Knee Biomechanics

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Knee Articulations

- Patellofemoral
- Medial
tibial plateau/femoral condyle
- Lateral
tibial plateau/femoral condyle
Range of Motion

- Flexion/Extension
- Internal and External rotation
- Abduction/Adduction
Ligaments and Their Function

- ACL
- PCL
- MCL
- LCL
- Others?

- Stabilize
- Control normal kinematics
- Prevent abnormal displacement and rotation
  - Static Stabilizers
  - Act in concert
Anterior Cruciate Ligament

- Two Bundles
  - AMB
    - 60-90 degrees
  - PLB
    - 30 degrees
    - Int/Ext rotation
ACL Mechanism of Injury

- Anterior tibial force
- Internal tibial torque
  - Near full extension
- Valgus moment
  - Near full extension
ACL Testing

- Anterior Drawer
- Lachman
  - More strain/elongation of ACL
ACL Rehabilitation

- **Quadriceps**
  - 60-90 degrees
    - No sig strain
  - 15-30 degrees
    - Sig force
- **Gastrocnemius**
  - 5-15 degrees > 30-45 degrees
- **Open vs Closed Kinetic Chain**
PCL and Posterolateral Corner

- **PCL**
  - Exam at 90 Degrees
  - Posterior tibial force
    - Varus Moment
- **PLC**
  - Arcuate Ligament
  - Popliteus
  - Exam at 30 Degrees
Medial and Lateral Collateral Ligaments

- How to examine?
- Secondary restraints
  - More active in extension
    - Joint capsule
    - Cruciates
Meniscal Cartilage

- Originally
  - Vestigial Structure
  - No function
  - Expendable

- 1970’s Biomechanical Studies
  - 30-99% force
  - Contact pressure
    - Linear correlation with % removed
Meniscus Function

- Absorb energy
- Reduce impulsive shock loading
- Contribute to stability
  - Varus/Valgus
  - Rotational
  - Translational
- Lubrication
Patellofemoral Joint

• Contact Area
  - Moves inferior to superior
    ▪ From extension to flexion
    ▪ Initiated at 10 degrees

• Forces
  - FPT > Fquad
    ▪ 0-45 degrees
Patellofemoral Joint Forces

- **Rehabilitation**
- **PFS**
  - Quad exercises
  - Start 15-20 degrees
- **Patellar Tendinosis**
  - Avoid 0-45 degrees

Walking (0.5xBW)  Stairs (3.5x BW)  Squat (6.5x BS)

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Force ratio:
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\frac{F_{PT}}{F_{Quads}}
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Knee flexion angle

Walking (0.5xBW)  Stairs (3.5x BW)  Squat (6.5x BS)
Patellofemoral Joint
Anatomic Considerations

- Hypoplasia of Trochlear Groove
- Abnormal Patellar Articular Configuration
- Underdeveloped VM
- Q angle