ACL INJURIES

Introduction

- ACL injuries common in sports & strenuous work
  » So frequent that the seriousness is often forgotten
- Totally disrupted more than any other knee ligament
- 200,000 ACL injuries annually
  Fu: AJSM ’99
- 148,714 ACL surgeries in 2013
- 19 yrs: 58% increase in number ACL surgeries
  Wilk: JOSPT ’15
- Rehab has changed in the past 10 yrs

Evidence Based Rehab

Knee Homeostasis
Introduction

- Over 200,000 ACL injuries annually
- 62-66% sports related, usually non-contact – 70%
- Over 60% in males
- 67% occurs in individuals 15-29 yrs of age
- 26% occurs in 30-44 yrs
- 7% occurs in individuals above 45 yrs of age

Carey et al: AJSM ‘06

- Effects of ACL injury on running backs & wide receivers in the NFL players (N=33)
  - 80% returned to NFL play
  - Performance of those returning – performance was reduced by 1/3

ACL Injuries

Return to Play

- 78% of NBA players returned to play following ACL surgery
- Of the players returning: 44% experienced a decrease in in standard statistical categories & player efficiency ratings
  
  Busfield et al: Arthroscopy ’09
Shah, Andrews, Fleisig, Lemak: AJSM ‘10

- 49 NFL players underwent ACL/PTG
  - 63% returned to NFL play (31/49)
  - Average length of time to return 10.8 mos
- Age, position & number of procedures not a factor in return rate
- Players who had more than 4 yrs of experience higher rate of return
- Players drafted in first 4 rounds – higher rate of return to play

Return to Sports
After ACL Reconstruction:
- Systematic review of 48 studies reporting return to sports of 5770 individuals after ACL reconstruction at mean follow-up of 41.5 months

<table>
<thead>
<tr>
<th>Return to Sports</th>
<th>Percentage (95% CI)</th>
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<tbody>
<tr>
<td>Return to Some Form of Sports</td>
<td>82% (95% CI 73 to 90%)</td>
</tr>
<tr>
<td>Return to Pre-Injury Level of Sports</td>
<td>70% (95% CI 54 to 71%)</td>
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<tr>
<td>Return to Competitive Sports</td>
<td>46% (95% CI 34 to 56%)</td>
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Ardern CL et al. 2011

Kinesiophobia

- Fear of movement/reinjury
  - “I’m afraid that I might injure myself if I play a sport or exercise”
- Tampa scale for kinesiophobia

  Woby et al: Pain ’05

Interventions which improve self efficacy may improve knee function short term

  Chmielewski et al: JOSPT ’08
  Chmielewski et al: Phys Ther ’11

Return to Sports

- Reasons for reduced sports participation for those that did not return to prior level:
  - Fear of re-injury (19%)
  - Problems with structure/function of knee (13%)
  - Family commitments or lifestyle changes (11%)

Ardern, BJSM: 2011
**ACL Rehabilitation**

*Limb Confidence*

- Various levels of dynamic stability
  - Stability → Mobility → Controlled Mobility → Skill
- Perturbation skill one of highest level
- Improves clinical outcomes
  - Wilk: J Athl Trn ’99
  - Fitzgerald: Phys Ther ’00

> Must gradually progress to skill level drills!!

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**Perturbation Training to Enhance Neuromuscular Control**

- Perturbation training ACL deficient knee patients (athletes)
- 26 patients isolated ACL rupture
- Randomly assigned to group:
  - A standardized program
  - Standardized program & perturbation training
- Results:
  - 91% perturbation group return to play (6 months)
  - 50% standardized group return to play (6 months)

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**Fitzgerald, Axe, Snyder-Mackler: Phys Ther ’00**

**Linking Arms & Lower Extremity**
Agility Drills

Lateral Slides

Movements & Change of Planes

Movements with Stabilization

Lateral Slides

Neuroplasticity Following ACL Injury

- Rehab Implications:
  - Dual tasking
  - Blindfolded
  - Eyes closed
  - Stroboscope glasses
  - Visual elements
ACL reinjury rate following ACLR
• 78 subjects underwent ACLR – return to sports
  ✔ 15x greater 2nd ACL in subjects with ACLR if they return to sports during the first year
  ✔ 6x greater 2nd ACL injury in subjects returning to sports within 12-24 mos
  ✔ Females ACLR 4x greater rate of injury 24 mos.
  ✔ 2x more likely to tear opposite knee ACL
  ✔ 30% athletes sustained 2nd ACL inj – 21% on contralateral side 9% opposite side

How Do You Know When Your ACL Patient is Ready to Run? Return to Sports?

Unbalanced Bar Balance Drills

- Can we reduce re-injury rates in ACLR pts
- Delaware-Oslo ACL Cohort Study
- 106 patients ACLR – 2yr FU
  - 30% pts returning Level I sustained reinjury, 8% returning to a lower level (4x higher reinj rate)
  - Every month delayed returned to sports until 9mos – rate of re-injury was reduced 51%
  - More symmetrical quadriceps strength prior to return to sports sign. Reduced reinjury rate

How Do You Reduce Re-Injury Rate by 84%

Strict Criteria to Return to Sports

Functional Movement Screen (FMS)

Post-Op ACL Reconstruction

Functional Screening Test

Return to Play Criteria

- 3 P Program:
  - Performance
  - Practice
  - Play
Introduction

• Usually occurs in “high risk” sports
  ✓ Football
  ✓ Basketball
  ✓ Volleyball
  ✓ Soccer
  ✓ Skiing
  ✓ Team Handball

ACL Injuries

• ACL Age Distribution
  • Scandinavian Registry Lind: Acta Orthop ’09
    ✓ Female peak age ~ 15 yrs
    ✓ Male peak age ~ 20 yrs

• Risk of Contralateral ACL Injury
  ✓ Systematic review of 13 prospective studies
  ✓ 2nd Inj Contralateral Risk > than First Time Risk
    Sward et al: KSST ’10

Functional Movement Screen
FMS

Y Balance Test
ACL Injuries

Dynamic Q Angle

- Proximal Components
  - Femoral adduction
  - Femoral internal rotation
- Distal Components
  - Hyperpronation
  - Tibial internal rotation

ACL Injuries

- Not an isolated injury
  - Injury affects both extremities
  - For at least 3.6 mos
    - Wilk, et al: CSM ’03
  - Alters firing mechanism
    - Wojtys, Huston: AJSM ’94

ACL Injuries

- Not an isolated injury
  - Injury affects both extremities
  - Quadriceps weakness & activation failure following ACL injury &/or reconstruction bilaterally
    - Hart et al: J Athletic Trn ’10
    - Chmielewski: J Orthop Res ’04
    - Farquhar: Muscle Nerve ’05
    - Holder-Powell: Eur J Appl Physiol 01
**ACL Injuries**

- **Deficits in Balance & Proprioception is Long Term**
  - Posture & balance deficits can be present up to 2-3 yrs
  
  Clark: *J Biomech* ’14 (6-18 mos)
  Howells: *Knee Surg Spts Trau* ’11
  (systematic review 10 studies – impaired posture at 29 mos)

- **Not an isolated injury**
  
  - Bone bruises present 71-100% patients
    
    Potter et al: *AJSM* ’12
    Spindler: *AJSM* ’93
    Rosen: *Arthroscopy* ’91
    Graf: *AJSM* ’93
    Johnson: *AJSM* ’98
  
  - 65% exhibited marrow changes & cartilage thinning 6 yrs after ACL injury
    
    Faber: *AJSM* ’99

**Potter, Jain, Ma, et al: AJSM ’12**

- 42 knees in 40 patients (28 ACLR, 14 non-op)
- MRI at time of initial injury then annually for a maximum of 11 yrs
- All patients sustained initial chondral injury 100% incidence
- Risk of cartilage loss doubled from yr 1 for the lateral & medial compartment & 3x for patella
- By 7 to 11 years: LFC 50x, MFC 19x, & patella 30x
- Size of the bone bruise associated to degeneration from yr 1 to yr 3
Proprioception & Neuromuscular Control Drills for the ACL Patient

Dynamic Stabilization
Stages of Motor Control

Fitts & Posner

COGNITIVE STAGE
- Identify Objectives
- Self-talk/Questioning
- Errors/Variability
- Instruction/Feedback

ASSOCIATIVE STAGE
- Associate with environmental cues
- Refining/Consistent
- Errors/Variability
- Identify/Correct Errors

AUTONOMOUS STAGE
- Subconscious/automatic
- Multiple tasks
- Errors/variability
- Identify/Correct
- Perfection

Beginner Expert

ACL Rehabilitation
Key Points

✓ Faster is Rehab is Better!
✓ But what is faster rehab?
  ✓ Immediate rehabilitation (ROM, muscle, NM)
  ✓ Early functional drills
  ✓ Building limb & knee confidence
  ✓ Neuromuscular control & proprioception
  ✓ Not Early Running or Sports!
✓ Return patients/athletes back to sport when they are ready! (physically & mentally)

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