QUADRICEPS-HAMSTRINGS RATIO & ITS RELATION TO ACL INTEGRITY: A CADAVER STUDY

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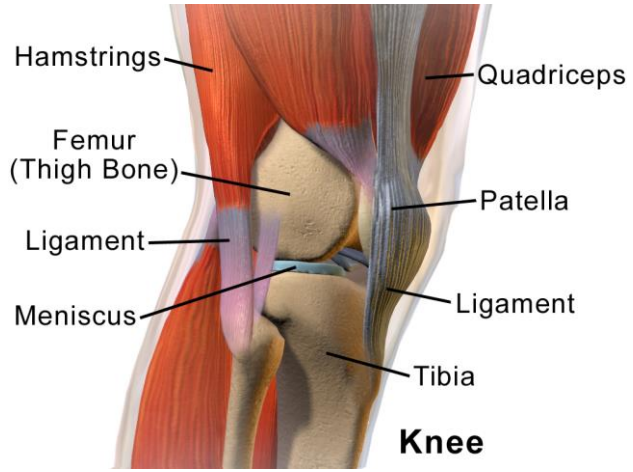
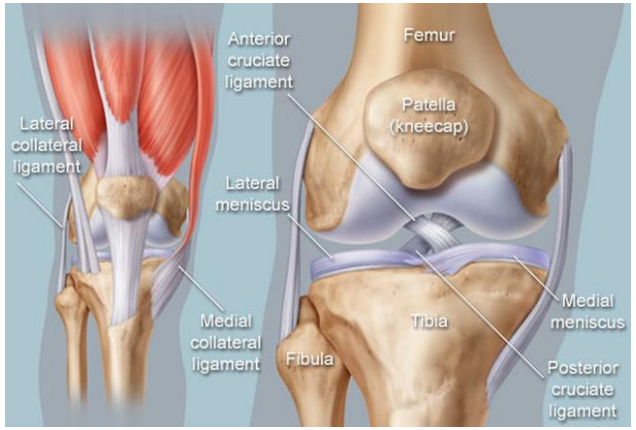
MEDICAL TERMINOLOGY 101

- Anterior/Posterior
- Flexion/Extension
- Adduction/Abduction
- Internal/External Rotations
- Proximal/Distal
- Origin/Insertion
- Midline
  - Medial/Lateral
- Muscle groups
  - Quadriceps
  - Hamstrings



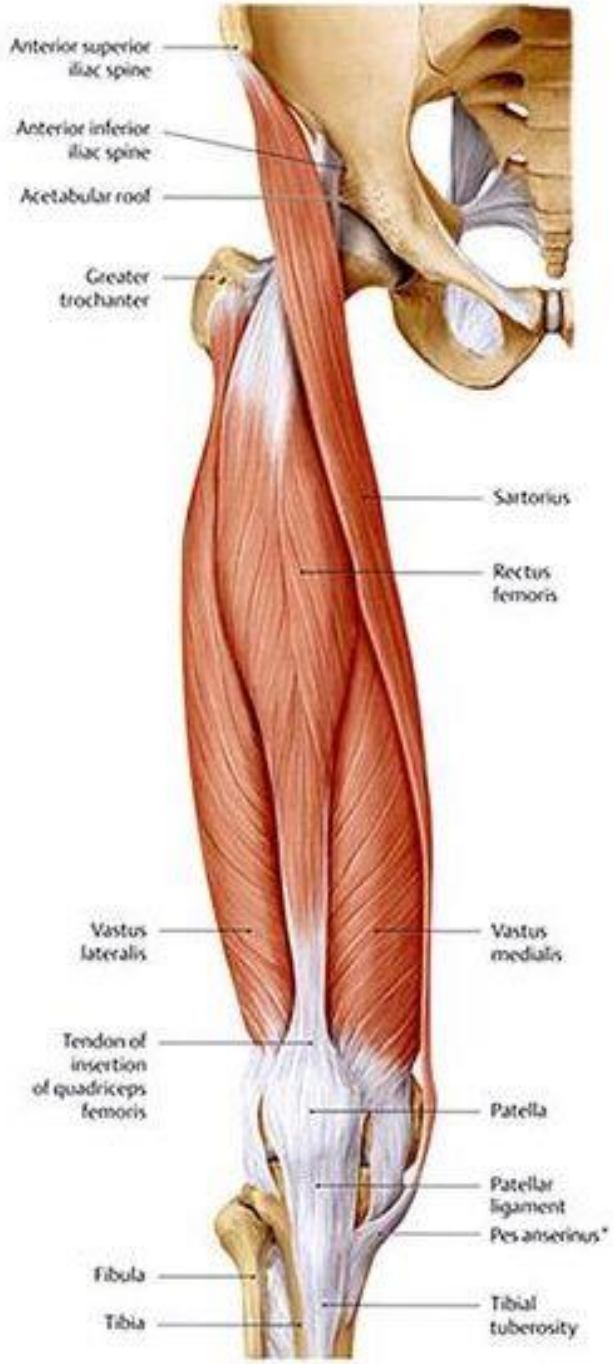


PRIMARY STRUCTURES

- Hinge Joint
- Bones
- Quads and Hamstrings
- 4 Ligaments
- Gastrocnemius

MUSCLES

- Primary: Quads vs Hamstrings (Partially gastrocnemius)
  - 2:1 ratio[1]
- Secondary: Hip abductors, foot supinators



ACL & ITS JOB

- Prevents anterior translation of the lower leg
- Also assists in the Screw Home Mechanism

RISKS OF DEVELOPING INJURY

- 250,000+ each year
- 70% noncontact injuries.
- Robert Lee Griffin III

-Hip adduction

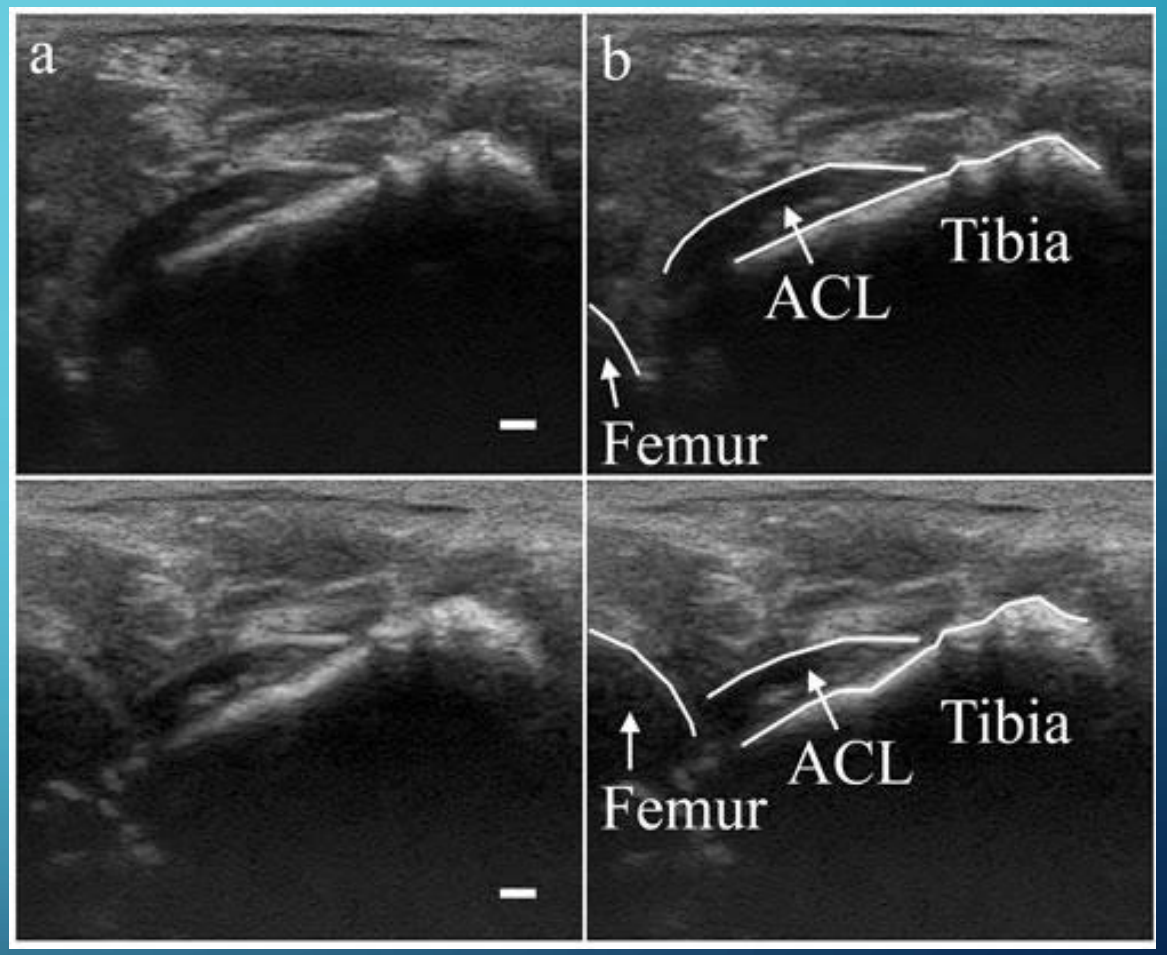
-Valgus knee collapse

-Excessive pronation

- Women 10x[7]
- Q Angle ASIS

WAYS TO EVALUATE AN ACL

- Lachman's Test & Anterior Drawer Test
- Grade types
- MRI
- Ultrasound (Full knee flexion)
  - Diameter at tibial insertion



WHY DOES DIAMETER MATTER?

Small Cross Sectional Area (CSA) = High risk of injury

Should we rely solely on ligaments?

HYPOTHESIS

- If cadavers have ≤2:1 quadricep-hamstring ratio then the ACL will have a larger cross-sectional area because the muscles are at a closer balance to each other.

HOW CAN THIS THEORY BE TESTED IN CADAVERS?

- **“The power that a muscle can produce is directly proportional to its volume.”** (4)
  - Dissect primary muscles of the knee.
- Cadavers allowed for controlled and precise measurements.

SAMPLE GROUP

- 6 cadavers
  - 3 male, 3 female
  - One leg of each cadaver was used
    - 4 quadriceps muscles
    - 3 hamstring muscles
    - 1 ACL

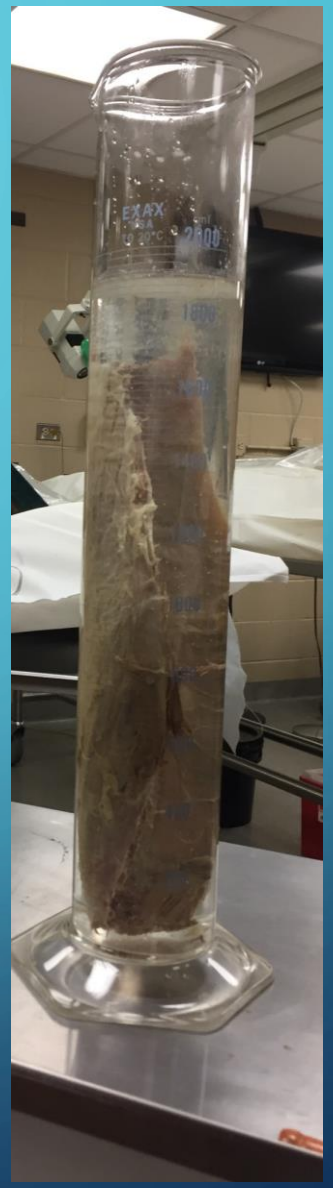
METHODS

- Special Tests
  - Anterior Drawer & Lachman's
- Q-Angle
- Circumference

METHODS (CONT.)

Volume Displacement

- 1 mL = 1 gram
- 2 L graduated cylinder
- Final - Initial = Displacement
  - Ex: 1920-1700 = 220 mL
    - 220 mL = 220 g

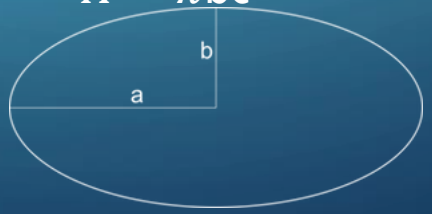


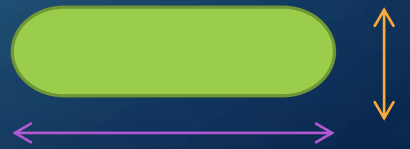
METHODS (CONT.)

- ACL Measurements
  - ACL's were removed from cadaver at the origin and insertion
  - Most medial portion was measured using electronic calipers in mm.

Area of an ellipse:

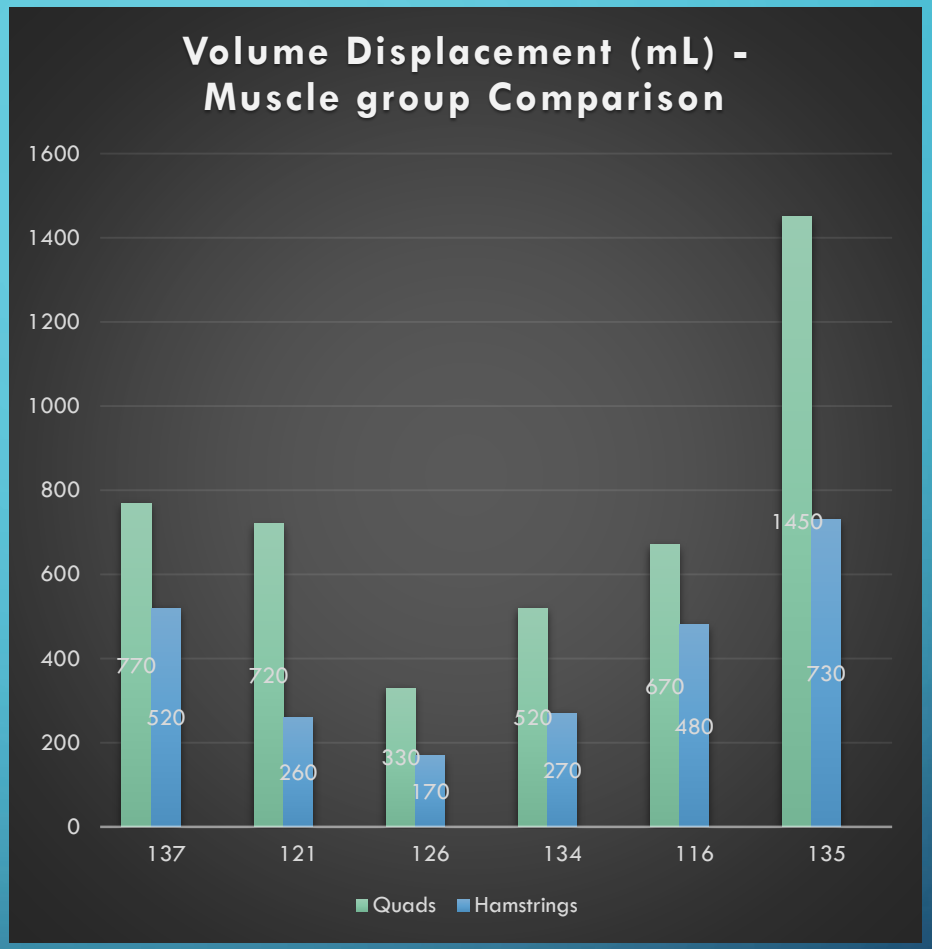
$A = \pi bc$





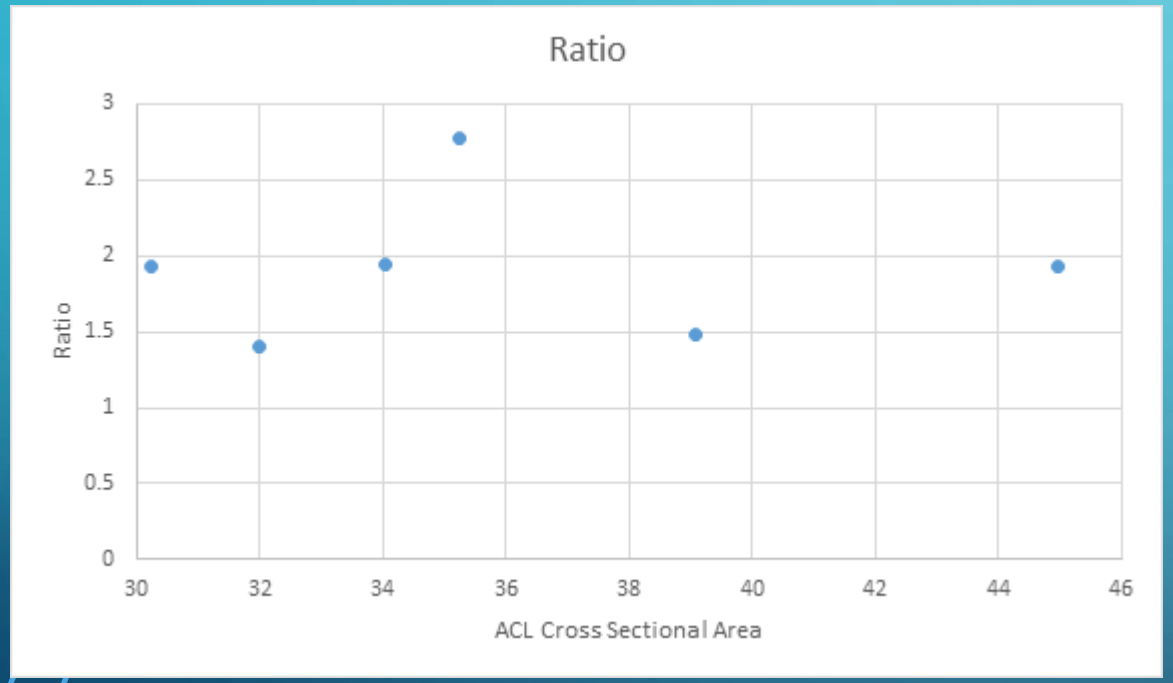
RESULTS

- $Ratio = \frac{\sum Quadriceps}{\sum Hamstrings}$
- A muscle ratio greater than 1:1 was found in all cadavers, with all ratios favoring quadriceps.



Cadaver #	Ratio
137	1.48
121	2.77
126	1.94
134	1.93
116	1.40
135	1.99

RESULTS (CONT.)



- We could then relate the mass of each muscle group to its ACL CSA to see if there was a correlation.

WHY DOES IT MATTER?

- Athletics
- Personal Health
- Strength training & prevention
  - Education
  - Awareness

THANK YOU!

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INJURY

- Hamstring prevent anterior tibial translation.
  - Weak Hamstrings/Slow Firing= Injury occurs.
  - Usually occurs at 30 degrees of knee flexion

  - After injury
    - Quadriceps function lowers 3 times more than the hamstrings.
    - Why does this happen? Which do we strengthen?