The Posterior Cruciate Ligament

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Disclosures

• I have no disclosures relevant to this topic.

Outline

1. PCL - Basic Science, Anatomy, Physiology
2. PCL pathology
3. Classification
4. Clinical Evaluation
5. Imaging
6. Management
7. Review of evidence
PCL Basic Science

- Intra-articular, extrasynovial ligament
- Blood supply primarily from middle geniculate artery
- Nerves from popliteal plexus
  - Ruffini corpuscles (pressure receptors)
  - Vater-Pacini corpuscles (velocity receptors)
  - Free nerve endings (pain receptors)
  - Golgi tendon structures (proprioception)
- Primary restraint to posterior tibial translation

PCL Anatomy

- Originates on medial femoral condyle & inserts on posterior tibia.
- 11-13 mm² in area at midpoint
- Continuous band of fibers
  - 2 functional "bundles"
    - Anterolateral - most of bulk; tight in flexion
    - Posteromedial - tight at 30°

PCL Anatomy - Femur
PCL Anatomy - Tibia

PCL Anatomy

PCL - Physiology

- Primary restraint to posterior tibial translation
  - Sectioning increases posterior translation 8-10 mm

- Secondary restraints
  - Posterior lateral corner structures
  - Posterior capsular structures
  - MCL

- Secondary restraint to ER of tibia & varus stress

- Non-isometric!
PCL Pathology

- Mechanism of injury
  - Pre-tibial trauma
  - Hyperflexion
  - Hyperextension

- Schultz et al. Arch Orthop Trauma Surg 2003:
  - 45% from MVC
  - 40% sports related
  - 15% other activities
  - 47% sustained other knee ligament injuries

Pathology

- Mechanism of Injury – Pre-Tibial Trauma
  - “Dashboard Injury”
  - Typically knee flexed with posterior force on proximal tibia
  - Can also be sports injury - fall directly onto tibial tubercle with ankle plantarflexed

Pathology

- Mechanism of Injury – Hyperflexion
  - Most commonly sports related injury
  - Increased tension in AL bundle w/ flexion
  - Impingement of PCL on notch in flexion

Pathology
Pathology

• Mechanism of Injury - Hyperextension
  o Usually proximal disruption of PCL
  o Commonly associated w/ other knee pathology
    • ACL
    • Knee dislocation
    • Neurovascular injury

Classification

• Acute vs chronic
• Isolated vs Multi-ligament
• Grading
  o Classical ligament grading
    • Grade 1
    • Grade 2
    • Grade 3
  o Based on posterior drawer exam - amount of posterior translation
    • Does not correlate with classical ligament grading

Clinical Evaluation

• History
  o Do not feel pop
  o Often minimal effusion
  o Able to ambulate
  o No sense of instability
  o Chronic injuries
    • Often functional & active
    • C/o Pain
    • Develop PF & medial arthritis
    • Instability & meniscal injury rare
Clinical Evaluation

• Posterior Drawer
  - Most sensitive
  - Grading – translation, not degree of tear
    • Grade 0 –
      - Tibia sits anterior to femur ~ 10 mm
    • Grade I –
      - ~ 5 mm of posterior translation
      - Tibia still anterior to femur ~ 5 mm

Clinical Evaluation

• Posterior Drawer
  • Grade II –
    - Up to 10 mm posterior translation
    - Tibia flush with femur
  • Grade III –
    - > 10 mm posterior translation
    - Indicates injury to secondary restraints!

Clinical Evaluation

• Posterior Sag
  - Graded similar to posterior drawer
  - Normal tibia sits ~ 1 cm anterior to femur
Clinical Evaluation

• Check other ligaments!
  o Near 50% of PCL injuries occur in multi-ligament injuries
  o Quadriceps active test can be useful in combined ACL/PCL injury

Imaging

• Plain Films – standard knee films
  o Avulsion fractures
  o Tibial Sag/Lateral
  o Stress radiographs
  o Chronic injuries – PF & medial arthritis

• MRI
  o 99% accurate in acute setting
  o Also can detect other ligament injuries
  o Can be misleading in chronic injuries

Natural History

• Controversial – the good

  • Shelbourne et al. AJSM 1999
    o 133 acute isolated PCL injuries followed for 5 yrs
    o Majority had good subjective results & 50% able to return to sport

  • Parolie & Bergfeld. AJSM 1986
    o 25 isolated PCL injuries followed for 6 yrs
    o 80% satisfied w/ knee fun; 84% return to sport
    o Unsatisfactory results correlated w/ decreased quad strength
Natural History

• Controversial – the bad

• Keller et al. AJSM 1993
  o 40 isolated PCL injuries followed for 6 yrs
  o 90% persistent knee pain, 65% states limited activity, 45% could not walk

• Dejour et al. Fr J Orthop Surg 1988
  o Long term study of 56 PCL deficient knees in France
  o 89% had persistent pain at 15 yrs & 50% chronic effusions
  o All had degenerative changes at 25 yrs

Patients with isolated PCL tears may maintain excellent strength but significant symptoms and degenerative changes increase with time.

Operative Treatment

• Indications
  o Acute PCL bony avulsion
  o Multiligament knee injury
  o Failed conservative treatment

• Controversies
  o Tibial inlay vs arthroscopic
  o Graft choice

• Surgical treatment not as reliable as ACL reconstruction

Tibial Inlay

• Advantages
  o Avoids “killer turn”
  o Graft secured to bony ridge on Tibia
  o Causes straight shot to femoral tunnel

• Disadvantages
  o Posterolateral
  o Proximity of Neurovascular structures to operative field
Tibial Inlay

- **Biomechanical Studies - cadavers**
  - No difference in stability at time of initial fixation
  - Inlay procedure had less attenuation & decreased failure after cyclic loading

- **Clinical Studies - real patients**
  - 3 comparative studies and one meta-analysis comparing multiple single technique studies
  - No differences in surgical outcomes with respect to patient reported outcomes or laxity

  - Bergfeld et al., *AJSM* 2001
  - Markolf et al., *JBJS* 2002
  - McAllister et al., *AJSM* 2002
  - MacFillivray et al., *Arthros* 2006
  - Kim et al., *JBJS* 2009.
  - Seon & Song, *Arthros* 2006
  - May et al., *J Knee Surg* 2010

Technical Tips

- Use 70° arthroscope to prepare tibial footprint
- Use postero-medial portal to facilitate retraction, clearing of tibial footprint, and occasionally to view.
- Use fluoroscopy to evaluate & confirm appropriate tibial tunnel placement (low on facet to try to avoid “killer turn”)

Technical Tips

- Femoral tunnel should be high (~1:00 position) and just off the articular cartilage.
- Use fluoroscopy to place tibial screw fixation as far into the tunnel as possible to limit eventual graft attenuation.
Post Op

- NWB for 6 weeks in brace
- Limit ROM 0-30 for first 2 weeks
- Progressive increase in ROM w/ goal of 90 by week 4-6 & 120 by week 18-10
- Limit active hamstring exercises in first 6 weeks.

Outcomes

- Multiple Studies
- Patient reported outcomes improve significantly from pre-op
- Not reliably back to pre-injury status
  - Tegner decreased from 7.2 pre-injury to 5.7 at final follow-up in one study.
- Persistent residual laxity common
  - Mean side to side differences in posterior translation range from 4.1-5.7
  - Systematic Review by Kim et al. AJSM 2011 concluded that patients can expect to achieve 1 grade improvement in posterior knee laxity
- Reconstruction does not necessarily prevent OA

Thank You!