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 quadriceps-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
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

- \( \text{Ratio} = \frac{\sum \text{Quadriceps}}{\sum \text{Hamstrings}} \)

- A muscle ratio greater than 1:1 was found in all cadavers, with all ratios favoring quadriceps.
• 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!
REFERENCES


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?