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**:
  - Kinetic Parameters @ 6 mos. **(DeVita P, et al. Med Sci Sports Exercise 1998)**
  - Kinematic Parameters @ 8-12 mos. **(Knoll Z, et al. J Electromyogr Kinesiol 2004; Timoney JM, et al. Am J Sports Med 1993)**

- **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 Hamstring Torque (w/ STG Auto) @ 2 yrs. **(Elmlinger BS, et al. Arthroscopy 2006; Landes S, et al. Knee Surg Sports Traumatol Arthrosc 2010)**
  - Peak Quad and Hamstring Torque @ 5 yrs. **(Lautamies R, et al. Knee Surg Sports Traumatol Arthrosc 2008)**

- **Proprioceptiv**e Deficits:
  - Impaired Knee Proprioception @ 6 mos. **(Zhou MW, et al. Chin Med J 2008)**
  - Impaired Knee Proprioception @ 2 yrs. **(MacDonald PB, et al. Am J Sports Med 1996)**
  - Impaired Knee Proprioception @ 12-30 mos. **(Bonfirm TR, et al. Arch Phys Med Rehabil 2003)**

- **Abnormal Landing** Mechanics/**LE Asymmetry**:
  - SL Hop for Distance @ 6-18 mos. **(Gokeler A, et al. Scand J Med Sci Sports 2009; Mattacola CG, et al. J Athl Train 2002)**
  - Drop Vertical Jump Limb Asymmetry @ 2 yrs. **(Paterno MV, et al. Clin J Sports Med 2007)**

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

   - Subsequent ACL **tear to either knee** following return-to-sports ranges from **12-17%** within first 5yrs **(Shelbourne KD, et al. Am J Sports Med 2009; Salmon L, et al. Arthroscopy 2005)**

4. ACL injury risk-factors

   - Decreased **Core/Pelvic/Trunk/Hamstring** Strength **(Myer GD, et al. Clin J Sports Med 2009; Zazulak BT, et al. Am J Sports Med 2007; Zazulak BT, et al. Am J Sports Med 2007; Ford KR, et al. Med Sci Sports Exerc 2007; Wilson JD, et al. J Am Acad Orthop Surg 2005)**

   - Decreased **Neuromuscular Control** with Landing/Jumping/Cutting Maneuvers **(Hewett TE, et al. Am J Sports Med 2005; Padua DA, et al. Med Sci Sports Exerc 2005; Ford KR, et al. Med Sci Sports Exerc 2003; Ford KR, et al. Med Sci Sports Exerc 2005; Chappell JD, et al. Am J Sports Med 2002; Ford KR, et al. Clin Biomech 2006; Pappas E, et al. Clin J Sports Med 2007; Kernozek TW, et al. Med Sci Sports Exerc 2005)**

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?**

- 9 wks of *LE strength training did not alter LE biomechanics* during a stop-jump task **(Herman DC, et al. Am J Sports Med 2008)**

- *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?**

- Program consisting of *plyometrics, core, balance, resistance and speed training* resulted in improvements in: **(Myer GD, et al. J Strength Cond Res 2005)**
    1. LE strength
    2. Single-leg hop for distance
    3. Vertical jump height
    4. Sprint speed
    5. Dynamic knee control

- Meta-analysis of injury prevention protocols showed *reduction best achieved when training includes* plyometrics, balance training, and strength training **(Hewett TE, et al. Am J Sports Med 2006)**

- <u>Four Stages of Late-Phase Rehabilitation Protocol</u> **(Myer GD, et al. J Strength Cond Res 2008)**
    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

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