Imaging work up for the Failed ACL

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Revision ACL Pre-op planning

• A meticulous approach should be utilized for patients after failed ACL surgery.
• Revision ACL surgery is associated with a significantly inferior outcomes vs 1 surgery.
• To avoid another failure – avoid compromise.
• Need to work out why the first ACLR Failed.

What do you need to know....?

• What Hardwear needs to be dealt with:
  • Tunnels?
    ▶ Where are they?
    ▶ Are they enlarged?
• Is there Mal-alignment?
• Status of:
  ▶ Cartilage
  ▶ Menisci
  ▶ Ligaments.

Questions I ask myself......

• 1 or 2 stage Revision....?
• Need for Osteotomy?
• Need for additional ligament surgery – MCL, PCL, PLC?
• Need for Extra-articular plasty?
• Need for Meniscal surgery – Menisectomy, Repair, Root Repair, MAT?
• Cartilage, Notch plasty, etc

My Standard Work-up

• AP and Lateral view – weight bearing in extension.
• Skyline patella view.
• Rosenberg views.
• Standing AP alignment both lower extremities (long film).
• CT scan.
• MRI scan.

Plain X-ray
AP and Lateral

• Best for overall assessment of:
  ▶ Significant Arthritis.
  ▶ What type of reconstruction?
  ▶ Hardwear you need to deal with.
  ▶ Idea of tibial slope and anterior tibial subluxation.
Hardware?

No Substitute for the old Operation Note!

Measuring position of the tunnel

Graft inclination angle

= 12°

< 16 degrees = Higher failure rate (Leo Pincewski)

Value of the Lateral

Measuring the position of the tunnel

Rosenberg Views

Amis and Jacob’s Line
42% = ACL centre
30% = AM centre
50% = PL centre
Lower Limb Malalignment

Weight bearing long leg alignment view

Properly Taken
- Patella forward
- Both legs

Alignment - Don't Forget the Lateral!

Lateral Long Leg Alignment
- Large Slope
- Primary
  - consider Lateral Extra-articular
- Revision
  - consider slope change osteotomy
Untreated laxity may result in abnormal tensile loads on the ACL which can lead to graft failure.

**Stress X-rays**

- Objective assessment of instability
- Validates instability pattern

**Stress X-rays – Determining and Documenting Instability**

<table>
<thead>
<tr>
<th>Side-to-side laxity</th>
<th>0°</th>
<th>20°</th>
</tr>
</thead>
<tbody>
<tr>
<td>sMCL only</td>
<td>&gt;2.7 mm</td>
<td>&gt;2.2 mm</td>
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<tr>
<td>Complete MCL</td>
<td>&gt;4.5 mm</td>
<td>&gt;4.8 mm</td>
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</tbody>
</table>

(LaPrade et al, AJSM 2010)

**CT Scan**

2D - Determining tunnel enlargement

2D - Determining tunnel enlargement
3D CT = gold standard for evaluation of bone tunnel enlargement & bone tunnel placement.

X-ray = Good? ....Bad ? ....Ugly ?

<table>
<thead>
<tr>
<th>Study</th>
<th>AMB Depth</th>
<th>PLB Depth</th>
<th>AMB Height</th>
<th>PLB Height</th>
<th>AMB Ave.</th>
<th>PLB Ave.</th>
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<tbody>
<tr>
<td>Bernard-Hertel (1997), N = 10</td>
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<td>28.5</td>
<td>24.8</td>
<td>28.5</td>
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<td>27.3</td>
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<tr>
<td>Nima et al. (2010), N = 8</td>
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<td>35.1</td>
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<tr>
<td>Atkeson (2010), N = 12</td>
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<td>29.0</td>
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<td>22.9</td>
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</table>

Weighted averages

<table>
<thead>
<tr>
<th>AMB Depth</th>
<th>PLB Depth</th>
<th>AMB Height</th>
<th>PLB Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.7%</td>
<td>30.3%</td>
<td>29.7%</td>
<td>32.4%</td>
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</table>
Femoral Tunnel Possibilities

- **TYPE 1** = Correct: (easy)
  - over drill existing tunnels

- **TYPE 3** = Entirely incorrect: (easy)
  - drill new tunnels

- **TYPE 2** = Almost correct: (difficult)
  - potential for tunnel overlap

Type 1

Type 1

Type 1

Type 3
Type 3

Type 3

Type 3

Type 2

Type 2

3D CT scan - Tibia
Anatomic ACL reconstruction: the normal central tibial footprint position and a standardised technique for measuring tibial tunnel location on 3D CT

<table>
<thead>
<tr>
<th>Study</th>
<th>AP</th>
<th>ML</th>
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<tbody>
<tr>
<td>Tsukada et al</td>
<td>37.6</td>
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<td>Lorenz et al</td>
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<td>41</td>
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<td>Sadoghi et al</td>
<td>41</td>
<td>49</td>
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<td>Lee et al</td>
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<td>Parkinson et al</td>
<td>39</td>
<td>43</td>
</tr>
<tr>
<td>Weighted Mean</td>
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<td>41.1</td>
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</table>

AP = 39.5%
ML = 52.1%

2D CT may underestimate the Problem
MRI

- ? Vertical Graft Intact
  - Deficient ACL but graft present
- ? Chondral Surfaces
- ? Meniscal Tear
- ? Root Tear

MRI

Lateral Meniscus Root Tear

Case Example

- 27 yr Man
- 2 Previous ACL reconstructions - last 5 years ago
- Subsequent medial meniscus injury – meniscectomy
- Further injury with pain and swelling; MRI confirms Graft rupture
- Now pain medially but main complaint of instability
Algorithm

- Alignment
- Ligament Stability
- Meniscus
- Cartilage

- Osteotomy
- ACL revision
  - Contra-lateral hamstrings
- Meniscus Allograft
1 year Post-op

Case Example – The Easy revision….?

Was this Predictable?

- Patient Height = 5ft 1’!
• Helpful to identify hardware and the location of the original bone tunnels

Intra-operative Fluoroscopy

• New tunnel position controlled using intraoperative c-arm images

Intra-operative Fluoroscopy

My Standard Work-up

• AP and Lateral view – weight bearing in extension
• Skyline patella view
• Rosenberg views
• Standing AP alignment both lower extremities (long film)
• CT scan
• MRI scan
• Consider Intra-op fluoroscopy