Current Concepts in Rehabilitation following ACL Reconstruction

What’s New & What You Need to Know!!

Kevin E. Wilk, PT, DPT, FAPTA

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
- 100,000 ACL surgeries
  Harner: Arthroscopy ‘04
- Rehab has changed in the past 10 yrs

Science to Rehabilitation  Knee Homeostasis

ACL INJURIES

Introduction

- 35 out of 100,000 people
  Walden et al: Knee Surg Sports Trauma Arthro ‘10
- Females are 4-6 times higher risk of ACL injury
- ACL outcomes (IKDC scores) 61-67%
  Biau et al: CORR ‘07
- 40-90% of ACL patients exhibit radiographic knee OA 7-12 yrs following surgery
  Pinczewski et al: AJSM ‘07
  Liden et al: Arthroscopy ‘08
- 10x greater rate OA in ACL injured knee
  Fleming et al: JOSPT ‘03

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

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
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

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

| Return to Some Form of Sports | 82% (95% CI 73 to 90%) |
| Return to Pre-Injury Level of Sports | 63% (95% CI 54 to 71%) |
| Return to Competitive Sports | 44% (95% CI 34 to 56%) |

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

Why Didn’t They Return to Sports (n=42)

- Kinesiophobia* - more present in low level athletes – elite athletes
- Instability*
  - 31/42 (74%) patients responded they had instability ★
- Quad PT/BW ratio*
  - important test parameter
  - quads are shock absorbers
  - Wilk et al: JOSPT ’94 correlation b/w QPT/BW
- IKDC scores (15 pts difference)*
- Knee effusion (present in 9 pts)* - 21%
- Pain scale difference*
- Tegner scale differences
ACL Injuries

Not an Isolated Injury!!

• Not an isolated injury

- Injury affects mechanoreceptors
  - Within 24 hrs after injury
    - Lephart: AOSSM ’97
  - Deficits may persist longer than 1 yr
    - Deni: Knee Surg Spines Trauma ’80
  - “Quadriceps avoidance gait”
    - Andriacchi: CORR ’94
    - Berechuck: JBJS ’90

- Injury affects both extremities
  - For at least 3.6 mos
    - Wilk, et al: CSM ’03
  - 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

- Alters firing mechanism
  - Wojtys, Huston: AJSM ’94

ACL Injuries

OVERALL

Initial
2 weeks
4 weeks
6 weeks
8 weeks
12 weeks
16 weeks
26 weeks
52 weeks

Open Inv
Open Non
Closed Inv
Closed Non
ACL Injuries in Female Athletes
Risk Factors

What affects injury rates???

8 Specific Risk Factors:
- Increased Knee Abduction angles – valgus collapse
- Decreased Knee flexion angles – “Q dominant”
- Core weakness - Lateral trunk displacement
- Decreased H/Q ratios
- Running, cutting & landing from jumps
- Increased generalized laxity
- Smaller intercondylar notch
- Hormonal changes

What’s New in ACL Rehabilitation:
What you need to know!

Successful outcome today

Asymptomatic Knee
5 – 10 years later!

ACL Rehabilitation
Outcome

Stability
Function

Longevity Livability
Treat the Entire Joint !!!
Not Just the ACL

Biology of the Rehab Program

ACL REHABILITATION
Rehab Program Changes Based on Surgery

- Graft
  » PTG, STG, QTG
- Meniscus
  » Repair, excised
- Articular Cartilage
  » Debride, procedure, bone bruise
- Other ligaments
  » MCL, PL corner, LCL, PCL

ACL REHABILITATION
6 Phase Program

- Pre-operative stage
- Immediate post-operative stage (day 1-7)
- Acute phase (week 2-4)
- Intermediate phase (wk 4-10)
- Advanced stage (wk 10-16)
- Return to activity stage (wk 16+)

Pre-Operative Planning – Adaptable Milestones

ACL Post-Op Rehabilitation
What You Need to Know!

- 10 important rehab factors to carefully consider, assess and ensure they happen

ACL REHABILITATION
Pre-Operative Phase
(Time of Injury to Surgery)
### ACL Rehabilitation

**Top 10 Key Factors**

- Prepare the patient & knee for surgery
- Restore full knee extension
- Calm the knee down first
- Gradually increase knee flexion
- Must restore patellar mobility
- Individualize the rehab program
- The need for Quads
- Restore dynamic stabilization
- Establish hip, posterior chain, & core control
- Protect the knee now & later
- Objective criteria to return to sports

### ACL Rehabilitation

**What You Need to Know**

1. **Prepare the patient & knee for surgery**
   - Reduce swelling & pain
   - Restore knee motion (extension)
   - Restore adequate flexion
   - Activate the quads
   - Control activities – protect the knee in brace from further injury
   - Prepare for surgery – mental/education

### ACL REHABILITATION

**Post-Operative Phase**

**Keys to the Knee Following ACLR**

2. **Restore Full Knee Extension**
   - Full knee extension critical
   - Prevents scar formation in knee
   - Assists in improving knee function running – hyperflexion
   - Must restore knee extension – hyperextension
   - How much? Symmetrical?
   - Shelbourne et al: J Orthop Sci ’06

### What About Restoring Hyperextension?

### ACL Strains at ROM Extremes
**Shelbourne & Gray: AJSM ‘09**

- ACL reconstruction PTG
- How the loss of motion compounds other factors related to development of OA
  - **Loss of extension** – even a loss of 3-5 degrees affected outcome
    - Especially with menisci injury & art cart damage
    - Patients with loss of extension & flexion had worse results

**Arthrofibrosis**

**TERT Principle**

- Total End Range Time
  - McClure et al: PT ‘94
  - Intensity
  - Frequency
  - Duration

**Low Load Long Duration Stretching**

- Low intensity
- Long duration
- Plastic deformation of collagen tissue

**Loss of Knee Motion**

- Loss of Extension

**Correlation between loss of knee motion and PF Pain**

3. Calm the Knee Down First
- To go fast (accelerate) you have to start slow
- Cannot accelerate a swollen/painful knee (“reactive knee”)
- Reduce the swelling/pain
- Restore full knee extension
- Activate quads
- Then progress

PACE Yourself First – Before you can go FAST !!!

It's all about milestones !!!

PRINCIPLES OF ACL REHAB

ACL Strain

• ACL strain during motion
  ✓ Passive ROM
  ✓ Active ROM
• Resisted movements

Johnson, Beynnon: AJSM ’96

Reduce Swelling & Pain
Gradually Restore Knee Flexion

- Start Slow
- Slowly restore flexion
- If you push it too fast – swelling
- Full flexion should be restored
- **Must** return hyperflexion
  - Heel to Glut
  - *Even a small loss of flexion - unacceptable*

**ACL REHABILITATION**

*Range of Motion - PTG*

- "**Full**" passive extension immediately
- Gradual restoration of flexion
  - Week 1: 90 degrees
  - Week 2: 105 - 110 degrees
  - Week 3: 115 - 125 degrees
  - Week 4: 125 degrees or >
  - Week 8-10: "heel to gluts"

Factors to Minimize Anterior Knee Pain in an ACL/PTG Knee

- Passive Knee Flexion
- Patellar Mobility
- Passive Knee Extension

Must Restore Patellar Mobility

- Especially when PTG are utilized
- Patellar mobility enables restoration of motion but also quad function
- Protects the patella wear & tear
- Prevents anterior knee pain
- *Patellar mobility is critical to successful outcome*

One of the Keys to the Knee
6. Individualize & Adjust the Rehab Program Based on Knee Status

- Base rehab program on knee status:
  - All involved tissues
  - Patient healing response
  - Rate of progression
  - MCL injury – stiffness
  - PF stabilization surgery
  - Meniscus repair – protection
  - Articular cartilage – protect/preserve/longevity

7. Need for Quads

- Activate the quads early
  - EMS to quads
- Need quads for shock absorption
- Assists in proper running, jumping, skating
- **Quad/Hamstring ratio important:**
  - **Males:** 66-70%
  - **Females:** 70-73%
7b Need for Hip Strength & Control
- Stabilization of the knee joint occurs from above & below
- Hip abduction, hip ER & hip extension strength & control
- Hyper-pronation of the foot control
- Key components to rehab
  Wilk et al: J Athl Train’99
  Wilk et al: JOSPT ’09
  Powers et al: JOSPT ’03

One of the Keys to the Knee

8. Restore Dynamic Functional Stability to the Knee Joint
- Proprioception & neuromuscular control restores stability
- Proprioception is diminished after ACL injury
- Utilize perturbation training

Key to Successful Outcomes

Co-Activation to Enhance Dynamic Stability
Co-Activation to Enhance Dynamic Stability

Perturbation Training to Enhance NM Control

Train the Uninjured Extremity Too!!

After ACL Injury – More Likely to Injury
Opposite ACL – Train to Prevent Injury

One of the Keys to the Knee
Knee Control from Above & Below

- Restore hip control for knee control
- Control hip adduction & IR
- Also train hip extensors & hamstrings
- Control foot mechanics
- Foot hyperpronation

One of the Keys to the Knee

Establish Hip Control
Wilk - ACL Rehab Top 10 Key Rehab Keys

ACL Rehabilitation
What You Need to Know

Hamstrings, Hamstrings & Hamstring Control

Hamstring Muscle Training

10. Protect the Knee Now & Later
- Knee outcomes dependent on joint integrity
- Protect menisci & articular cartilage
- Rehab the bone bruise

Longevity is the Key !!!

Bone Bruises
**ARTICULAR CARTILAGE INJURIES ACUTE ACL TEARS**

- **Johnson D: AJSM '98**
  - 10 patients, acute ACL injury
  - All exhibited osseous lesions
  - Arthroscopic & histological art. Cart. changes

- **Rosen et al: AJSM '91**
  - 75 patients < 3 weeks injury
  - 85% exhibited a bone bruise

**Treat The Osseous Lesion**

- **Rehabilitation Guidelines:**
  - Control wt. bearing forces (crutches)
  - No early running & jumping
  - Cryotherapy & compression
  - Train & restore proprioception
  - Emphasize unloading programs
  - Pool exercises, bicycle, etc...
  - Muscle stimulation to quads
  - Motion, motion, motion ...

**ACL Rehabilitation**

- **What You Need to Know**

**PRINCIPLES OF ACL REHABILITATION**

- Pool drills ______ dry land
- Plyometrics ______ running
- Backward runs ______ lateral drills
- lateral drills ______ forward runs
- Forward running ______ deceleration
- Deceleration ______ cutting/pivot
- Half speed ______ increase %

**Gradual Progression**

**Assess Technique & Response**
When to Return to Sports:
- When the knee is ready – not based on timeframes, protocols, …
- Use criteria based approach
- Objective test information
  - Subjective knee score
  - KT Test
  - Isokinetic test
  - Functional test
- Appropriate rehab progression
- Return to sport is variable

Key Points:
- Rehab plays vital role to outcome
- “faster is not better”
- Injury to ACL & to the joint
- There are speed limits
- Progressive & sequential rehab program
- Restore Knee motion but also neuromuscular control
  
Longevity is the Knee – Painfree Function

Thank You!