



The Structure and Function of the Anterolateral Ligament of the Knee: A Systematic Review

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Purpose: The purpose of this systematic review was to evaluate the anatomic structure and function of the anterolateral ligament (ALL) of the knee. **Methods:** The Medline, Embase, and Cochrane databases were screened for all studies related to the ALL of the knee. Two reviewers independently reviewed all eligible articles and the references of these articles. Inclusion and exclusion criteria were applied to all searched studies. Quality assessment was completed for the included studies. **Results:** Nineteen studies were identified for final analysis. Pooled analysis identified the ALL in 430 of 449 knees (96%) examined. The ligament was found to originate from the region of the lateral femoral epicondyle and insert on the proximal tibia midway between the Gerdy tubercle and the fibular head. The ALL was found to be 34.1 to 41.5 mm in length, 5.1 to 8.3 mm in width above the lateral meniscus, and 8.9 to 11.2 mm in width below the lateral meniscus. By use of magnetic resonance imaging, the ALL was identified in 93% of knees examined (clinical, 64 of 70; cadaveric, 16 of 16). In one case study the ligament was clearly visualized by ultrasound examination. Histologic analysis across 3 studies showed characteristics consistent with ligamentous tissue. Though not shown in biomechanical studies, it is hypothesized that the ALL provides anterolateral stability to the knee, preventing anterolateral subluxation of the proximal tibia on the femur. One study identified a network of peripheral nerves, suggesting a proprioceptive function of the ALL. **Conclusions:** This systematic review shows the ALL to be a distinct structure with a consistent origin and insertion sites. The ALL is an extra-articular structure with a clear course from the lateral femoral epicondyle region, running anteroinferiorly, to the proximal tibia at a site midway between the Gerdy tubercle and the head of the fibula. The function of this ligament is theorized to provide anterolateral knee stability. **Level of Evidence:** Level IV, systematic review of cadaveric and imaging studies.

The “recently” described structure known as the anterolateral ligament (ALL) was in fact described in the literature more than 130 years ago in a study by Dr. Paul Segond. In 1879 he described “a pearly,

resistant, fibrous band” associated with an avulsion fracture at the anterolateral proximal tibia as a result of forced internal rotation of the knee.¹ This fracture was termed the “Segond fracture” and is considered pathognomonic for its association with anterior cruciate ligament (ACL) tears.^{2,3}

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Management of knee instability including ACL reconstruction is one of the most common orthopaedic procedures performed, with over 400,000 ACL reconstructions performed in North America annually.^{4,5} Recent biomechanical investigations suggest that reconstruction of the ALL may play an important role in knee stability; thus it is essential for surgeons managing knee instability to understand the structure and function of this ligament.⁶

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Since Segond’s first description of this structure, there have been numerous studies investigating the extra-articular ligamentous structures in and around the knee. Recently, the term “anterolateral ligament” of the knee has been used to describe this structure in a study by Vieira et al.⁷ Although the ALL has been investigated in a number of other studies, consensus regarding the exact

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structure and function of this ligament remains unclear. The purpose of this study was to systematically review the literature and describe the structure and function of the ALL. The hypothesis of this study was that the ALL contributes significantly to the stability of the knee and it can be clearly identified by anatomic dissection.

Methods

Identification of Studies

Two reviewers (L.V.d.W., M.K.) with methodologic and content expertise independently and in duplicate searched the Medline, Embase, and Cochrane databases for studies published up to and including August 10, 2014. The search strategy combined the following terms: anterolateral ligament, anterior lateral ligament, Segond fracture, lateral capsular ligament, and iliotibial tract. Medical Subject Headings and Emtree headings and subheadings were used in various combinations in Ovid and supplemented with free text to increase sensitivity. The search strategy was adapted in PubMed to include studies E-published ahead of print. Consultation with experts, hand searching of the references of eligible full-text articles, and use of the "related articles" feature in PubMed were all used to identify additional eligible studies. The abstracts from the past 3 years of 4 orthopaedic organizations' conferences were also searched: Canadian Orthopaedic Association; American Academy of Orthopaedic Surgeons; International Society of Arthroscopy, Knee Surgery & Orthopaedic Sports Medicine; and the European Society of Sports Traumatology, Knee Surgery and Arthroscopy.

Disagreement regarding data and study inclusion was resolved by discussion and consensus with a senior author (O.R.A.). Duplicate articles were excluded. A full-text review of selected studies was then performed. There were no articles requiring translation.

Assessment of Study Eligibility

Studies meeting the following inclusion criterion were included in this review: studies discussing the structure and/or function of the ALL. The exclusion criteria were as follows: (1) commentaries, (2) review articles, and (3) non-human studies. There were no restrictions regarding year of publication, type of study, or language.

Data Abstraction

Data were collected and recorded by one reviewer (L.V.d.W.) and verified by a second reviewer (M.K.) in a piloted computer spreadsheet program (Microsoft Excel 2013; Microsoft, Redmond, WA). The following data were abstracted from the included studies: authors, date of publication, type of study, sample size, mean age, name of ligament, purpose of study, incidence of ALL, and structure and function of ALL.

Assessment of Methodologic Quality

To our knowledge, no methodologic assessment tool is available for the evaluation of cadaveric studies. A scoring system, composed of evaluative criteria for ligament structure and function, was developed to assess the methodologic quality of the cadaveric studies ($n = 15$) using input from orthopaedic surgeons and research methodologists. As shown in [Appendix 1](#) (available at www.arthroscopyjournal.org), items are divided into 1 of 6 categories: (1) anatomy by dissection; (2) anatomy by imaging; (3) histology; (4) biochemical composition; (5) function, including biomechanical properties and clinical examination; and (6) methodologic quality. Because no individual study is likely to comprehensively examine parameters falling under all 6 categories, categorization of similar items allows comparison across studies that focus on one or a few categories.

Two reviewers (L.V.d.W., M.K.) independently assessed the methodologic quality of all included studies. Observational studies were evaluated with the Methodological Index for Non-Randomized Studies (MINORS), which was developed and validated by Slim et al.⁸ The ideal MINORS score is 24 for comparative studies and 16 for non-comparative studies. We graded all studies for the level of evidence according to the principles of evidence-based medicine.⁹

Data Analysis

All data abstracted from eligible studies were organized into a table (Microsoft Word; Microsoft). Descriptive statistics were calculated to reflect the frequency of outcome measures.

The κ statistic was used to examine interobserver agreement for study eligibility. On the basis of the guidelines of Cohen, a κ of 0 to 0.2 represents slight agreement; 0.21 to 0.40, fair agreement; 0.41 to 0.60, moderate agreement; and 0.61 to 0.80, substantial agreement. A value above 0.80 is considered almost perfect agreement.¹⁰

Interobserver agreement for methodologic quality assessment was calculated using the intraclass correlation coefficient (ICC). Both the κ and ICC were calculated using SPSS statistical analysis software (SPSS, Chicago, IL).

Results

Study Identification

Our initial electronic literature search identified 1,028 articles. Title and abstract review excluded 227 duplicates and 780 studies not related to the ALL. A full-text review and hand searching of the reference lists excluded 6 articles and identified 4 additional articles. Nineteen articles were included for final analysis ([Fig 1](#)). The κ statistic for overall agreement between

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