Special Considerations for ACL Rehab in the Pediatric Patient

Robyn LeBeau, PT, DPT, OCS
Senior Physical Therapist
Nemours Children's Hospital

Sports-related Pediatric Injuries

- Estimated between 100,000-200,000 ACL injuries annually, encompassing all ages[6]
  - Peaking in high school years [1]
- Knee Injuries account for 50-60% of adolescent sports-related surgical procedures[5]
  - More than ¼ of those are ACL injuries
- Injury rate of 6-7 injuries per 100,000 athlete exposures [5]
- Highest risk to those young athletes participating in cutting/pivoting type sports[6]
  - Basketball, football, soccer, lacrosse[1]
- 21% re-injury rate in ages 20 and younger; 20% secondary injury rate[6]
  - Usually occur early in the return to play period

Youth Sports are Trending

- Increased participation in youth sports [1,5]
  - >50% of all high school students participate in organized sports [1]
  - Continuing to rise, especially in females [1,3]
- Earlier specialization in sports [1,5]
- Higher levels of competition at an earlier age [5]
- Year-round training at higher intensities [1,5]
- Improved Injury Recognition [1,5]

The Consequences

- Annual health care costs > $625 million [3,6]
- Missing extended periods in sports [6]
  - Loss of one's self identity
- Potential loss of scholarship earnings [6]
  - Trickle down effect
- Lower academic performance [3]
- Increased risk of subsequent and secondary injuries [2]
- Chronic knee problems and long-term disability [2,6]
  - Osteoarthritis (nearly 100x greater risk) [3]

Pediatric-specific Risk Factors

- Growth-plate vulnerability [5]
- Adolescent growth spurt [1,5]
- Differential growth [5]
- Biological vs. Chronological age [1,5]
- Female [1,2,3,4,5]

❖Underdeveloped: [1,2,5]
- ❖Strength and opposing muscle ratios
- ❖Coordination
- ❖neuromuscular control
- ❖skills
- ❖perception

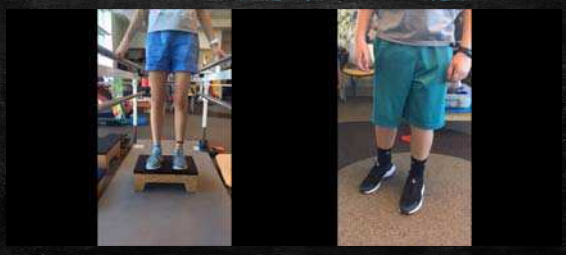
General Guidelines for Rehab Progression

- Supervised Physical Therapy for 4-7 months
  - 2-4x per week
  - Insurance limitations
- Performance-based Protocol
  - Utilize healing times as a guide for "earliest" advancement through phases but progressions not made without achievement of specific performance-based milestones

Phase 0: Prehab

- The "Everyone learns" Phase
- Pre-operative Evaluation
  - Baseline measurements
  - Screen for aberrant movement patterns
  - Protocol Review
  - Expectations and Goals
  - Education
  - Authorization

Phase 0: Identifying Aberrant Movement Patterns



Phase 0: Prehab

- Education and Instructions
  - 3 post-operative goals
    - Graft protection: brace wear, crutch training, proper transferring, activity modification
    - Control pain and swelling: pain medication, cryotherapy, proper elevation, ankle pumping
    - Re-activation of Quads and achievement of full knee extension: heel propping, quad setting, no pillow under knee

Phase 1: Post-operative Weeks 0-4

- The "Boring but critical" Phase
- New objective measures taken at first post-op treatment visit
- Goals to advance to phase 2:
  - Continue goals discussed pre-operatively: graft and fixation protection, pain/swelling control, regain full knee extension and quad contraction
    - Goal is good quad set and ability to SLR without extensor lag
  - Active flexion to 90 degrees
  - Restore normal gait pattern on level surfaces in order to discharge crutches
  - Provide continued education on rehab progression

Phase 1: Post-operative Weeks 0-4

- Brace:
  - unlocked to avoid post-operative stiffness and allow for proper gait pattern
  - Continued use of brace until cleared by therapist for good quad control
  - Locked into 10 deg hyperextension for sleep if pt has difficulty maintaining extension gains
- Other Considerations:
  - School considerations
  - Compliance with HEP and with restrictions
  - Avoid strong hamstring stretching

Phase 1: Post-operative Weeks 0-4

- ROM/Flexibility Exercises:
  - Heel prop (with or without quad sets), Prone hang, gastroc/soleus stretches, gentle hamstring stretches
  - PROM EOB knee flexion, heel slides, prone quad stretch, stationary recumbent bike
- Strength:
  - Quad sets, SLR focus on extensor lag, TKEs
  - SLR for the hip in all other directions (standing or on treatment table)
  - Ankle theraband, heel raises
- Gait Training:
  - Floor and treadmill; with and without crutches
- Balance:
  - Weight shifting forward/backwards and side/side; SLS
- Modalities:
  - NMES with quad setting, SLR and TKE
- Manual therapy:
  - Scar mobilization, patellofemoral mobs, tibiofemoral mobs, PROM

Phase 2: Post-operative Weeks 4-12

- The "Impatient Patient" Phase
- Special Considerations:
  - Protect patient from themselves
  - Review milestone achievements necessary to progress
- Goals to advance to phase 3:
  - Continue protection of graft and graft fixation
  - No patellofemoral pain
  - Flexion AROM > 120 degrees
  - Discharge brace when patient is able to perform x20 slow eccentric step downs from 6" step without dynamic valgus at the knee
  - Restore reciprocal stair ascent/descent pattern
  - Improve hip, quad, calf, core strength
  - Improve balance and proprioception
  - Begin treadmill jogging

Phase 2: Post-operative Weeks 4-12

ROM/Flexibility:
- Heel Prop or prone hang prn, gastroc/soleus/hamstring stretches
- Heel slides; Prone quad stretch; hip flexor stretch
- Stationary Bike (progress to upright bike if no patellofemoral symptoms)

Strength:
- Progress LE strengthening at all joints and core
- Resisted OKC hamstring strengthening
- CKC exercise progression
- Repetition!!!

Gait Training:
- Maintain normalized gait pattern with discharge of brace
- Begin treadmill jogging @ 10-12 weeks

Phase 2: Post-operative Weeks 4-12

- Balance:
  - SLS progressing
    - Surface
    - Movement
    - Eyes open/closed
    - Multiple variables
    - unknowns
  - Treadmill 4 ways
- Cardiovascular fitness:
  - Stationary bike progressing time and resistance
  - Swimming >week 10
  - Treadmill walking on incline (forwards and backwards)
- Agility/Plyometrics:
  - Jump training
  - Trampoline jog in place
  - Shuffling, backpedaling, jogging
  - Dynamic resistance
- Modalities:
  - Continue post-treatment cryotherapy as needed for soreness vs. swelling
- Manual therapy:
  - Maintain patellofemoral mobility
  - Scar mobilizations as needed

Phase 2: Criteria to Jog

1) Able to SLS with eyes closed x 60 seconds
2) Able to consistently demonstrate eccentric quad control, control for dynamic valgus at the knee and IR of the hip, and good trunk alignment with CKC single leg squat in multi-planes[7]
3) Proper landing form bilaterally and unilaterally when dropping from 6" step

Phase 2: Criteria to Jog

Phase 2: Criteria to Jog

Phase 2: Jogging

Phase 3: Post-operative weeks 12-20

- The "I'm out of shape" phase
- Goals to advance to phase 4:
  - Full ROM
  - Improve strength, endurance and proprioception to prepare for sport activities
  - Continue to address unilateral deficits
  - Continue to avoid over-stressing graft
  - Protect patellofemoral joint
  - Normalize running mechanics

Phase 3: Post-operative weeks 12-20

- ROM/Flexibility:
  - Progress stretching; dynamic
- Strength:
  - OKC quad strengthening 90-30 degrees
  - Progress core strengthening
  - Continue to progress LE strengthening and neuromuscular control
  - Lunge walking; SL squats
- Balance:
  - Continue to advance balance/proprioception; incorporate sport if possible

Phase 3: Post-operative weeks 12-20

- Cardiovascular fitness:
  - Bike/Swimming/Elliptical/Treadmill
  - Straight plane jogging on track
- Agility/Plyometrics
  - Ladder drills
  - DL/SL Hopping
  - Agility drills: butt kicks, marios, high knees, gassers
  - Slow paced lateral motion drills
- Manual therapy:
  - Joint mobilizations as needed

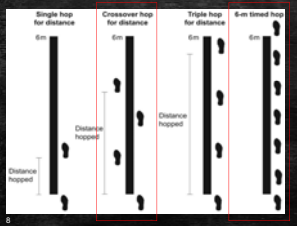
Phase 4: Post-operative Months 5-6

- The "It's gettin' real" phase
- Goals to advance to phase 5:
  - Symmetric performance of basic and sport-specific agility drills
  - Single limb hop for distance, three hop for distance, crossover hop and 6-m timed hop tests 90% of uninvolved leg [6,8]
- Begin sports-specific training no earlier than 5 months post-op
  - Criteria:
    - no significant inflammation or swelling
    - full, pain free ROM
    - no patellofemoral joint irritation
    - no other developing irritations
    - sufficient strength and proprioception to initiate agility drills
    - normal running gait on level surfaces

Phase 4: Post-operative Months 5-6

- Flexibility:
  - Progress based on individual needs and deficits
- Strength:
  - Progress strengthening, bilaterally
  - Continue core strengthening
- Cardiovascular Fitness:
  - Progress running time and distance
  - Cycling, swimming
- Agility/Plyometrics
  - Initiate plyometric program based on patient's athletic goals
  - Agility progression: figure 8 running, shuttle running, cone drills, 1 and 2 legged jumping (height, distance, direction), cutting, advanced ladder drills, acceleration/deceleration drills

Phase 4: Hop Testing



- Can asses combination of
  - Muscle strength
  - Neuromuscular control
  - Confidence in the limb
  - Ability to tolerate loads related to sport-specific activities
- Best predictors of self-reported knee function at 1 year post-op

8

Phase 5: Months 6-7

- The "Prepped and ready" Phase
- Goals of final formal rehab phase:
  - Gradual, safe return to sports
  - Maintenance of strength, endurance and proprioception
  - Patient education with regards to possible limitations

Additional Challenges of the Pediatric Patient

- Attendance
- Maturity level; peer and social pressures
- Figuring out what motivates them
- How to get them to comply with a home program

References

1) Gornitzky AL, Lott A, Yellin JL, Fabricant PD, Lawrence JT, Ganley TJ. Sport-specific yearly risk and incidence of anterior cruciate ligament tears in high school athletes. *Am J Sports Med*. 2015; 44(10): 2716-2723.
2) Gagnier JJ, Morgenstern H, Chess L. Interventions designed to prevent anterior cruciate ligament injuries in adolescents and adults: a systematic review and meta-analysis. *Am J Sports Med*. 2013; 41(8): 1952-1962.
3) Hewett TE, Ford KR, Myer GD. Anterior cruciate ligament injuries in Female athletes: part 2, a meta-analysis of neuromuscular interventions aimed at injury prevention. *Am J Sports Med*. 2006; 34(3): 490-498.
4) Myer GD, Sugimoto D, Thomas S, Hewett TE. The influence of age on the effectiveness of neuromuscular training to reduce anterior cruciate ligament injury in female athletes: a meta-analysis. *Am J Sports Med*. 2013; 41(1): 203-215.
5) Yellin JL, Fabricant PD, Gornitzky A, Greenberg EM, Conrad S, Dyke JA, Ganley TJ. Rehabilitation following anterior cruciate ligament tears in children. *Journal of bone and joint surgery*. 2016; 4(1): 1-15.
6) Wiggins AJ, Grandhi RK, Schneider DK, Stanfield D, Webster KE, Myer GD. Risk of secondary injury in younger athletes after anterior cruciate ligament reconstruction: a systematic review and meta-analysis. *Am J Sports Med*. 2016; 44(7): 1861-1876.
7) Garrison JC, Bothwell JM, Wolf G, Aryal S, Thigpen CA. Y Balance Test anterior reach symmetry at three months is related to single leg functional performance at time of return to sports following anterior cruciate ligament reconstruction. *The International Journal of Sports Physical Therapy*. Oct 2015; 10(5): 602-611.
8) Logerstedt D, Grindem H, Lynch A, Eitzen I, Engebretsen L, Risberg MA, Axe MJ, Snyder-Mackler L. Single-legged hop tests as predictors of self-reported knee function after anterior cruciate ligament reconstruction. *Am J Sports Med*. 2012; 40(10) 2348-2356.