The Posterior Cruciate Ligament

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Disclosures

- I have no disclosures relevant to this topic.

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Outline

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

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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

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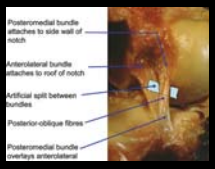
PCL Anatomy

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

Average Surface Area (in mm^2) of the Posterior Cruciate Ligament Attachments to the Femur and Tibia

	Overall	Anterolateral Bundle	Posteromedial Bundle
Femur	209 ± 33.82	118 ± 23.86	90 ± 16.13
Tibia	243 ± 38.2	93.1 ± 16.6	150.8 ± 31.0

Voos et al. AJSM 2012



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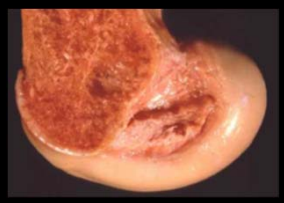
PCL Anatomy - Femur



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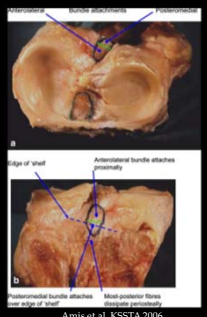
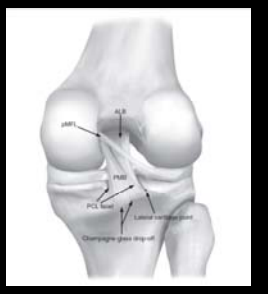
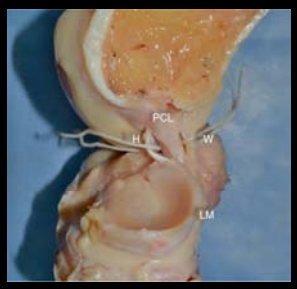
PCL Anatomy - Tibia





Amis et al. KSSTA 2006

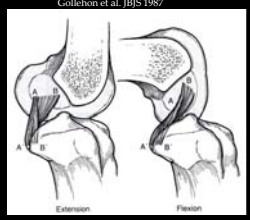
PCL Anatomy



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!

Gollehon et al. JBJS 1987

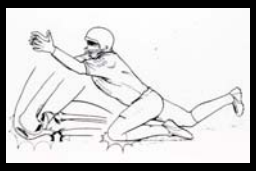


PCL Pathology

- 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 inuries

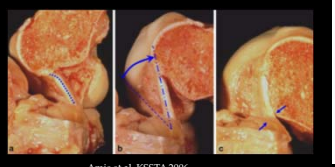
Pathology

- 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



Amis et al. KSSTA 2006

Pathology

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

Classification

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

Clinical Evaluation

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

Clinical Evaluation

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

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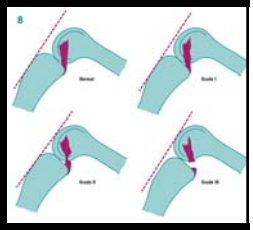
Clinical Evaluation

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



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Clinical Evaluation

- Posterior Sag
  - o Graded similar to posterior drawer
  - o Normal tibia sits 1 cm anterior to femur

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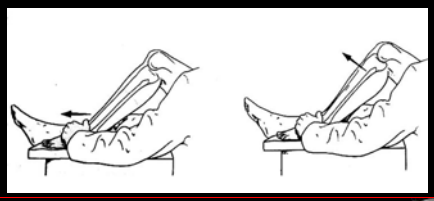
Clinical Evaluation

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



Imaging

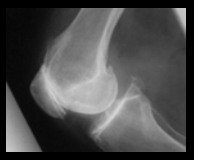
- Plain Films – standard knee films
  - Avulsion fractures
  - Tibial Sag on lateral
  - Stess radiographs
  - Chronic injuries – PF & med arthrosis
- MRI
  - 99% accurate in acute setting
  - Also can detect other ligament injuries
  - Can be misleading in chronic injuries

Natural History

- Controversial – the good
- Shelbourne et al. AJSM 1999
  - 133 acute isolated PCL injuries followed for 5 yrs
  - Majority had good subjective results & 50% able to return to sport
- Parolie & Bergfeld. AJSM 1986
  - 25 isolated PCL injuries followed for 6 yrs
  - 80% satisfied w/ knee fxn; 84% return to sport
  - Unsatisfactory results correlated w/ decreased quad strength

Natural History

- Controversial – the bad



- Keller et al. AJSM 1993
  - 40 isolated PCL injuries followed for 6 yrs
  - 90% persistent knee pain; 65% states limited activity; 43% difficulty walking
- Dejour et al. Fr J Orthop Surg 1988
  - Long tern study of 36 PCL deficient knees in France
  - 89% had persistent pain at 15 yrs & 50% chronic effusions
  - 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.

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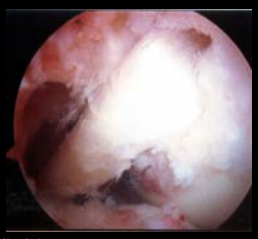
Operative Treatment

- Inidcations
  - Acute PCL bony avulsion
  - Multi-ligament knee injury
  - Failed conservative treatment



- Controversies
  - Tibial inlay vs arthroscopic
  - Graft choice
- Surgical treatment not as reliable as ACL reconstruction

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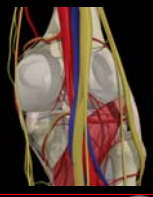
Tibial Inlay

- Advantages
  - Avoids "Killer Turn"
  - Graft secured to trough on Tibia
  - Creates straight shot to femoral tunnal
- Disadvantages
  - Prone Positioning
  - Proximity of Neurovascular structures to operative field



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Tibial Inlay

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

Bergfeld et al. AJSM 2001
Markolf et al. JBJS 2002
McAllister et al. AJSM 2002

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

MacFillivray et al. Arthros 2006
Kim et al. JBJS 2009.
Seon & Song. Arthros 2006
May et al. J Knee Surg 2010

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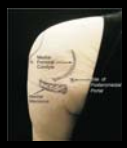
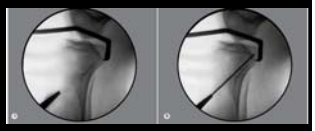
Technical Tips

- 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")





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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.

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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.

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Outcomes

- Multiple Studies
- Patient reported outcomes improve significantly from pre-op
- Not reliably back to pre-injury status
  - Tegner decreased from 7.2 pre-injry to 5.7 at final f/up in one study.
- Persistent residual laxity common
  - Mean side to side differences in posterior translation range from 4.1-5.7
  - Systemic 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

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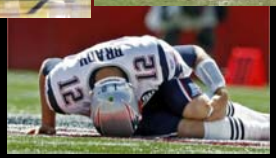
Thank You!







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