ACL INJURY AND MANAGEMENT

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No financial disclosures or industry relationship affiliated with this talk.
Objectives

- Learn the anatomy and function of the ANTERIOR CRUCIATE LIGAMENT (ACL)
- Provide details with regards to management of ACL injury
- Understand the rehabilitation, return to activity, and implications of ACL injury
Knee Ligaments

- Cruciate Ligaments (internal)
  - ACL (anterior)
  - PCL (posterior)

- Collateral Ligaments (external)
  - MCL (medial)
  - LCL (lateral)
**ACL Anatomy**

- **Size**
  - Mean length: 3.3 cm (+/- 1cm)
  - Mean width: 1.1 cm (+/- 0.1 cm)

- **Function**
  - Primary restraint to anterior translation of the tibia
  - Secondary restraint to tibial rotation and to varus/valgus stress
<table>
<thead>
<tr>
<th>Activity</th>
<th>Maximum Force (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascending stairs</td>
<td>67</td>
</tr>
<tr>
<td>Ascending ramp</td>
<td>107</td>
</tr>
<tr>
<td>Descending stairs</td>
<td>133</td>
</tr>
<tr>
<td>Sitting and rising</td>
<td>173</td>
</tr>
<tr>
<td>Level walking</td>
<td>210</td>
</tr>
<tr>
<td>Descending ramp</td>
<td>485</td>
</tr>
<tr>
<td>Jogging</td>
<td>630</td>
</tr>
</tbody>
</table>

Ultimate Tensile Load = 2160N
Epidemiology

- Isolated ACL injuries account for 50% of all ligamentous knee injuries
- 1/3500 in general population per year suffer ACL injury
  - 100,000 new ACL injuries per year in the US
- 70% occur during sporting activities

* Sports Medicine OKU 3
Who below is more likely to sustain ACL injury?

- High School Male Football athlete
- High School Male Soccer athlete
- NFL football player
- High School Female Soccer athlete
Occurrence of anterior cruciate ligament (ACL) injury expressed as (A) a percentage of all injuries and (B) the rate per 1000 exposures (games and practices combined, 1988–9 through 2003–4).

Female athletes are at considerably higher risk for ACL injury

4-8 X more likely
Factors Contributing to Increased Injury in Women

- Increased hamstring laxity
- Smaller ACL
- Hormonal implications
- Upright running posture
- Increased Q angle
- Narrower intercondylar notch
Meniscal tears in patients with unreconstructed ACL:
- 40% at 1 year
- 60% at 5 years
- 80% by 10 years


ACL injury carries increased risk of arthritis

Convincing evidence that arthritis can be prevented by ACL reconstruction is lacking
Timing of Surgery

- Depends on other potential associated injuries

- Prehabilitation
  - Important to minimize risk of post-operative stiffness after ACL reconstruction
III. Evaluation of an ACL Injury
ACL Injury

- History:
  - 25% no clear MOI
  - 1/3 Direct contact and 2/3 indirect non-contact in nature
  - Sudden deceleration and rotational maneuvers (cutting, jumping)
  - Hyperextension (kissing lesions) and valgus stress (direct blow)
  - Rapid Knee effusion (within 4-12 hours of injury)
**Physical Examination**

- **Effusion**
- **Lachman**: test translation and endpoint
- **Anterior Drawer**: not as sensitive as Lachman
- **Pivot Shift**:
  - Assess “rotational” component of instability associated with ACL injuries
Imaging

- X-rays

- MRI
IV. Treatment
Goal: provide a return of functional stability to the knee and help prevent further injury.
**Treatment Options**

**Surgery**
- Return to high risk sporting activities
- Recurrent instability despite rehab
- Concomitant knee injuries
- Young

**Conservative**
- Sedentary lifestyle
- Older patient
- Open growth plates
- Moderate to Severe arthritis
Non Surgical Management

- Activity modification

- Rehabilitation
  - Proprioceptive training
  - Quad/hamstring strengthening
  - ROM

- Bracing
  - Improves proprioception
  - Biomechanically does not prevent abnormal tibial translation and rotation
Surgical Management

- Reconstruct Ligament
  - Not repair
  - Need tissue to reconstruct = the GRAFT

- Graft
  - AUTOgraft (patient’s own tissue)
  - ALLOgraft (cadaver tissue)
## Ideal ACL Graft

- Equivalent/Greater tensile strength/stiffness
- Allow for secure fixation
- Enable unrestricted rehabilitation
- No graft harvesting morbidity

### GRAFT TYPE vs. ULTIMATE T LOAD (N)

<table>
<thead>
<tr>
<th>GRAFT TYPE</th>
<th>ULTIMATE T LOAD (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NATIVE ACL</td>
<td>2160</td>
</tr>
<tr>
<td>NATIVE PCL</td>
<td>1867</td>
</tr>
<tr>
<td>PATELLAR TENDON</td>
<td>2977</td>
</tr>
<tr>
<td>QUADRUPLED HAMSTRING</td>
<td>4140</td>
</tr>
<tr>
<td>QUADRICEPS</td>
<td>2353</td>
</tr>
<tr>
<td>SINGLE LOOP TIB ANT (CAMPBELL TABLE 48-1)</td>
<td>4122</td>
</tr>
</tbody>
</table>
Multiple Graft Options

Autograft
- Patellar Tendon
- Hamstring Tendon
- Quadriceps Tendon

Allograft
- same 3 as above
- plus additional options
Allograft Advantages

- No graft site morbidity
  - Preservation of flexor/extensor mechanisms
  - Less pain
  - Smaller Incision
- Shorter surgery
- Consistent size
- Facilitates early phase of rehabilitation
Allograft Disadvantages

- Incorporation and maturation is slower
- Increased risk of recurrent rupture
  - Especially in younger patients
- Disease transmission
- More expensive
  - Graft cost
Advantages:
- Strength Characteristics
- Rigid Fixation
- Bone to Bone Healing
- Strong Reliable History

Disadvantages
- Anterior knee pain (Freedman 17%)
- Risk of Patellar fracture
- Disruption of extensor mechanism
Advantages:
- Minimal donor site morbidity
- Stronger graft
- Minimal post-op pain
- Faster quadriceps recovery

Disadvantages:
- Harvest learning curve
- Tendon to bone healing
- Loss of Hamstring tendons (46%G and 79%ST Regenerate)
Indications for Allograft

- Older individual
- Lower activity levels
- Revision ACL reconstruction
Synthetic Grafts

- Were attempted in the past
- Do not work
Surgical Technique

- Knee scope
- Debride remnant ACL fibers
- Notchplasty
- Graft Harvest
- Tunnel placement
- Graft Tensioning and Fixation
BPB Harvest

Middle third of patellar tendon cut and removed

Bony plugs
Notchplasty
Tunnel Placement is Key to Eliminating Lachman and Pivot Shift!
Tunnel Placement

- Tunnel position critically influences postoperative knee stability and mechanics.
- Recreating the original anatomy as closely as possible will limit such problems as graft elongation, generation of undue graft tension and graft impingement.
- Recent advances in techniques and instrumentation now make it easier to place ACL reconstruction in its original anatomic position.
Graft Passage and Fixation

- After the femoral tunnel and tibial tunnels are drilled

- Need to pass the graft through the tunnels and secure the graft in place

- Place under appropriate tension
Fixation is the weak link during the initial 6-12 week period while healing of the graft tissue to the bone tunnels occurs.

- Bone to bone healing is faster than soft tissue to bone healing
  - Bone to Bone 6 weeks
  - Soft Tissue to Bone 8-12 weeks
Fixation Devices

- Interference Screw
- Suspension Device
- Screw and Washer
Rehab

- Physical Therapy is a critical part to successful ACL reconstruction
- May weight bear with crutch assist initially
- Need to recover knee ROM and strength
- Graft healing and maturation
- Return to sport
  - ~6 months
Results: Sixty-three percent (31 of 49) of NFL athletes returned to NFL game play at an average of 10.8 months after surgery. Age at time of surgery, position, and the type and number of procedures were not significantly different between those who did and did not return to play. The average number of games before surgery was 51 for those who did return to play and 28 for those who did not (P = 0.039). The odds ratio favoring RTP was 5.5 (P = 0.016) for those players who had more than 4 years of NFL experience before surgery. The average NFL draft round was 3.4 for the group who returned to play and 6.4 for those who did not (P < 0.001). The odds ratio favoring RTP was 12.2 (P < 0.001) for those players drafted in the first 4 rounds of the NFL draft compared with those drafted after the fourth round.

<table>
<thead>
<tr>
<th>TABLE 2</th>
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<tbody>
<tr>
<td>Return to Play (RTP) by Position</td>
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<tr>
<td>---------</td>
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<tr>
<td>Position</td>
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<tr>
<td>---------</td>
</tr>
<tr>
<td>Wide receiver</td>
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<tr>
<td>Quarterback</td>
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<tr>
<td>Cornerback</td>
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<tr>
<td>Tight end</td>
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<tr>
<td>Linebacker</td>
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<tr>
<td>Offensive line</td>
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<tr>
<td>Running back</td>
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<tr>
<td>Safety</td>
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<tr>
<td>Defensive line</td>
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<tr>
<td>Fullback</td>
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<table>
<thead>
<tr>
<th>TABLE 5</th>
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</thead>
<tbody>
<tr>
<td>Distribution of Players by Draft Round Data&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>---------</td>
</tr>
<tr>
<td>Draft Round</td>
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<tr>
<td>---------</td>
</tr>
<tr>
<td>First</td>
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<tr>
<td>Second</td>
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<td>Third</td>
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<tr>
<td>Fourth</td>
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<td>Fifth</td>
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<tr>
<td>Sixth</td>
</tr>
<tr>
<td>Seventh</td>
</tr>
<tr>
<td>Eighth (undrafted)</td>
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</tbody>
</table>

<sup>a</sup>RTP, return to play.
Bracing

To brace or not to brace?......
Keys to Successful Outcome

- Correct graft placement
- Secure fixation
- Proper tension
- Freedom from impingement
- Post op physical therapy
- Compliance with restrictions
Thank you

- Questions?