

# Anterolateral Ligament

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# What in the world...?

- TIME magazine in November 2013 stated:
  - “In an age filled with advanced medical techniques like MRIs, artificial hearts, and laser eye surgery, one could be forgiven for believing doctors are also at least vaguely familiar with every one of your body parts. However, a new discovery by Belgian physicians has proved this assumption wrong...two surgeons have located a new ligament in the human knee, and their findings may mean a revolution in how we treat ACL injuries.”

- Jacob Davidson, TIME



# The AnteroLateral Ligament

- Also called the ALL
- Is it new?
- What is the anatomy?
- What does it do?
- Will it change the way we treat ACL injuries?

## Current Concepts of the Anterolateral Ligament of the Knee

### Anatomy, Biomechanics, and Reconstruction

Matthew J. Kraeutler,<sup>\*†</sup> MD, K. Linnea Welton,<sup>†</sup> MD, Jorge Chahla,<sup>‡</sup> MD, PhD,  
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**AJSM 2017**

# Paul Segond

- French OB/GYN doctor in 1879 (who apparently also knew a little about the knee)
  - Described an avulsion fracture at the anterolateral proximal tibia—the “Segond” fracture
  - All orthopedic residents learn that this is pathognomonic for diagnosis of an ACL tear
  - Segond described that attached to this fracture was a “pearly, resistant, fibrous band which invariably showed extreme amounts of tension during forced internal rotation of the knee” (Claes, J Anat 2013)

# Vincent et al 2012 *Knee Surg Sports Traumatol Arthrosc*

- “Occasional references” to the ALL in the literature over the next 133 years
- Vincent, et al described the ligament and named it the anterolateral ligament in 2012
- TIME magazine attributed the “discovery” to Claes, et al—but they published in 2013 after detailing the anatomy of the ALL in a series of cadaveric knees (Kraeutler, AJSM 2017)

- Since then, numerous studies have been undertaken to examine:
  - Biomechanics
  - Function
  - Injury Pattern
  - Reconstruction

# Does it really exist?

- There is debate as to whether or not the ligament actually exists (Musahl, et al 2016)
  - Dissected 24 different species of animals and did not find the ALL in any
  - Dissected human cadavers and found an “ALL” in 30%
  - Noted that this structure mimics a fold in the capsule with internal rotation and has none of the biomechanics expected with a ligamentous structure
  - Other authors find an ALL in 12-100% of cadavers

# Sonnery-Cottet, et al

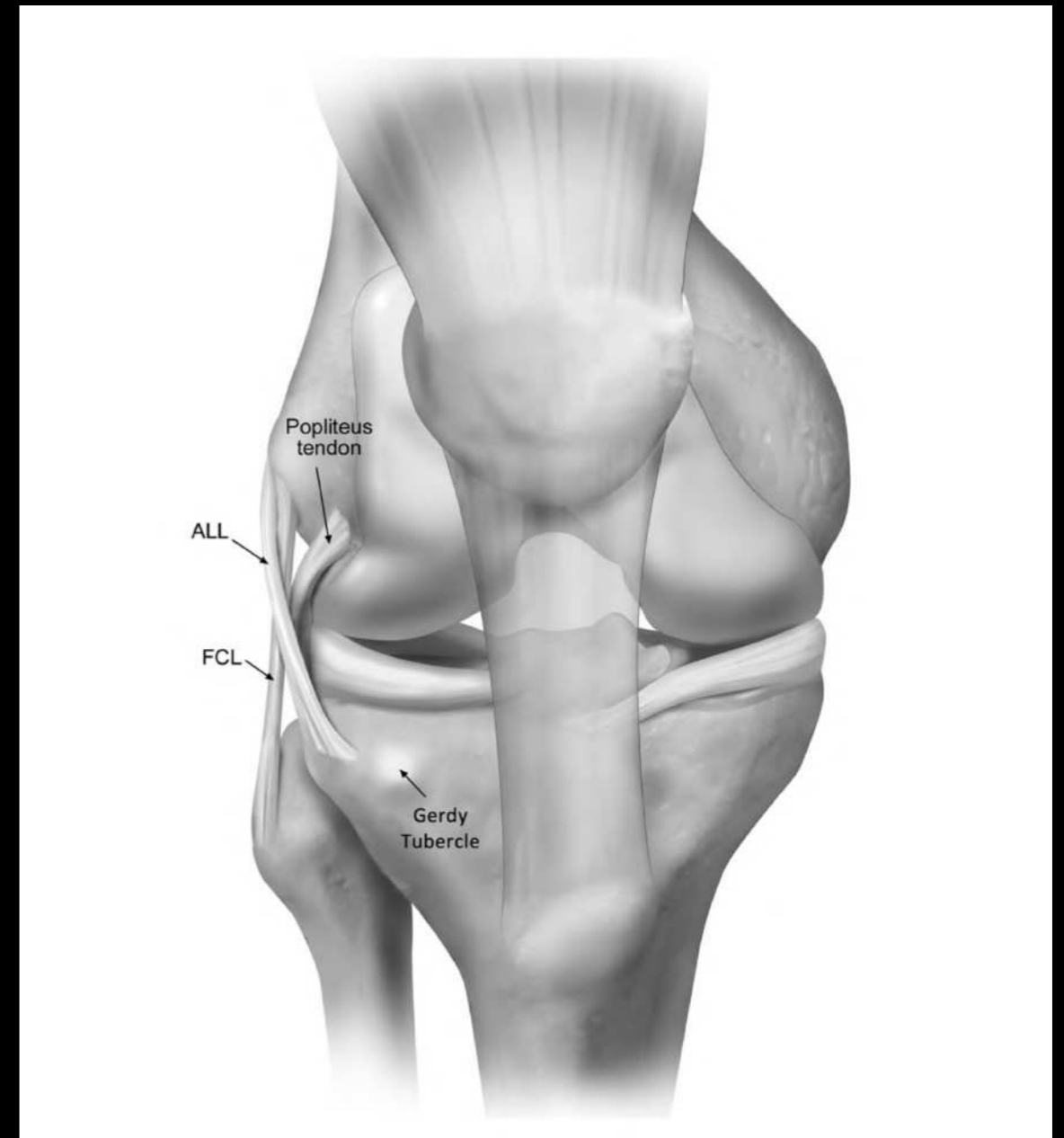
- Arthroscopy 2016
  - Challenged that there was indeed an ALL and that careful dissection and clear knowledge of anatomy reveals the ligament in all cases
  - Admitted that the subject required more scrutiny



# Anatomy

(Kraeutler et al, AJSM 2017)

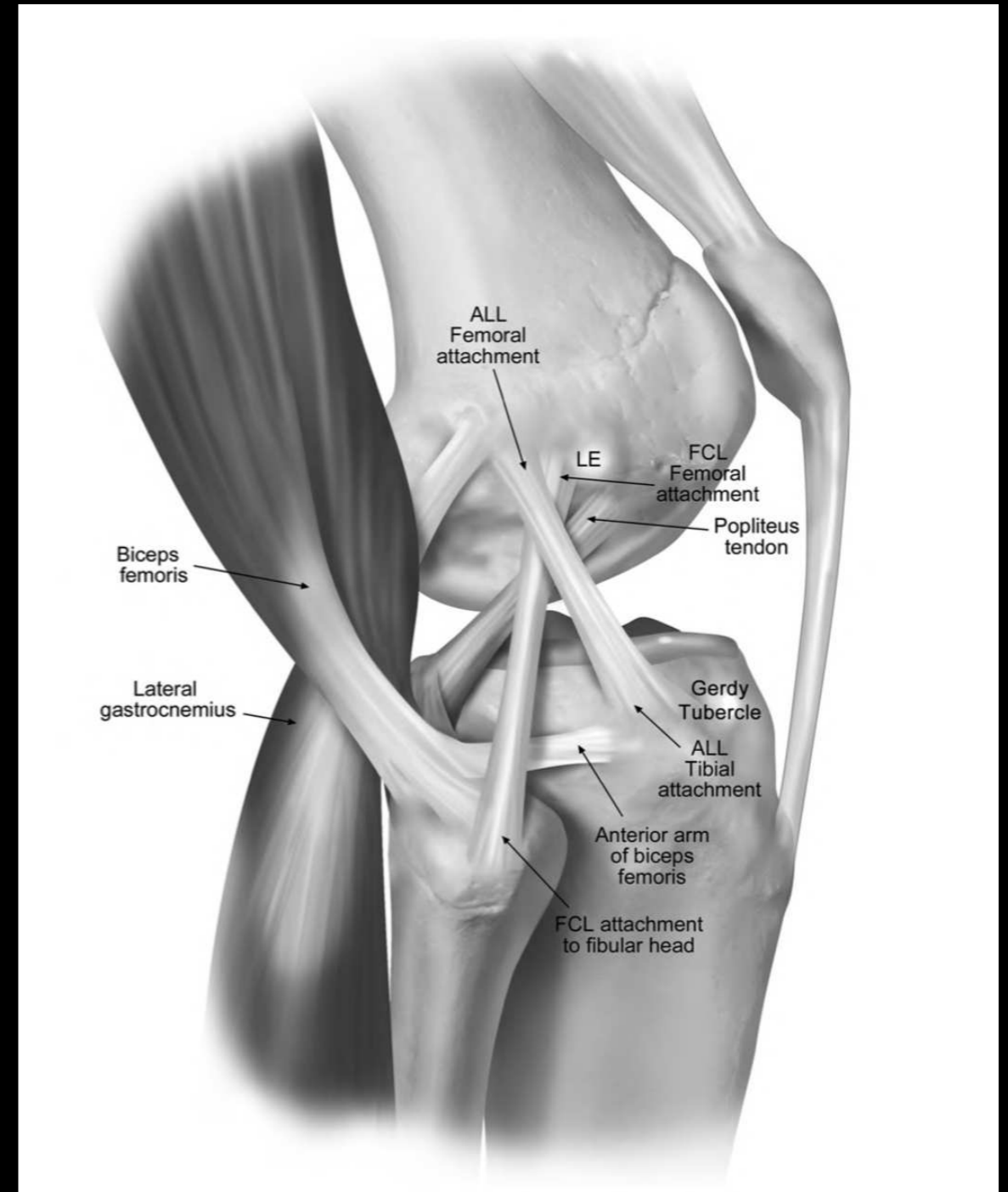
- Ligamentous structure that comes under tension at 30 degrees of IR
- Sometimes an actual structure vs bundles of tense capsular tissue
- Approximately 33-37 mm in length, 7.4 mm wide, 2.7 mm thick
- NOT isometric
  - Length increases with flexion and internal rotation



Kennedy et al AJSM 2015

# Anatomy

- Origin just posterior and proximal to the lateral epicondyle (or on the LE)
- Has deep connections to the lateral meniscus
- Inserts on tibia on average of 24.7 mm posterior to Gerdys tubercle and 26.1 mm proximal to anterior margin of fibular head
- 9.5 mm distal to joint line and just proximal to tibial insertion of biceps femoris



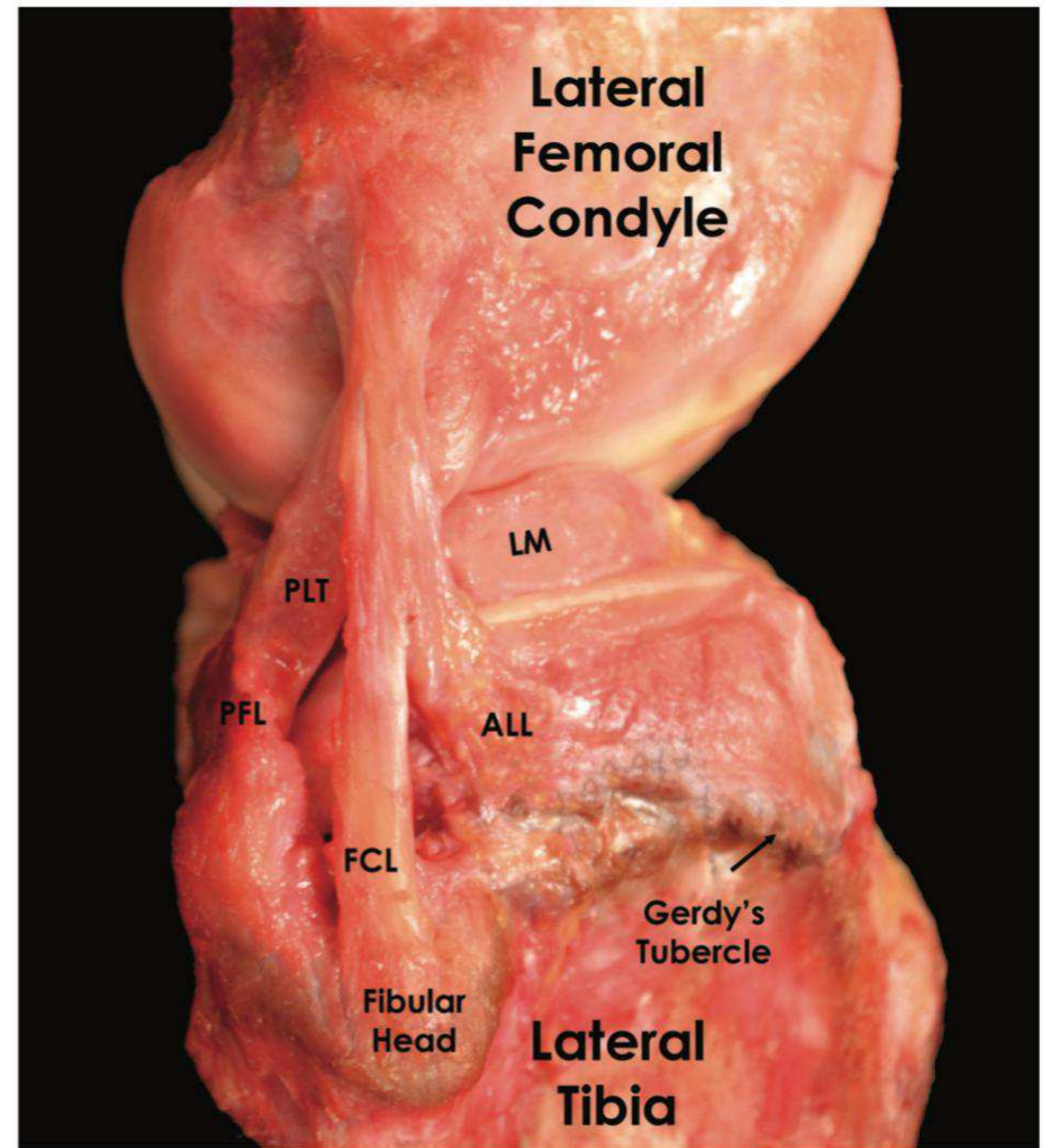
# Biomechanics

- Several studies have tested the biomechanics of the ALL
- Varying results:
  - Ultimate load to failure 50-205N
  - Stiffness of 20-42 N/mm
  - Ultimate strain 36%
- Failure: origin or insertion, midsubstance, or via avulsion (Segond)

# Function

(Kraeutler et al, AJSM 2017)

- Secondary stabilizer to ACL to prevent anterior translation, internal rotation, and pivot shift
- Some studies find more effect on these motions than others
- Most studies show increased IR and anterior tibial translation when sectioning the ALL in an ACL *deficient* knee, less or no effect if the ACL remains intact
- Contradicting studies exist
- Long term clinical effects of ALL deficiency are unknown



# ALL Injury

(Kraeutler et al, AJSM 2017)

- Ferreti et al, *Arthroscopy* 2016 examined injuries to the ALL in 60 pts undergoing ACL recon
  - Hemorrhage near anterior capsule (32%)
  - Hemorrhage to posterior capsule (27%)
  - Transverse tear near tibial insertion (22%)
  - Bony tibial avulsion (10%)
  - (So NOT ruptures off the femoral insertion)

# MRI

(Kraeutler et al, AJSM 2017)

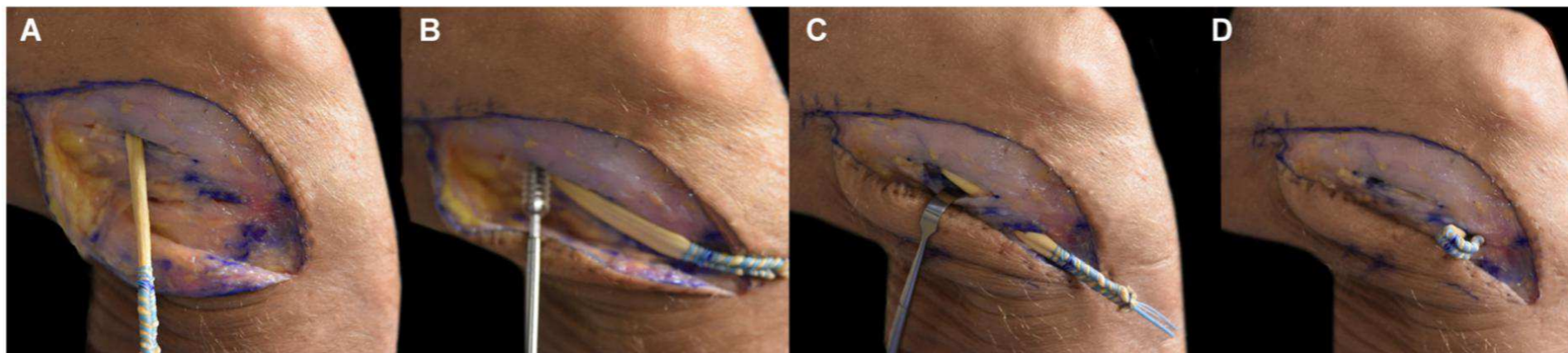
- Claes et al: MRI abnormalities in ALL in 78% of patients with ACL tear (most near tibial insertion)
- van Dyck et al: ALL abnormal in 46% of 90 knees with ACL tear
  - These patients also had increased lateral meniscal tears
- Pivot shift bone contusions: increased risk of ALL tear
- Several authors confirmed attachment of ALL on Segond avulsion fractures, leading some to call a Segond fracture an “ALL equivalent”

# Reconstruction

(Kraeutler et al, AJSM 2017)

- Indications: there is no absolute indication for ALL reconstruction, but a number of authors advocate ALL recon for elite athletes in pivoting sports, revision ACL reconstruction, patients with hypermobility
- Graft type: Not clearly defined. Gracilis is a common choice (auto or allograft). Gracilis vs native ALL: gracilis 6x stiffness and higher load to failure
- Location of fixation:
  - Tibia: midway between Gerdys tubercle and the anterior aspect of the fibular head
  - Femur: Most authors recommend posterior and superior to the LE, but some have alternative fixation points, as there is no clear origin on anatomic studies
- Fixation angle: ALL is NOT isometric, tighter in flexion than extension. Most authors tension in 30 degrees of flexion





**Figure 3.** Anterolateral ligament reconstruction sequence. (A) The graft is inserted into the femoral tunnel with the help of the previously placed passing suture and (B) secured with a 7 × 23-mm biointerference screw. (C) The graft is then passed between the superficial layer of the iliotibial band and fibular collateral ligament. (D) The graft is passed through the tibial tunnel and fixed in the tibial tunnel with a 7 × 23-mm biointerference screw on a left knee.



# Outcomes

(Kraeutler et al, AJSM 2017)

- Several older studies (prior to 2012) attempted to compare ACL recon alone with ACLR with extraarticular augmentation in an attempt to reduce internal rotation laxity and protect the ACL
- None of these studies proved that adding an extraarticular augmentation improved outcomes compared to ACL recon alone

# Sonnery-Cottet

(AJSM 2015)

- Retrospective series of 92 patients with 2 yr follow up after ACLR and ALL reconstruction
- Patients with chronic ACL tears, elite athletes, pivoting athletes, or a lateral femoral condyle sulcus sign
- Used ST-Gracilis autograft for ACL and remaining gracilis for ALL
- Mean follow up 32.4 mo
- Only one ACL failure (1.1%)
- Improvements in all measures (Lysholm, IKDC)
- All with negative or grade 1 pivot shift
- No control group, retrospective

# Conclusion

(Kraeutler et al AJSM 2017)

- ALL described first by Segond in 1879, but named by Vincent in 2012
- Originates near the LE and insert between the fibular head and Gerdys tubercle
- Biomechanical studies show the ALL is a secondary stabilizer to IR and anterior tibial translation
- Concurrent recon in cadaver studies shows improvements in ALL+ACL compared to ACL alone
- Graft type, location of fixation, angle, and clinical effect require future study before definitive recommendations can be given



