How to make new discoveries in (human) anatomy

OR

Can we develop predictive guidelines to help us make new anatomical discoveries?

Matt Wedel
Western University of Health Sciences, Pomona, California
Anatomy of the anterolateral ligament of the knee

Steven Claes, Evie Vereecke, Michael Maes, Jan Victor, Peter Verdonk and Johan Bellemans

1Department of Orthopedic Surgery & Traumatology, University Hospital Leuven, Leuven, Belgium
2Department of Development and Regeneration, Faculty of Medicine-KU Leuven, Catholic University Leuven, Kontich, Belgium
3Department of Orthopedic Surgery & Traumatology, University Hospital Gent, Ghent, Belgium
4Antwerp Orthopedic Center, Monica Hospitals, Antwerp, Belgium

Abstract

In 1879, the French surgeon Segond described the existence of a 'pearly, resistant, fibrous band' at the anterolateral aspect of the human knee, attached to the iliotibial band. The eponymous Segond fracture. To date, the existence of this structure has been widely accepted and studies of the anterolateral ligament (ALL) have been described both qualitatively and quantitatively. In all but a well-defined anatomic structure, clearly distinguishing the ALL was found to be the prominence of the lateral collateral ligament, although connecting fibrous structures were noted. This study showed that the ALL is an oblique band between the anterior aspect of the lateral femoral condyle and the posterolateral aspect of the tibia. The ALL is an important structure to control the knee's movement, although further studies are needed to confirm its function.

Key words: anatomy; anterior cruciate ligament; anterior lateral ligament; knee

Introduction

In 1879, years before the discovery of X-rays, Dr. Paul Segond described a remarkable constant avulsion fracture pattern at the anterolateral aspect of the knee, as a result of forced internal rotation at the knee (Segond, 1879). This eponymous Segond fracture was reported to occur in the tibial region 'above and behind the umbilicus of Genu'. At this anatomical location, the ALL is an oblique band between the anterior aspect of the lateral femoral condyle and the posterolateral aspect of the tibia. The ALL is an important structure to control the knee's movement, although further studies are needed to confirm its function.

Correspondence

Steven Claes, Department of Orthopedic Surgery & Traumatology, University Hospital Leuven, Volkswagenplatz 1, B-3000 Leuven, Belgium. E: steven.claes@uhlen.be

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Why, after centuries of careful study, are we still making new discoveries in human anatomy?

- Humans are complex; lots of stuff to find
- Not everything that gets found gets published
Filters to the publication of new discoveries

Palaeontology
- What gets fossilized
- What gets discovered
- What gets collected
- What gets prepared
- What gets published
Filters to the publication of new discoveries

**Palaeontology**
- What gets fossilized
- What gets discovered
- What gets collected
- What gets prepared
- What gets published

**Human anatomy**
- What gets preserved
- What gets noticed
- What gets recognized as possibly important
- What gets published
Why, after centuries of careful study, are we still making new discoveries in human anatomy?

- Humans are complex; lots of stuff to find
- Not everything that gets found gets published
Case Study 1:
Anterolateral ligament of the knee
A new knee ligament described this decade! (sorta)

“In 1879, years before the discovery of X-rays, Dr. Paul Segond described...‘a pearly, resistant, fibrous band which invariably showed extreme amounts of tension during forced internal rotation (of the knee)’.”

- Claes et al. (2013: p. 321)

Right knee in right lateral view (Claes et al. 2013: fig. 2)
Endoscopic knee surgery
Distractors: superficially similar structures in the same region

Anterolateral Ligament

lateral collateral ligament

Right knee in right lateral view

femur

patella

tibia

fibula
Distractors: superficially similar structures in the same region

Right knee in right lateral view

Anterolateral Ligament

lateral collateral ligament

1. joint capsule

femur

patella

tibia

fibula
Right knee in right lateral view

Distractors: superficially similar structures in the same region

1. joint capsule
2. iliotibial tract

- Anterolateral Ligament
- Lateral collateral ligament
- Patella
- Femur
- Tibia
- Fibula
Why wasn’t the anterolateral ligament of the knee recognized sooner?

- Anatomically complex region
- Rarely dissected completely
- Known distractors in the same area
Case Study 2:
Pararecurrent nerve
(recurrent pharyngeal nerve)
Neck viscera in right lateral view
Neck viscera in left lateral view
Neck viscera in left lateral view
Innervation of the larynx and trachea in a dog, modified from Lemere (1932: fig. 1)
Innervation of the larynx and trachea in a dog, modified from Lemere (1932: fig. 1)

recurrent laryngeal N (to larynx only)
Why wasn’t the pararecurrent nerve in humans recognized sooner?

- Anatomically complex region
- Rarely dissected completely
- Known distractors in the same area
Case Study 3:
Long cutaneous branch of the obturator nerve
MOST COMMON PATTERN

- femoral nerve
- cutaneous branch of the obturator nerve
- saphenous branch of the femoral nerve (typically 2)
Left lower limb in anteromedial view
cutaneous branch of obturator N

femoral vein

femoral artery

femoral nerve

great saphenous vein
Left lower limb in anteromedial view
2014

Case

obturator nerve

femoral artery

femoral nerve

cutaneous branch of obturator N
cutaneous branch of obturator N

saphenous branch of femoral N
MOST COMMON PATTERN

- femoral nerve
- cutaneous branch of the obturator nerve
- saphenous branch of the femoral nerve (typically 2)

NEWLY-DISCOVERED VARIATION

- femoral nerve
- cutaneous branch of the obturator nerve
- saphenous branch of the femoral nerve

great saphenous vein
great saphenous vein

Coronary Artery Bypass Graft (CABG)
Endoscopic vein harvesting

Elalfy et al. (2015: fig. 2)
MOST COMMON PATTERN

- femoral nerve
- cutaneous branch of the obturator nerve
- saphenous branch of the femoral nerve (typically 2)

NEWLY-DISCOVERED VARIATION

- femoral nerve
- cutaneous branch of the obturator nerve
- saphenous branch of the femoral nerve
Why wasn’t the long obturator nerve recognized sooner?

• Challenging, fragile structure

• Rarely dissected completely

• Known distractors in the same area
Places to look for new discoveries in (human) anatomy

• Complex regions that are rarely dissected fully
  – joints, distal tendon insertions, nerve plexes
• Recent evolutionary changes from close relatives
  – e.g., pararecurrent nerve
• Opportunities for “replaced” structures
  – blood vessels, nerves (especially cutaneous nerves)

These principles probably work at least as well for non-human organisms as they work for humans!
Places to look for new discoveries in (human) anatomy

• Talk to surgeons (or other morphologists), ask them what they’ve seen that they didn’t expect
• Get to know the literature and look where no-one else is looking
Alamosaurus sanjuanensis
BIBE 45885
Caudal neural arch height 99mm

Astrophocaudia slaughteri
SMU 61732
Caudal 14 height 198mm
"I am firmly convinced that the best book in medicine is the book of Nature, as writ large in the bodies of men. You remember the answer of the immortal Hunter, when asked what books the student should read in anatomy – he opened the door of the dissecting-room and pointed to the tables."

— Sir William Osler, 1901

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