I. Rationale for *need of supervised exercise structure* in Late-Phase Rehabilitation

1. Residual biomechanical and neuromuscular deficits

- **Biomechanical Gait Deviations:**

- **Strength Deficits:**
  - Peak Quad Torque (w/ BPTB Auto) @ 18 mos. (Mattacola CG, et al. J Athl Train 2002)

- **Proprioceptive Deficits:**

- **Sport-Specific Movement Asymmetries:**

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

- 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) @ 2 yrs. (Gobbi A, et al. Knee Surg Sports Traumatol Arthrosc 2006)
- Inability to return to preinjury level of sports @ 12 mos. influenced by:
  - Psychological readiness to return to sport
  - Fear of reinjury
  - Sport locus of control
  - Athlete’s Pre-Op estimate of number of months to return to sport

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. Return to pre-injury level of sports participation

   • **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
- 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