice Monthly Volume 10 Number 21 July 26, 2022

7599 Rare primary rectal mucosa-associated lymphoid tissue lymphoma with curative resection by endoscopic submucosal dissection: A case report and review of literature
  Tao Y, Nan Q, Lei Z, Miao YL, Niu JK

7609 Differences in examination results of small anastomotic fistula after radical gastrectomy with afterward treatments: A case report
  Lu CY, Liu YL, Liu KJ, Xu S, Yao HL, Li L, Guo ZS

LETTER TO THE EDITOR

7617 Baseline differences may impact on relationship between dietary tryptophan and risk of obesity and type 2 diabetes
  Ren XH, Ye YW, He LP
ABOUT COVER
Editorial Board Member of World Journal of Clinical Cases, Rajesh Kumar Rajnish, MBBS, MS, Assistant Professor, Department of Orthopaedics, All India Institute of Medical Sciences, Bilaspur, Bilaspur 174001, Himachal Pradesh, India. duktiraj@gmail.com

AIMS AND SCOPE
The primary aim of World Journal of Clinical Cases (WJCC, World J Clin Cases) is to provide scholars and readers from various fields of clinical medicine with a platform to publish high-quality clinical research articles and communicate their research findings online.

WJCC mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

INDEXING/ABSTRACTING
The WJCC is now abstracted and indexed in Science Citation Index Expanded (SCIE, also known as SciSearch®), Journal Citation Reports/Science Edition, Current Contents®/Clinical Medicine, PubMed, PubMed Central, Scopus, Reference Citation Analysis, China National Knowledge Infrastructure, China Science and Technology Journal Database, and Superstar Journals Database. The 2022 Edition of Journal Citation Reports® cites the 2021 impact factor (IF) for WJCC as 1.534; IF without journal self cites: 1.491; 5-year IF: 1.599; Journal Citation Indicator: 0.28; Ranking: 135 among 172 journals in medicine, general and internal; and Quartile category: Q4. The WJCC’s CiteScore for 2021 is 1.2 and Scopus CiteScore rank 2021: General Medicine is 443/826.

RESPONSIBLE EDITORS FOR THIS ISSUE
Production Editor: Ying-Yi Yuan; Production Department Director: Xiang Li; Editorial Office Director: Jin-Lei Wang.

NAME OF JOURNAL
World Journal of Clinical Cases

ISSN
ISSN 2307-8960 (online)

LAUNCH DATE
April 16, 2013

FREQUENCY
Thrice Monthly

EDITORS-IN-CHIEF
Bao-Gan Peng, Jerzy Tadeusz Chudek, George Kontogeorgos, Maurizio Serati, Ja Hyeon Ku

EDITORIAL BOARD MEMBERS
https://www.wjgnet.com/bpg/editorialboard.htm

PUBLICATION DATE
July 26, 2022

COPYRIGHT
© 2022 Baishideng Publishing Group Inc
Anatomy of the anterolateral ligament of the knee joint

Jun-Gu Park, Seung-Beom Han, Hye Chang Rhim, Ok Hee Jeon, Ki-Mo Jang

Abstract

Despite remarkable improvements in clinical outcomes after anterior cruciate ligament reconstruction, the residual rotational instability of knee joints remains a major concern. The anterolateral ligament (ALL) has recently gained attention as a distinct ligamentous structure on the anterolateral aspect of the knee joint. Numerous studies investigated the anatomy, function, and biomechanics of ALL to establish its potential role as a stabilizer for anterolateral rotational instability. However, controversies regarding its existence, prevalence, and femoral and tibial insertions need to be addressed. According to a recent consensus, ALL exists as a distinct ligamentous structure on the anterolateral aspect of the knee joint, with some anatomic variations. The aim of this article was to review the updated anatomy of ALL and present the most accepted findings among the existing controversies. Generally, ALL originates slightly proximal and posterior to the lateral epicondyle of the distal femur and has an anteroinferior course toward the tibial insertion between the tip of the fibular head and Gerdy’s tubercle below the lateral tibial plateau.

Key Words: Knee joint; Anatomy; Anterolateral ligament; Anterior cruciate ligament; Anterolateral rotational instability; Anterolateral ligament reconstruction

©The Author(s) 2022. Published by Baishideng Publishing Group Inc. All rights reserved.
INTRODUCTION

The anterolateral ligament (ALL) has recently gained attention because of its discovery as a new ligament structure, as well as its potential role in the anterolateral rotational stability[1,2]. However, the anterolateral structures defined as ALL were not newly discovered by Claes et al[3]. ALL has previously been described as the anterior band of the lateral collateral ligament (LCL), the mid-third-capsular ligament, the anterior oblique band, and the capsular-osseous layer of the iliotibial tract in previous studies to present the anterolateral structure that tightens during the internal rotation of the tibia between 30° to 60° knee flexion[4-6]. After the "re-discovery" of ALL, its clinical significance was demonstrated in several biomechanical studies, suggesting that its possible association with the rotational stability of the knee joint[2].

Although the outcomes after anterior cruciate ligament (ACL) reconstruction have improved with a better understanding of the anatomy of the ACL and advances in surgical technique, some patients complain of residual anterolateral rotational instability (ALRI) even after successful ACL reconstruction, which presents with a persistent “pivot shift test.” ALL reconstruction has recently gained attention as an alternative option to control ALRI in ACL-injured patients. Many studies have shown that ALL reconstruction combined with ACL reconstruction significantly decreases the rate of ACL retear and ALRI, in addition to improving patient-reported outcomes[7].

However, there are still inconsistent findings regarding the anatomy of the ALL, including its prevalence, femoral origin, tibial insertion, and relationship with the surrounding structures. Several cadaveric studies reported that ALL was identified as a distinct ligamentous structure, separate from the anterolateral capsule. However, some studies reported only a thickening of the articular capsule or a complex of fibrous tissue on the anterolateral capsule[3,8]. With these inconsistent findings, questions regarding the anatomical implications of ALL reconstruction for the restoration of rotatory stability, and the surgical technique for proper tunnel placement may emerge. Therefore, there is a need for detailed understanding of the ALL anatomy to ensure proper diagnosis and treatment of knee joint pathology. This article aimed to review recent studies regarding the anatomy of ALL and present the most accepted findings among several controversies.

HISTORICAL REVIEW OF ALL

In 1872, Friedrich Henle noted a structure wherein the most anterior fibers of the lateral collateral ligament curved forward at a nearly right angle and disappeared into the edge of the meniscus, which was later found to correspond to the ALL[12]. Thereafter, this anatomic structure has been investigated by several researchers and described by different terms such as “deep external lateral ligament,” “lateral epicondylo-meniscal ligament,” “lateral capsular ligament,” “mid-third lateral capsular ligament,” “anterior oblique band of the LCL.” ALL was first named by Vincent et al[13] in 2012. In 2013, Claes et al[3] identified a well-defined ligamentous structure (ALL) that was clearly distinguishable from the anterolateral joint capsule in human cadaveric knees. In a subsequent study, the tibial insertion site of the ALL on a cadaver was compared with the location of the Segond fracture on magnetic resonance imaging (MRI) images, and a high correlation between the two locations was demonstrated, which suggested that the Segond fracture is a bony avulsion of the ALL[14].

Core Tip: Although there are some anatomical variations in the anterolateral ligament (ALL), the most recent studies agree that it exists as a distinct ligamentous structure on the anterolateral aspect of the knee joint. ALL reconstruction can be a solution for residual rotational instability after anterior cruciate ligament reconstruction. Further investigations are necessary to resolve the controversies regarding ALL anatomy and to establish appropriate ALL reconstruction techniques.
PREVALENCE OF ALL

One of the debatable issues regarding ALL is whether it is a distinct ligamentous structure or a simple capsular thickening. This controversy resulted from the inconsistent findings related to the presence of ALL in previous cadaveric studies, which ranged from 0% to 100%.[8,15,16]. In a study reported by Claes et al.[3], ALL was identified in almost all the cadaveric knees (40 of 41, 97.6%). Thereafter, numerous cadaveric studies reported various prevalence rates of the ALL, and some studies insisted that it does not exist as a distinct ligamentous structure[17]. However, a recent systematic review found that ALL was identified in 83.0% of the 39 cadaveric dissection studies of 952 specimens, indicating a high prevalence[18]. Ariel de Lima et al.[18] suggested that different dissection preservation methods could affect ALL identification. They demonstrated that ALL prevalence was low in embalmed cadaveric studies, whereas it was high in fresh-frozen cadavers[18]. This is because the anterolateral structures, including LCL, ALL, iliotibial band (ITB), and biceps, have a complex relationship, and their insertions are often merged together. In addition, the clear identification of ALL could be restricted in the embalmed specimen. Several studies have demonstrated that the anatomical structure of the ALL varies from a distinct ligamentous structure to a sheet-like structure[14,15,19]. Most studies reported ALL as a true ligamentous structure; however, in some cases it may only be palpated as bundles of tense capsular tissue[15,19,20]. Olewnik et al[19] classified the ALL structure into five types, and demonstrated that type 1 corresponds to the typical description of ALL. After considering the differences in race, sex, preservation method, and dissection techniques, the current consensus is that ALL exists at the anterolateral aspect of the knee joint in the most people, as a distinct ligamentous structure that tightens when tibial internal rotation with 30° to 60° knee flexion is applied.

ANATOMY OF THE ALL

Anterolateral complex

The structures related to the anterolateral aspect of the knee joint constitute the anterolateral complex. This complex consists of the superficial ITB and iliotibial band, deep ITB (Kaplan fibers, retrograde condylar attachment continuous with the capsulo-osseous layer), and ALL. The first layer consists of the superficial ITB, the second layer consists of the iliotibial band, and the third layer is comprised of ALL. Within the third layer of the anterolateral capsule, the ALL is the superficial lamina, and the deep lamina is the true capsule of the knee joint. Several dissection techniques for identifying ALL have been introduced, and Ariel de Lima et al.[21] and Daggett et al.[22] suggested that a uniform and standardization dissection technique can improve ALL identification. With antegrade dissection, they were able to identify ALL in all fresh-frozen cadavers.

For anterograde dissection, ITB was transversely cut at 10 cm proximal to the lateral femoral epicondyle and bluntly dissected until its insertion into Gerdy’s tubercle in the anterolateral aspect of the tibia by cutting the Kaplan fibers. This step must be done carefully because the deep part of the ITB can closely adhere to ALL, towards the lateral femoral epicondyle. Inadequate dissection does not separate the deep ITB and ALL, which may result in confusion in distinguishing them. However, the ITB is connected to the distal femur with Kaplan fibers, and has no attachment to the lateral femoral epicondyle. ALL is a ligamentous structure that is clearly distinct from the ITB. Both the “deep layer” (Kaplan’s fibers) and “capsulo-osseous layer” of ITB should not be confused with ALL. After reflection of ITB, the anteroinferior trajectory parallel fibers on the anterolateral capsule, which originate from around the lateral epicondyle and extend distally in a fan-like fashion, are inserted into the tibia between the Gerdy’s tubercle and the fibular head. With a tibial internal rotation at 30° to 60° knee flexion, this structure becomes more obvious and distinct. ALL is anteriorly merged with the anterior capsule and posteriorly close to the LCL. Since the origins of the LCL and ALL are closely located, and ALL overlaps the LCL at the lateral epicondyle, careful dissection should be performed to separate the LCL and ALL. After excision of the capsule anterior to ALL, the entire ALL can be isolated (Figure 1).

The length of ALL reported in previous studies varied from 30 mm to 59 mm[13,18,23,24]. A recent systematic review demonstrated that the length of ALL is typically between 33.0 and 42.0 mm in most studies[18]. The length of ALL increased with knee flexion and tibial internal rotation[23,25]. The thickness of ALL ranged from 1.0 to 2.5 mm, and the width of ALL varied between 4.0 and 7.0 mm[18].

Proximal attachment site: Femoral origin

Another controversial issue regarding the anatomy of the ALL is the exact location of its femoral origin. This issue arises from the complexity of the close origins of the ALL and LCL at the lateral epicondyle of the distal femur. Claes et al.[3] described that ALL originated slightly anterior to LCL. However, in subsequent studies, there were various descriptions about the femoral origin of ALL, using references to LCL’s femoral origin or the lateral femoral epicondyle. These studies described the origin of ALL as (1) proximal and posterior to the lateral femoral epicondyle[8,15,21,23,25-28]; (2) the center of the lateral epicondyle[27]; or (3) anterior to the LCL femoral origin[3,24,29,30]. Recently, most studies have reported the origin to be proximal and posterior to the lateral epicondyle (Table 1). Even though there...
Table 1 Summary of recent anatomical cadaveric studies of the anterolateral ligament

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Year</th>
<th>Preservation method</th>
<th>Prevalence of the ALL</th>
<th>Femoral origin</th>
<th>Tibial origin</th>
<th>Length of the ALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vincent et al</td>
<td>2012</td>
<td>Fresh-frozen cadaver</td>
<td>100%</td>
<td>Anterior to the popliteus tendon insertion</td>
<td>Posterior to GT</td>
<td>34.1 ± 3.4 mm</td>
</tr>
<tr>
<td>Claes et al</td>
<td>2013</td>
<td>Embalmed cadaver</td>
<td>100%</td>
<td>Anterior to LCL</td>
<td>Between GT and FH</td>
<td>38.5 ± 6.1 mm (0°)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>41.5 ± 6.7 (90°)</td>
</tr>
<tr>
<td>Helito et al</td>
<td>2013</td>
<td>Fresh-frozen cadaver</td>
<td>100%</td>
<td>Anterior and distal to LCL</td>
<td>Between GT and FH</td>
<td>37.3 ± 4.0 mm</td>
</tr>
<tr>
<td>Dodds et al</td>
<td>2014</td>
<td>Fresh-frozen cadaver</td>
<td>83%</td>
<td>Proximal and posterior to LFE</td>
<td>Between GT and FH</td>
<td>59.0 ± 4.0 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tightened at internal rotation and flexion</td>
</tr>
<tr>
<td>Caterine et al</td>
<td>2015</td>
<td>Fresh-frozen cadaver</td>
<td>100%</td>
<td>Proximal and posterior to LCL</td>
<td>Between GT and FH</td>
<td>40.3 ± 6.2 mm (0°)</td>
</tr>
<tr>
<td>Kennedy et al</td>
<td>2015</td>
<td>Fresh-frozen cadaver</td>
<td>100%</td>
<td>Proximal and posterior to LFE</td>
<td>Between GT and FH</td>
<td>36.8 mm (0°)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>41.6 mm (90°)</td>
</tr>
<tr>
<td>Watanabe et al</td>
<td>2016</td>
<td>Embalmed cadaver</td>
<td>37%</td>
<td>Type I (ALL) Overlapped LCL origin</td>
<td>Between GT and FH (Type II-b, lateral aspect of tibial plateau)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Posterior to LCL origin</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Type II (ALLT)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Anterior to LCL origin</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Type II anterior to posterior of LCL origin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stijak et al</td>
<td>2016</td>
<td>Embalmed cadaver</td>
<td>50%</td>
<td>Anterior to LCL</td>
<td>Between GT and FH</td>
<td>41.0 ± 3.0 mm</td>
</tr>
<tr>
<td>Daggett et al</td>
<td>2016</td>
<td>Fresh-frozen cadaver</td>
<td>100%</td>
<td>Center of LFE, proximal and posterior to LFE</td>
<td>Between GT and FH</td>
<td>N/A</td>
</tr>
<tr>
<td>Neri et al</td>
<td>2017</td>
<td>Fresh-frozen cadaver</td>
<td>95%</td>
<td>Proximal and posterior to LFE</td>
<td>Posterior and proximal to GT, anterior and proximal to FH, and distal to ACT</td>
<td>50.4 ± 6.6 mm</td>
</tr>
<tr>
<td>Goncharov et al</td>
<td>2018</td>
<td>Fresh-frozen cadaver</td>
<td>68% women</td>
<td>65% proximal and posterior to LFE</td>
<td>Between GT and FH</td>
<td>38.5 ± 4.4 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>42% men</td>
<td>24% anterior to the origin of the LCL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12% popliteus tendon insertion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olewnik et al</td>
<td>2018</td>
<td>Embalmed cadaver</td>
<td>64%</td>
<td>Type I, proximal and anterior to LCL</td>
<td>Type I, II-a, II-b, posterior to GT</td>
<td>35.5 ± 7.3 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Type II-a, proximal and posterior to LCL</td>
<td>Type III, blends with deep fascia</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Type II-b, proximal and posterior to LCL</td>
<td>Type IV, posterior to GT and deep fascia</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Type IV, LFE and anterior to LCL</td>
<td>Type V, posterior to GT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Type V, LCL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lima et al</td>
<td>2019</td>
<td>Fresh-frozen cadaver</td>
<td>100%</td>
<td>Proximal and posterior to LFE</td>
<td>Between GT and FH (4.0 mm to 7.0 mm below the tibial plateau)</td>
<td>40.0 ± 0.4 mm</td>
</tr>
<tr>
<td>Nasu et al</td>
<td>2020</td>
<td>Embalmed cadaver</td>
<td>0% (Complex of fibrous tissues with a sheet-like)</td>
<td>Proximal and posterior to LFE</td>
<td>Lateroposterior area to the GT</td>
<td>N/A</td>
</tr>
</tbody>
</table>
are some variations, the current consensus is that the femoral origin of ALL is typically located proximal and posterior to the lateral femoral epicondyle[18].

**Distal attachment site: Tibial insertion**

Although there are controversies regarding the femoral origin of ALL, most studies agree that the tibial attachment site of ALL is located halfway between Gerdy’s tubercle and the tip of the fibular head. The tibial insertion site of ALL is approximately 5-10 mm below the lateral tibial plateau[2,25].

**Meniscal attachment**

On the anteroinferior course between the distal femur and proximal tibia, the ALL has a branch of dense collagen fibers attached to the lateral meniscus at the joint level. Helito et al[31] demonstrated that the meniscal insertion of ALL was located between the anterior horn and the body of the lateral meniscus (specifically beginning at 36.0% and ending at 41.9% of the circumference of the lateral meniscus), and that the mean attachment length was 5.6 mm. Kosy et al[32] demonstrated that an attachment to the lateral meniscus was identified in all 94 cases, wherein ALL was visualized using MRI. They reported four types of variations of meniscal attachment (complete, central, bipolar, and inferior-only).

**HISTOLOGY OF THE ALL**

Several studies have demonstrated that ALL consists of well-organized dense collagen fibers, and that its mechanical properties resemble those of ligaments[13,24,33]. Redler et al[33] reported that the ALL consists of dense collagen fibers oriented in the longitudinal and transverse directions of the fiber bundles. However, Patel et al[15] showed that this ligamentous characteristic was only observed when ALL was identified as a distinct ligamentous structure; otherwise, the properties of ALL resembled those of the anterolateral capsule, suggesting the variability in the microstructural and mechanical properties of the ALL. Macchi et al[34] reported that ALL is composed primarily of type I collagen (90%), followed by type III collagen (5%), type IV collagen (3%), and scarce elastic fibers (1%). Several
studies have demonstrated peripheral nerve innervation and type 1 mechanoreceptors in ALL[16,34].

IMAGING OF THE ALL

MRI is the most useful imaging tool for evaluating the ALL and its combined pathology. MRI evaluation of ALL could be limited due to its complex relationship with other adjacent structures, small thickness and width, and anatomical variability. However, most of the previous studies demonstrated relatively high detection rates of ALL on MRI, which ranged from 51% to 100%[16,35].

The most useful sequences for evaluating ALL are coronal and axial proton density sequences with fat saturation. Considering the anteroinferior trajectory of the ALL, it is easier to identify ALL on coronal images (Figure 2). The lateral inferior genicular artery is a reproducible landmark for identification of ALL[36]. On coronal images, this artery is seen as a small dot and the meniscal attachment fiber of the ALL is easily found proximal to it. The femoral origin of ALL is not clearly distinguished from that of the adjacent lateral collateral ligament. Instead, just below the lateral epicondyle, ALL can be found as a long, thin, low-signal ligamentous structure that runs distally deep into the ITB and anterior to the LCL. The tibial insertion just distal to the joint line was more clearly identified than the femoral insertion[37]. Several studies using MRI have shown a high rate of ALL in the ACL-injured patients, which ranges between 40% and 80%.[38].

Identification of the femoral and tibial ALL insertions on plain radiographs may be helpful for tunnel placement in ALL reconstruction. Several authors have found radiographic anatomic references on lateral radiographs. Although there are some differences, most studies described that the femoral origin is approximately 50% of the anteroposterior distance from the posterior femoral cortex and slightly distal (3.7 to 9.0 mm) to the Blumensaat line, and that the tibial insertion is approximately 50% of the anteroposterior distance from the anterior edge of the tibial plateau[39].

FUNCTION OF THE ALL

Several previous cadaveric and clinical studies have demonstrated that ALL functions as a secondary stabilizer to ACL when it resists the anterior translation and internal rotation of the tibia[40]. Although most studies have found important roles of ALL in the anterolateral rotational stability of the knee joint, some studies have also demonstrated that it has a limited role in rotational stability[2,40]. Therefore, further biomechanical and clinical studies are needed to clarify the exact role of ALL and its long-term clinical effects.
CONCLUSION

Sound anatomical knowledge is essential for treating various musculoskeletal disorders, and pathologic findings can be identified after a thorough understanding of the normal anatomy has been established. Even though there are some anatomical variations, most recent anatomical studies agree that ALL exists as a distinct ligamentous structure on the anterolateral aspect of the knee joint. Typically, ALL originates from the proximal and posterior to the lateral epicondyle of the distal femur, and it has an anteroinferior course towards tibial insertion between the tip of the fibular head and Gerdy’s tubercle below the lateral tibial plateau. Further cadaveric and imaging investigations are necessary to resolve several controversial issues regarding the anatomy of ALL, and to establish additional insights for appropriate ALL reconstruction techniques.

FOOTNOTES

Author contributions: Jang KM and Park JG wrote the paper; Park JG, Han SB, and Jang KM performed data collection and analysis; Jang KM, Rhim HC, Jeon OH and Han SB performed review and editing.

Supported by a grant of Korea University Anam Hospital, Seoul, Republic of Korea, No. K2209741.

Conflict-of-interest statement: All the authors report no relevant conflicts of interest for this article.

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: https://creativecommons.org/Licenses/by-nc/4.0/

Country/Territory of origin: South Korea

ORCID number: Seung-Beom Han 0000-0003-1880-4229; Hye Chang Rhim 0000-0002-7986-6493; Ok Hee Jeon 0000-0002-3725-7526; Ki-Mo Jang 0000-0001-9370-3319.

S-Editor: Gong ZM
L-Editor: A
P-Editor: Gong ZM

REFERENCES

9 Segond P. Recherches cliniques et expérimentales sur les épanchements sanguins du genou par entorse. Progrès Med 1879; 7: 297-341
11 Weitbrecht J. Desmographie, ou, Description des ligaments du corps humain [electronic resource]: Avec
Abnormalities and Associated Injuries in Knees with Acute Anterior Cruciate Ligament Injury.}

**Imaging.**


