ACL Rehabilitation: From Surgery to Sports

Post-Op Months 3 → 8
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I. Rationale for increased exercise structure in Late-Phase Rehabilitation

1. Residual biomechanical and neuromuscular deficits

   - Biomechanical Gait Deviations:

   - Strength Deficits:
     - Peak Quad and Hamstring Torque @ 6 mos. (Carter TR, et al. Arthroscopy 1999)
     - Peak Quad Torque @ 18 mos. (Mattacola CG, et al. J Athl Train 2002)
     - Peak Quad and Hamstring Torque @ 5 yrs. (Lautamies R, et al. Knee Surg Sports Traumatol Arthrosc 2008)

   - Proprioceptive Deficits:

   - Abnormal Landing Mechanics/LE Asymmetry:

2. Psychological fear of reinjury in return-to-sports

   - Correlation of TSK-11 (fear of re-injury) to IKDC subjective scores @ 6-12 mos. (Chmielewski TL, et al. J Orthop Sports Phys Ther 2008)
   - Correlation of TSK-11 (fear of re-injury) to inability to return to pre-injury activity levels @ 3-4 yrs. (Kvist J, et al. Knee Surg Sports Traumatol Arthrosc 2005)
Correlation of **Psychovitality Questionnaire** to inability to return to pre-injury level of sports participation (despite good IKDC, Lysholm, Noyes, & Tegner scores) @ 2yrs. (Gobbi A, et al. Knee Surg Sports Traumatol Arthrosc 2006)

3. **Re-injury To Ipsilateral Knee or Injury to Contralateral Knee after Return-to-Sports**


4. **ACL injury risk-factors**


II. **Late-Phase ACL Rehabilitation**

- **Late-Phase Goals**
  1. Progress from current ADL status to proficiency in sports-related activities
  2. Develop bilateral LE symmetry
  3. Create a dynamically functional knee
  4. Reduce risk of re-injury
  5. Meet or exceed pre-injury athletic performance

- **Late-Phase Exercise Prescription** (What Modes are Best?)
  - **CKC or OKC?**
    - Greater residual quad weakness and gait deviations w/ CKC only vs OKC only (Snyder-Mackler L, et al. J Bone Joint Surg 1995)

    - Significantly more patients using OKC/CKC training vs CKC training only returned to sports at pre-injury level, and did so 2 months earlier (Mikkelsen C, et al. Knee Surg, Sports Traumatol, Arthrosc 2000)
**Strength Training Only?**

- No difference in objective measures between strength training only vs neuromuscular training only groups, but significantly greater perception of knee function in neuromuscular training group (Risberg MA, et al. Phys Ther 2007)

**Multimodal Approach?**
  1. LE strength
  2. Single-leg hop for distance
  3. Vertical jump height
  4. Sprint speed
  5. Dynamic knee control


  1. Core Strengthening and Dynamic Stability
  2. Functional Strengthening
  3. Power Development
  4. Sports Performance Symmetry

**Criteria for Entrance into Late-Phase Rehab Program**
- **VAS:** 0/10 rest; < 3/10 rehab activities
- **Anthropometric @ jt line:** < 10 % uninvolved
- **AROM:** < 10% uninvolved, esp. extension (Mayr HO, et al Arch Orthop Trauma Surg 2004)
- **KT 1000:** < 3-5mm difference (Kim SJ, et al. J Bone Joint Surg 2008)
- **Isokinetic Assessment Peak Torque/Body Weight:** (Biodex Med System)
  i. 180°/s
     a. Males 60%
     b. Females 50%
  ii. 300°/s
     a. Males 40%
     b. Females 30%
Stage 1: Core Strengthening and Dynamic Stability (Post-op Wks 12-15)

- Initiate straight plane running w/ focus on mechanics and symmetry
- Progressive CORE strengthening/stabilization
- Progressive LE strengthening using body weight and destabilizing surfaces
- Emphasis on single-limb postural control w/ perturbations
- Emphasis on proper acceleration/deceleration of center of mass

Stage 2: Functional Strengthening (Post-op Wks 16-19)

- Continue OKC/CKC strength, balance, and perturbation training
- Progress weight training to ensure overload and adaptation
- Utilize sports-specific postures/movements during training; SAID principle
- Emphasis on single-limb landing force attenuation

Stage 3: Power Development (Post-op Wks 20-23)

- Initiate mid-level bilateral plyos and low-level unilateral plyos
- Focus on low volume and proper technique with anticipated movements during plyos
- Movements progress from single-plane to multiple-planes (lateral, diagonal, 90°-180° turns)
- Progress strength training to sports related power, including Olympic lifts (snatch, cleans, jerks…) when applicable
- Initiate interval sprint training on inclined treadmill &/or with band resistance
Stage 4: Sport Performance Symmetry (Post-op Wks 24-32)

- Initiate high-intensity plyometrics, with progression to *unanticipated* movements
- Incorporate sport-specific movements and performance-oriented training
- Focus on power, cutting and directional changes similar to athletes’ sport
- Emphasize symmetry in power production and GRF attenuation
- Strong emphasis on proper biomechanics, especially with higher training volumes
References: