ACL REHAB

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Objectives

- Problems with the stiff ACL knee
- Importance of full knee extension early
- Identify loads during common exercises and activities
- Describe exs to achieve optimal movement and return to sport
General Concepts and Principles

1. Immediate motion
2. Early weight bearing
3. Full passive knee extension
4. Immediate muscle training
5. Closed kinetic chain exercises
6. Functional activities
7. Proprioception training
Factors related to ROM deficits

- Pre-operative motion loss\(^1\)
- Injury Severity\(^2\)
- Prolonged post operative immobilization\(^3\)
- Delayed P.T.\(^2\)
- Length of time between injury and surgery?\(^4\)
- Surgical techniques\(^5\)
- Therapy techniques
Complications

- Changes arthrokinematics and contact pressures
- Anterior knee pain
- Increase in quad and HS activity and early fatigue
- Quad muscle strain
- As little as 5 deg. alters gait\(^2\)
- Increase OA\(^6\)
What is full Extension?

- 0 degrees?
- Some degree of hyperextension?
- Equal to opposite?
- Within 2 deg of contralateral (AAOSM)
Extension ROM

- Alternate measurement:
  - Heel height difference
  - $1 \text{ cm} = 1 \text{ deg of knee flex contracture}$
Incidence

- True incidence unknown due to differences in definition of extension loss
- Mauro et al, 2008: 25%: loss of extension 4 wks after ACL
  - Of these... 48% remained with deficit and/or required arthroscopic debridement
- Carneiro, Nakama, Luzo: 7-17% incidence
- Improving now with improved surgical techniques and early motion/WB rehab
Extension

- Early ROM does NOT increase incidence of instability
- Critical to normal pain-free knee function
- The earlier the better
  - Goal: Week 1-2
Flexion

Week 1: 90 deg
Week 2: 105-115
Week 3: 115-125
Week 4: >125

Heel to glut at 4-6 wks
Flexion

- As little as 10 deg flexion loss:
  - Changes in running speed
  - Squat and kneel
Treatment

- Control swelling
  - Compression
  - Vasopneumatic device
- Patient education
- Scar mobs
- Flexibility training
- Patella mobility (Especially if bone-tendon-bone)
- Joint mobs (Caution with ant tib glides early on)
- Drop-lock bracing
Low load/long duration principles\textsuperscript{9-10}

Low-load and long-duration techniques to improve knee extension ROM: (A): Prone hangs with weights; (B): Bag hangs with weights.
“Easy to get them back, hard to keep them back” - Bill Knowles
Neuromuscular Training

“It is the best brace we can give our patients!!”
Mechanoreceptors

- “ACL Reflex”
  - Direct stress to normal ACL results in reflex hamstring activity
  - Significant number of mechanoreceptors exist in the ACL
  - These along with PCL, collateral, and capsular receptors play important role in proprioception
  - Influenced by ROM loss
Proprioceptive training

Perturbation training
Strength Training

- NMES
  - Quad is inhibited
- Hamstring/Quad Muscle Ratios
- Recruitment order\(^\text{14}\)
- Proximal Control
Weight Bearing vs Non-Weight Bearing Exercises

CKC
- Functional
- Co-Contraction

OKC
- Isolated
- Shearing forces
### ACL forces during rehab

<table>
<thead>
<tr>
<th>Rehabilitation Exercise</th>
<th>Peak Strain at Knee Angle</th>
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<tbody>
<tr>
<td>Isometric leg extension seated (30 Nm torque)</td>
<td>4.4% at 15°</td>
</tr>
<tr>
<td>Dynamic leg extension seated with 45 N (10 lb) of resistance</td>
<td>3.8% at 10°</td>
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<tr>
<td>150 N (33 lb) Lachman test</td>
<td>3.7% at 30°</td>
</tr>
<tr>
<td><strong>Squatting with or without 136 N (30 lb) of resistance</strong></td>
<td><strong>3.6%-4.0% at 10°</strong></td>
</tr>
<tr>
<td>Dynamic leg extension seated without external resistance</td>
<td>2.8% at 10°</td>
</tr>
<tr>
<td>Single-leg sit-to-stand (tested at 30°, 50°, and 70°)</td>
<td>2.8% at 30°</td>
</tr>
<tr>
<td>Step-up/-down and stair climbing (tested at 30°, 50°, and 70°)</td>
<td>2.5%-2.7% at 30°</td>
</tr>
<tr>
<td>Leg press with 40% body weight resistance</td>
<td>2.1% at 20°</td>
</tr>
<tr>
<td>Forward lunge (tested at 30°, 50°, and 70°)</td>
<td>1.9% at 30°</td>
</tr>
<tr>
<td>Stationary bicycling</td>
<td>1.7%</td>
</tr>
</tbody>
</table>
“Train the brakes”
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- Stopping more important than starting
  - Body positions
  - Lean angles
- Decelerators
- Eccentric Training
Landing

Preferred

Valgus or Abduction
Plyometrics

- One of the best tools to improve athleticism
- Explosive
- Focus on landing/eccentric phase
Agility

MDSA (Multi-Directional, Speed and Agility)
Return to Sport

- Strength: Leg press
  - 1 RM
  - 10 RM
Return to Sport

- Balance: LE functional reach test
Return to Sport - Jumps

- 2-legged jump
- Single leg jump
- Hop for distance
- Cross-Over hop test
- Vertical Jumps
Speed and Agility tests

- Agility Tests
  - T-test
  - Illinois Test

- Speed

- Sport-specific testing
Take Home Points

- Early Extension = Less pain and less complications
- Avoid “over-exercise” early on
- Caution at 6-10 wks
- Takes time to recover
- “Train movements, not muscles”
- MDSA and plyometric training
References


References (continued)


