UNC ACLR Return to Sport Criteria

Summary of Testing Criteria for RTS (See Specifics Below for Each)

1. **Time (≥ 9 Months Post ACLR to Return to Unrestricted Cutting & Pivoting)**
2. **Symptoms (No Pain and Minimal to No Joint Effusion)**
3. **Normal AROM (Equal & Pain Free Compared to the Uninvolved Limb)**
4. **Restored Isolated Strength (Quadriceps & Hamstrings LSI ≥ 90%)**
5. **Restored Functional Performance (Hop & Jump Tests LSI ≥ 90%)**
6. **Sport-Specific Activities (Completion of An On-Field / Court Rehab Program)**
7. **Patient-Reported Outcomes (GROC ≥ 90%; ACL-RSI ≥ 60)**
8. **Physician Clearance**

Sport Specific Activities (If Goal Is to Return to Cutting, Pivoting, Contact etc.)

Completion of An On-Field / On-Court Rehab Program with Good Movement Quality

Completion Should Be Tailored to the Respective Needs of the Individual

- **Stage 1 - Linear Movement Training**
  - Specific Entry Criteria
    - No Pain or Swelling
    - No Reports of Instability
    - Hamstring & Quad LSI >/= 80%
    - Good Movement Quality with Gym Based Movement Tasks
  - Goals of stage
    - To Establish A Foundation for High Speed Running Exposure (Up to 55% Max Sprint Speed)
    - To Establish A Foundation for Deceleration & Turn Capacity (Up to 55% Max Sprint Speed)
    - To Establish A Foundation for Skill Work Integration
- **Stage 2 - Multidirectional Movement Training**
  - Specific Entry Criteria
    - No pain or swelling
    - Satisfactory progression through stage 1 activities
    - Patient reports confidence with movements and activities
    - Clinician notes confidence with movements and activities
  - Goals of stage
    - Multidirectional movement
    - Progress high-speed running
    - Introduce less controlled tasks
- **Stage 3 - Technical & Reactive Movement Training**

    - Specific Entry Criteria
        - No pain or swelling
        - Knee flexor and extensor strength >90% compared to non-surgical limb
        - Satisfactory progression through stage 2 activities
        - Good movement quality with preplanned sport tasks
        - Patient reports confidence with movements and activities
        - Clinician notes confidence with movements and activities
    - Goals of stage
        - Sport technical training
        - Reactive movement training
        - Intro to max effort sprinting
- **Stage 4 - Sport Specific Movement & Skill Restoration**
    - Specific Entry Criteria
        - No pain or swelling
        - Satisfactory progression through stage 3 activities
        - Patient reports confidence with movements and activities
        - Clinician notes confidence with movements and activities
    - Goals of stage
        - Sport skill training
        - Reactive high-speed running
        - Intro to tasks with opponent pressure (minimal contact)
- **Stage 5 - Training Simulation & Reconditioning**
    - Specific Entry Criteria
        - No pain or swelling
        - Satisfactory progression through stage 4 activities
        - Patient reports confidence with movements and activities
        - Clinician notes confidence with movements and activities
    - Goals of stage
        - Sport simulation
        - Training reconditioning
        - Technical tasks at game speeds with reactive demands

Evidence

Stage Specific Entry Criteria

- **Stage 1 - Linear Movement Training**
  - Specific Entry Criteria
    - No Pain or Swelling
    - No Reports of Instability
    - Hamstring & Quad LSI >/= 80%
    - Good Movement Quality with Gym Based Movement Tasks
- **Stage 2 - Multidirectional Movement Training**
  - Specific Entry Criteria
    - No pain or swelling
    - Satisfactory progression through stage 1 activities
    - Patient reports confidence with movements and activities
    - Clinician notes confidence with movements and activities
- **Stage 3 - Technical & Reactive Movement Training**
  - Specific Entry Criteria
    - No pain or swelling
    - Hamstring & Quad LSI >/= 90%
    - Satisfactory progression through stage 2 activities
    - Good movement quality with preplanned sport tasks
    - Patient reports confidence with movements and activities
    - Clinician notes confidence with movements and activities
- **Stage 4 - Sport Specific Movement & Skill Restoration**
  - Specific Entry Criteria
    - No pain or swelling
    - Satisfactory progression through stage 3 activities
    - Patient reports confidence with movements and activities
    - Clinician notes confidence with movements and activities
- **Stage 5 - Training Simulation & Reconditioning**
  - Specific Entry Criteria
    - No pain or swelling
    - Satisfactory progression through stage 4 activities
    - Patient reports confidence with movements and activities
    - Clinician notes confidence with movements and activities

Rationale

The outline of our recommendations for specific entry criteria are based the work of Buckthorpe et al who propose a five stage process for on-field rehabilitation following an anterior cruciate ligament reconstruction (ACLR).[1] Each stage presents with different and progressive criteria designed to create the highest probability that the athletes is physically and psychologically prepared to enter the phase while attempting minimizing the chance of

reinjury or secondary injury. Each stage presents the criteria that the athlete should report no pain and demonstrate no swelling before entering the stage. Control of pain and swelling are classically utilized as progression criteria in ACLR return to sport rehabilitation programs, especially in the early phases, as pain and swelling have been shown to be problematic in this population. Potential issues if pain and swelling are not controlled can include altered gait patterns, arthrogenic inhibition of the quadriceps, decreased ability to bear weight, and decreased knee extension range of motion.[2] In stage 1, the entry criteria of >/=80% limb symmetry index (LSI) is based primarily on literature examining changes in gait and jogging mechanics in individuals following ACLR who display quadriceps force output levels of <80% compared to the uninvolved limb.[3] Lewek et al demonstrated that individuals who had a quadriceps LSI of >80% following ACLR demonstrated decreased knee flexion angles during walking and jogging tasks and resembled movement patterns demonstrated by ACL deficient subjects.[3] In stage 3, the entry level criteria of >/=90% LSI is based primarily on literature from examining the impact of asymmetrical quadriceps force output on risk of reinjury following ACLR.[4] Grindem et al found quadriceps strength to be a significant predictor of reinjury in this population and expressed the importance of individuals reaching a 90% LSI before returning to level I sports (e.g., sports that require hard cutting, running, and jumping).[4] Considering that stage 3 is the introductory stage for sport technical training and reactive movement training, it is ideal if individuals reach the >/=90% LSI for quadriceps and hamstring force output as these tasks likely align with, or represent components of, tasks demands of sport. Stages 2-5 also include the criteria of "satisfactory progression through" the previous stage in order to have a logical sequence of progression from tasks and drills that are more controlled, preplanned, and closed to those that are less controlled, reactive, and open. Lastly, criteria were added to allow both patient and clinician reflections on confidence with movements and activities in stages in 2-5 before progressing to more challenging situations. There is evidence suggesting that lower levels of psychological readiness and/or higher levels of fear avoidance when returning to sports after an ACLR can negatively influence self-reported knee function related to activities of daily living and sporting activities and may place patients at a higher risk of secondary ACL injuries, particularly in younger patient populations.[5–7]

References

1. Buckthorpe M, Della Villa F, Della Villa S, Roi GS. On-field Rehabilitation Part 2: A 5-Stage Program for the Soccer Player Focused on Linear Movements, Multidirectional Movements, Soccer-Specific Skills, Soccer-Specific Movements, and Modified Practice. *J Orthop Sports Phys Ther*. 2019;49(8):570-575. doi:10.2519/jospt.2019.8952

2. van Grinsven S, van Cingel REH, Holla CJM, van Loon CJM. Evidence-based rehabilitation following anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 2010;18(8):1128-1144. doi:10.1007/s00167-009-1027-2

3. Lewek M, Rudolph K, Axe M, Snyder-Mackler L. The effect of insufficient quadriceps strength on gait after anterior cruciate ligament reconstruction. *Clin Biomech (Bristol, Avon)*. 2002;17(1):56-63. doi:10.1016/s0268-0033(01)00097-3

4. Grindem H, Snyder-Mackler L, Moksnes H, Engebretsen L, Risberg MA. SIMPLE DECISION RULES REDUCE REINJURY RISK AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION. *Br J Sports Med*. 2016;50(13):804-808. doi:10.1136/bjsports-2016-096031

5. McPherson AL, Feller JA, Hewett TE, Webster KE. Psychological Readiness to Return to Sport Is Associated With Second Anterior Cruciate Ligament Injuries. *Am J Sports Med*. 2019;47(4):857-862. doi:10.1177/0363546518825258

6. Ross MD. The relationship between functional levels and fear-avoidance beliefs following anterior cruciate ligament reconstruction. *J Orthop Traumatol*. 2010;11(4):237-243. doi:10.1007/s10195-010-0118-7

7. Genoese F, Baez S, Hoch JM. The Association of Fear-Avoidance Beliefs and Self-Reported Knee Function in Patients With a Knee Injury: A Critically Appraised Topic. *International Journal of Athletic Therapy and Training*. 2018;23(5):187-191. doi:10.1123/ijatt.2017-0108

Goals of Stage

- **Stage 1 - Linear Movement Training**
  - Goals of stage
    - To stablish A Foundation for High Speed Running Exposure (Up to 55% Max Sprint Speed)
    - To Establish A Foundation for Deceleration & Turn Capacity (Up to 55% Max Sprint Speed)
    - To Establish A Foundation for Skill Work Integration
- **Stage 2 - Multidirectional Movement Training**
  - Goals of stage
    - Multidirectional movement
    - Progress high-speed running
    - Introduce less controlled tasks
- **Stage 3 - Technical & Reactive Movement Training**
  - Goals of stage
    - Sport technical training
    - Reactive movement training
    - Intro to max effort sprinting
- **Stage 4 - Sport Specific Movement & Skill Restoration**
  - Goals of stage
    - Sport skill training
    - Reactive high-speed running
    - Intro to tasks with opponent pressure (minimal contact)
- **Stage 5 - Training Simulation & Reconditioning**

- Goals of stage
  - Sport simulation
  - Training reconditioning
  - Technical tasks at game speeds with reactive demands

Rationale

The outline of our recommendations for the goals of each stage are based the work of Buckthorpe et al and Taberner et al who both propose a five stage process for on-field rehabilitation following an anterior cruciate ligament reconstruction (ACLR).[1,8] The overarching theme with the goals is to create an on-field rehab program that is progressively more challenging in nature with the early stages involving more controlled, pre-planned, and closed tasks (standardized skills in non-changing environment) and later stages involving more "chaotic", reactive, and open movements and tasks (varying tasks in changing environments).[1,8] In stage 1, our aim is to lay the foundation for the following stages by introducing submaximal running speeds (< 55% maximal sprint speed), introducing the athlete to tasks that act as precursors to deceleration during running and sport-specific tasks (such as snap-downs, lunge and holds, lunge and explode out), and to introduce tasks to familiarize the athlete with skill work integration (tapping soccer ball back and forth, keep ups with soccer ball, dribbling basketball in place, or passing basketball in place). In stage 2, the primary goals are to build upon the foundation created in stage 1 and progress to movements that are multidirectional in nature, introduce less-controlled tasks (such as change of direction with and without a ball at lower speeds and shallow cutting angles), and to progress high speed running (around 70% maximal sprinting speed). Stage 3 can be viewed as a transitional period to more advanced movements and tasks as the goals align with sport technical training as well as those that introduce maximal speed training. Some of goals include increasing high speed running distances and introducing reactive training. Stage 4 signifies the initiation of contact drills with and without a ball along with reactive high speed running, increased sport-specific skill training, and progressions of maximal effort running. Stage 5 represents the final stage of the on-field rehab process and focuses on sport-specific tasks performed in chaotic environments and at game speeds. During this stage, and potentially even sooner, a sport or skill coach should be consulted to assist in designing an appropriate program.

References

1. Buckthorpe M, Della Villa F, Della Villa S, Roi GS. On-field Rehabilitation Part 2: A 5-Stage Program for the Soccer Player Focused on Linear Movements, Multidirectional Movements, Soccer-Specific Skills, Soccer-Specific Movements, and Modified Practice. *J Orthop Sports Phys Ther*. 2019;49(8):570-575. doi:10.2519/jospt.2019.8952

8. Taberner M, Allen T, Cohen DD. Progressing rehabilitation after injury: consider the 'control-chaos continuum.' *Br J Sports Med*. 2019;53(18):1132-1136. doi:10.1136/bjsports-2018-100157

Combined references:

1. Buckthorpe M, Della Villa F, Della Villa S, Roi GS. On-field Rehabilitation Part 2: A 5-Stage Program for the Soccer Player Focused on Linear Movements, Multidirectional Movements, Soccer-Specific Skills, Soccer-Specific Movements, and Modified Practice. *J Orthop Sports Phys Ther*. 2019;49(8):570-575. doi:10.2519/jospt.2019.8952

2. van Grinsven S, van Cingel REH, Holla CJM, van Loon CJM. Evidence-based rehabilitation following anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 2010;18(8):1128-1144. doi:10.1007/s00167-009-1027-2

3. Lewek M, Rudolph K, Axe M, Snyder-Mackler L. The effect of insufficient quadriceps strength on gait after anterior cruciate ligament reconstruction. *Clin Biomech (Bristol, Avon)*. 2002;17(1):56-63. doi:10.1016/s0268-0033(01)00097-3

4. Grindem H, Snyder-Mackler L, Moksnes H, Engebretsen L, Risberg MA. SIMPLE DECISION RULES REDUCE REINJURY RISK AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION. *Br J Sports Med*. 2016;50(13):804-808. doi:10.1136/bjsports-2016-096031

5. McPherson AL, Feller JA, Hewett TE, Webster KE. Psychological Readiness to Return to Sport Is Associated With Second Anterior Cruciate Ligament Injuries. *Am J Sports Med*. 2019;47(4):857-862. doi:10.1177/0363546518825258

6. Ross MD. The relationship between functional levels and fear-avoidance beliefs following anterior cruciate ligament reconstruction. *J Orthop Traumatol*. 2010;11(4):237-243. doi:10.1007/s10195-010-0118-7

7. Genoese F, Baez S, Hoch JM. The Association of Fear-Avoidance Beliefs and Self-Reported Knee Function in Patients With a Knee Injury: A Critically Appraised Topic. *International Journal of Athletic Therapy and Training*. 2018;23(5):187-191. doi:10.1123/ijatt.2017-0108

8. Taberner M, Allen T, Cohen DD. Progressing rehabilitation after injury: consider the 'control-chaos continuum.' *Br J Sports Med*. 2019;53(18):1132-1136. doi:10.1136/bjsports-2018-100157