Hot topics in PCL reconstruction
1. **Vascular anatomy** and how to avoid injury
2. **Peroneal nerve anatomy** and how to avoid injury
3. **Residual laxity** and how to avoid
4. **Native ligament anatomy** - Tunnel Placement 101
5. **Technical controversies** - # of tunnels, inlay vs transtibial, graft choices
6. **Understanding concomitant malalignment**

Vascular Anatomy
and
How to avoid Injury
Neurovascular Injury

- Principle concern!
  - Posterior N/V structures
    - Popliteal A
    - Tibial N
    - Saphenous V/N
  - Posterolateral structures
    - Peroneal nerve

Posteromedial Portal – PCL

Safe Zone to avoid Saphenous N/V
- Superior and posterior to equator of MFC
- At least 2 cm above joint line, as posterior as possible

Posterior (Popliteal) Protection

- Distance between PCL insertion and Popliteal Artery greatest in knee flexion (100 degrees)
  - 9.9 mm (axial)
  - 9.2 mm (sagittal)

- Tips to maximize distance
  - Limited capsular release
  - Safety incision between MH gastroc and posterior capsule
  - Low medial wall notchplasty, P-M cannula, 70 deg scope
  - Stay anterior to PCL stump!
Other pearls to prevent popliteal artery injury

- Spade tip drill bit
  - (rather than trochar tip)
- Tapered drill bit
- Oscillating drill

=> Advance the drill bit by hand, under scope and/or flouro visualization

Peroneal Nerve Anatomy
and
How to avoid Injury
Peroneal Nerve Protection

- High risk during knee dislocation
  - Tethered to back of fibula

- Nerve is best isolated proximally, released distally

- Isolate with penrose unclamped

Must identify and protect through case:

Residual Postoperative Laxity
and
How to avoid
Residual Posterior Instability

#1 complication of PCL reconstruction

1) diagnostic error
2) technical error

Diagnostic Errors

• Diagnostic error #1 ➠ missed concurrent PLC
  – Results in higher stress on PCL (ER @ 30°, 90°)
  – Tibial insertion rotates Medially & Anteriorly
    • Results in shortened ligament distance
      – Ultimately results in functional laxity

• Diagnostic error #2 ➠ varus mal-alignment
  – Lateral thrust ➔ increases stress across PCL/PLC
  – HTO can be used as to correct this

Physical Exam: Specific, but not Sensitive:

<table>
<thead>
<tr>
<th>Technique</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior drawer</td>
<td>0.33-0.70</td>
<td>0.90</td>
</tr>
<tr>
<td>Posterior sag</td>
<td>0.50-0.80</td>
<td>0.90</td>
</tr>
<tr>
<td>Quadriceps action</td>
<td>0.33-0.70</td>
<td>0.90-1.00</td>
</tr>
<tr>
<td>Supplemetal tests</td>
<td>0.33-0.70</td>
<td>0.90</td>
</tr>
<tr>
<td>Internal rotation resistance test</td>
<td>0.20-0.30</td>
<td>0.90</td>
</tr>
<tr>
<td>Reverse pivotshift test</td>
<td>0.05-0.26</td>
<td>0.95</td>
</tr>
<tr>
<td>Varus-valgus at 9°</td>
<td>0.20-0.30</td>
<td>0.90</td>
</tr>
<tr>
<td>Varus at 20°</td>
<td>0.00-0.10-1.00</td>
<td>No data</td>
</tr>
<tr>
<td>Valgus at 30°</td>
<td>0.00-0.10-1.00</td>
<td>No data</td>
</tr>
<tr>
<td>Dial test</td>
<td>0.00-0.30</td>
<td>0.90</td>
</tr>
</tbody>
</table>

*Adapted from Kaplir et al.16
Technical Errors

- Inadequate graft size
- Inadequate graft fixation
- Inappropriate tensioning
- Inaccurate tunnel placement → graft abrasion and failure

Technical Errors

- Overly aggressive early rehab → graft failure
- Posterior capsulotomy (via tibial inlay) → additional posterior translation

PCL Reconstruction Outcome:

- Grade I/II posterior drawer at follow-up acceptable
  - compare to opposite knee

- Etiology of Failure often Multifactorial →
  - 40% associated PLC
  - 33% improper tunnel placement
  - 31% associated varus alignment
Native PCL Anatomy

Tunnel Placement 101

Pertinent PCL anatomy

• 32-38 mm in length, CSA 11mm² (midpoint)
• AL bundle larger than PM bundle
• Tibial attachment → anatomic facet
  posterior tibia 1-1.5 cm distal to joint line
Native PCL Anatomy - Tunnel Placement 101

Technical PCLR controversies

PCLR controversies

- Double versus Single femoral tunnels
- Trans-tibial tunnel versus Posterior inlay
- Graft choice → Auto versus Allograft
Single Bundle PCL-R

Fixation angles => No laxity difference with tensioning at 75, 90, 105 degrees

Double Bundle PCL-R
Single Versus **Double Bundle** PCL-R

Fixation of PMB at 0 degrees, better than 15 degrees
Fixation of ALB at 90-105 degrees, better than 75 degrees

Trans-tibial tunnel versus Posterior inlay

**Advantages**
- Familiar techniques of tunnel drilling
- Soft tissue grafts may be used
- Familiar tibia guides are available (similar to ACL)

**Disadvantages**
- Risk of neuro-vascular injury with drilling tibial tunnel
- 'Killer turn' tunnel angle
Inlay – Pros/Cons

**Advantages**
- Reduces the ‘killer turn’ tunnel angle
- Reduces risk of neurovascular injury

**Disadvantages**
- Procedure is technically difficult – NV injury
- Patient must be turned over to expose the back of the tibia
- Increase laxity with the posterior capsule arthroscopy

Graft options – Autograft versus Allograft

**Allograft disadvantages:**
- Limited availability, Cost
- Potential for disease transmission
- Longer to incorporate
- Slight increase in laxity over long term

**Autograft Disadvantages**
- Increased harvest site morbidity
- Longer operative time due to harvest of graft
- Lack of graft with multiple ligament reconstructions

Concomitant Mal-alignment and How to Recognize
Concomitant Mal-alignment

- Can lead to failure of PCL reconstruction
- Noyes AJSM 2005 → analysis of 52 PCL failures
  - Associated PLC insufficiency (40%)
  - Improper tunnel placement (33%)
  - Varus mal-alignment (31%)

Similar results seen in Lee JBJS 2012 study → 77% with failure 2/2 P-L insufficiency

Concomitant Malalignment – must perform a thorough preoperative workup!

- History and physical examination
- Long-leg alignment x-rays
- Review of prior arthroscopic photographs (i.e. increased lateral gap in patient with failed isolated PCL reconstruction)

Understanding Concomitant Malalignment – Associated Varus

- ± lateral thrust gait
- Correct with HTO → decrease stress on PCL graft
Understanding Concomitant Malalignment –
Associated PLC injury

• Unclear if staged vs simultaneous reconstruction is beneficial

• Failure to reconstitute PLC → PCL failure
  – Leads to ER stress on PCL graft at 30°, 90°
  – Anterior/medial displacement of tibial attachment → shortening of ligament distance → functional laxity

Thank You