

Return to Play: Evidence Based Decision Making

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Life In Motion

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I have no disclosures

Dino Pinciotti, PT

- Director of Physical Therapy at The Center of Rehabilitation and Sports Excellence at UOA
- 39 years of clinical practice in Orthopedics
- Lecture on ACL Rehab
- He has treated professional, Olympic, amateur and high school athletes. Over his career, Dean has worked directly with:
 - The United States Olympic Rowing Team
 - The United States Olympic Rehabilitation Center
 - The American Repertory Ballet Company
 - The New Jersey Nets
 - Rutgers University lightweight football
 - The New Jersey Wildcats women's soccer team
 - The New Jersey Stars World Team Tennis team
 - Princeton Day School Athletics
- He also traveled internationally with the U.S. Rowing Team to the World Championships in Gifu, Japan in 2005.



Return to Play – What does it mean?

- Are there, validated objective/subjective criteria to determine appropriate RTP for athletes?
- What does the research say?
- No clear “Most Common” Criteria for RTP
- 40% - 60% of athletes return to the same level of sports after an ACLR
- Injury Rates:
 - Males: 1 out of 50
 - Females: 1 out of 36

More Statistics:

- Likelihood of re-injury of the ipsilateral or contralateral ACL is 19.4% (9 months post op)
- 7 Times greater for those who return earlier
- Are the tests sensitive and specific enough for predicting RTP?
- Educate the athlete about the risk of re-injury when returning to sports regardless of adequate functional performance and need to consider other factors know to increase re-injury...
 - Time post op, younger age, symmetry of quad strength, and fear

Need Objective Guidelines

- How many of you currently do some sort of return to sport testing prior to allowing an athlete return to the field?
- Need for a multidisciplinary approach to ACL Rehab and RTP criteria
- No clear consensus for RTP tests or battery of tests can predict the risk of reinjury better than others
- There are some promising outcome data of which RTP tests we should use

Survey Says....

- 250,000 ACL injuries annually in the US
- Estimated cost of ACL rupture including surgery and
 - Rehabilitation is \$17,000–\$25,000 per injury
- 55% of athletes return to sport at their previous level of participation
- 50% osteoarthritis within 10–15 years after ACLR
- No current consensus on key components of return-to-sport testing after ACL reconstruction

1. Griffin et al., 2006 2. Hewett et al., 1999 3. De Loes et al, 2000 4. Ardern et al., 2014
5. Oiestad et al., 2011 6. Oiestad et al., 2010

Return-to-Sport (RTS) Decision-Making: Current Evidence Review

- **Key components to determining RTS readiness**
 - – Quadriceps strength
 - – Fear of reinjury/confidence
 - – Time from surgery
 - – Functional testing performance

RTP Criteria:

- ***Time from surgery*** – most prevalent in 85% of published literature
- ***Strength*** – second most common criteria in 41% of the studies
 - Isokinetic Testing or Isometric Testing Knee Extension/ Flexion
 - Leg Symmetry Index (LSI) – primary variable of interest rather than absolute or relative strength value
- ***Functional Performance Testing*** –
 - Hop Tests (4 – distance, triple hop, cross over trip hop & 6 meter timed hop)
 - Easy to administer
 - Excellent inter-rater reliability
 - Reid et al 2007, Gustavsson et al. 2006, Noyes, Mangine 1991
 - Greater than 90% Limb Symmetry Index

RTP Criteria: (continued)

- ***Psychological Readiness –***
 - *Tampa Scale of Kinesiophobia: (TSK)*
 - *Re-Injury Anxiety Inventory: (RIAI)*
 - *Injury-Psychological Readiness to Return to Sport Scale: (IPRRS)*
 - *ACL Return to Sport After Injury Scale: (ACL-RSI)*
 - *Knee Self-Efficacy Scale: (K-SES)*
- ***Video Analysis – 3D***
- ***Neurocognitive Rehab – Blaze Pods, Perbutation Ex's***
- ***Athletic Performance Assessment – (may be in the future)***
 - Speed, agility, strength, and cardiovascular endurance
 - Not fully valid or reliable testing for APA

Psychological Readiness:

- The mind matters for returning to sport
- Simple support strategies fit into your rehabilitation practice to support athletes
- Monitoring psychological readiness can use generic and condition-specific tools

Return-to-Sport Decision-Making: Quadriceps Strength

- **Quad strength**
 - – Isokinetic quadriceps strength LSI >95%
 - – Handheld dynamometry
 - – Leg press 1RM

Return-to-Sport Decision-Making: Fear

- **Patients with high fear**
 - Four times more likely to report lower levels of activity
 - More likely to have hop test LSI <95%
 - More likely to have quadriceps symmetry lower than 90%
 - Higher risk of ipsilateral ACL injury
 - Psychological readiness to RTS has been found to be predictive of actual return to sport
- **How do we measure fear?**
 - Tampa Scale of Kinesiophobia (TSK-11)
- **How do we measure psychological readiness?**
 - ACL Return to Sport After Injury (ACL-RSI) scale

1. Chmielewski et al., 2008

2. Paterno et al., 2017

3. Ardern et al., 2014

4. Webster & Feller, 2018

Return-to-Sport Decision-Making: Time from Surgery

- **Current evidence suggests a delayed return to sport is protective**
 - 30% risk reduction for each month delay in RTS up to nine months
 - Seven times reinjury rate for those who return before nine months
 - Others suggest 50% increased risk before seven months

1. Grindem et al., 2016 2. Beischer et al., 2020 3. Chaaban et al., 2017

Return-to-Sport Decision-Making: Functional Performance Tests

- **Hop tests**
 - Zwolski et al., 2016
 - Only individuals with unilateral ACLR demonstrated an altered LSI during hop testing
 - Low quadriceps strength despite symmetrical hop tests
 - Hop tests not associated with psychological factors
 - (ACL-RSI, KOOS [q 3]) at RTS decision time
 - Patients with good hop test results (85% limb symmetry index) were more likely to return than patients with poor results
 - Consider adding an assessment of quality of movement
 - **Tuck jump**
 - **Cutting assessment**
- Video Analysis –phone**

Zwolski et al., 2016

Return-to-Sport Decision-Making: RTS Clearance Testing

Quadriceps strength	Quadriceps LSI >95%
Fear of reinjury	Alert for highly fearful athletes
Time from surgery	>9 months postoperative
Functional testing performance	Hop Tests but Consider LSI and quality of movement

TIME:

- Is there a minimal time for an athlete to return?
- Outlier:
- Adrian Petersen
- ACL Tear and MCL Tear 2011
 - Returned to the NFL in 8 months
 - Won the rushing record the next year
 - MVP of the NFL in 2012



LSI Long Term Results

- Systematic Review 42 studies and 13,150 Adolescents
 - Increased odds of poor knee-related outcomes after 1-37 years
 - Did not achieve adequate LSI on unilateral functional tests
 - Need to optimize knee function in in the first 1-2 years post ACLR to reduce long-term burden ie. OA
 - West, TJ et al Br J Sports Med 2023

How, When, and Who Decides RTP?

- Literature is inconclusive
- Current outcome measures lack sensitivity to detect impairments that could impact function
- Need to perform objective testing criteria
- Performed at the appropriate time period
- Collective decision – Surgeon, PT, ATC

Objective Measurements / Tests

- **Joint stability**
 - Lachman
 - Pivot Shift
 - Anterior Drawer
 - Collateral injury
 - **Muscle Strength**
 - Free Weights
 - Hand held dynamometer – isometrics - MicroFet
 - Isokinetic testing
 - **Proprioception**
 - Not much literature focuses on balance/control stability
 - Star Excursion Balance Test – (SEBT)
 - Neurocom,
 - KAT

Objective Measurements / Tests (Cont.)

- Leg Symmetry Index (LSI)
 - Ratio of operated leg vs non-operated Leg
 - LSI – (prefer 4 hop tests can include vertical for 5)
 - One legged hop for distance, triple hop, cross over triple hop and timed 6 m single leg hop
 - LSI of 90% in all 4 tests performed
 - Pivoting sports must be 100% or greater

Anterior / Posterior Knee Laxity:

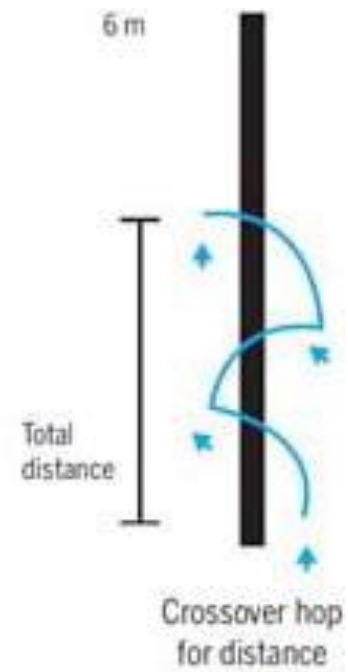
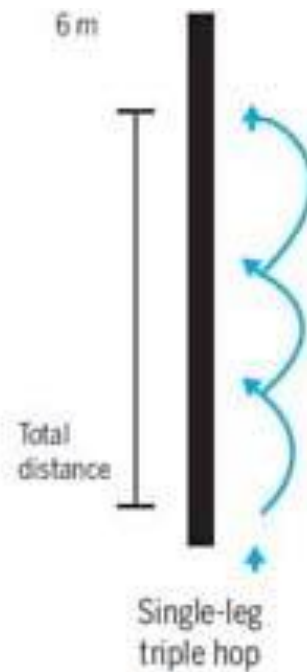
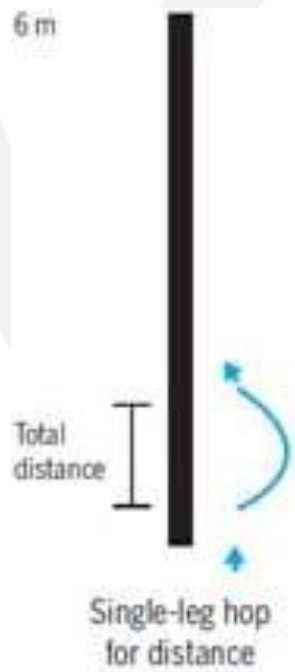
- KT-1000 Knee Ligament Arthrometer
- 3 mm or more if increased translation, compared to the normal contralateral knee
- Performed Pre-Op and Post-Op
- > 3mm difference in bilateral comparison – increased laxity therefore increased risk



Functional Testing: Hop Tests

- Single Leg Hop Tests
 - Quick and inexpensive
 - Allow for a more comprehensive assessment of functional capacity of the knee joint
- Single leg hop for Distance
 - 85% (90-100%) LSI
 - 1991 Noyes – Gold standard
- High Reliability and Validity - Gustavsson A, 2006
- Cross Over Triple Hop for Distance
 - Good indicator for lateral movement /stability
- Timed 6 meter Single leg hop

4 Single Leg Hops



Prehabilitation:

- A preoperative extension deficit (lack of full extension) is a major risk factor for an extension deficit after ACLR.
- A preoperative deficit in quadriceps strength of >20% has a significant negative consequence for the self-reported outcome 2 years after ACLR.
- Prehabilitation ensures better self-reported knee function up to 2 years after ACLR.

Risk of Re-injury

- Prospective cohort studies of Hewett *et al* and Paterno *et al* support the conclusions of the systematic review of Swärd *et al* that altered neuromuscular function and biomechanics could be responsible for the risk of second ACL rupture (graft re-rupture and contralateral ACL).
- Factors contributing could be greater hip internal rotation, the occurrence of dynamic knee valgus or less knee flexion when landing from a jump.

How Are Athletes Faring?

- 17.4% of patients met criteria for a return to noncompetitive sports at nine months
 - One patient fulfilled the criteria for a full return to competitive sports after the second test battery
- Gokeler et al. (2019): RTS test battery at six months (isokinetic test, three hop tests, LESS, IKDC, ACLRSI)
 - 2 out of 28 patients passed all criteria of the test protocol
- Sugimoto et al. (2019): 4.2% of skeletally immature patients achieve >90% LSI in three tests (isokinetic strength, hop tests, Y-balance) seven months post-ALCR

1. Marshall et al, 2016

2. Myklebust et al., 2003

3. Sugimoto et al., 2019

4. Gokeler et al., 2019

RTS Testing and Secondary ACL Injury Risk Prediction

- **Kyritsis et al. (2016)**
 - Athletes who did not meet all six discharge criteria (isokinetic strength testing, a running t-test, single hop, triple hop, and triple crossover hop tests) = four times greater risk of reinjury
- **Webster & Feller (2019)**
 - 29% met the threshold for satisfactory function (a flexion deficit of ≤ 5 , an extension deficit of ≤ 3 , a side-to-side difference in anterior knee laxity of < 3 mm, LSIs of $\geq 90\%$ for the hop tests, and an IKDC score of ≥ 90)
 - Those who met criteria had a 33% reduction in the risk of sustaining a second ACL injury ($p = .05$)

1. Kyritsis et al., 2016 2. Webster & Feller, 2019

Conclusions:

- There is also no conclusive evidence that any test or test battery can accurately identify athletes at high risk of reinjury. Therefore, we recommend to perform an extensive test battery for quantity and quality of movement.
- This test battery should include at least a strength test battery and a hop test battery and measurement of quality of movement for determining the moment for return to play. An LSI of $>90\%$ could be used as a cut-off point. For pivoting/contact sports, an LSI of $\geq 100\%$ is recommended.
- Qualitative scoring systems as the Jump Landing System and Landing Error Scoring System have been developed in the past few years, but it is still unclear in which manner quality of movement plays a role in the occurrence of ACL reinjuries.
- Therefore, prospective studies are needed to evaluate whether these scoring systems are able to measure neuromotor control and to investigate the predictive validity of those qualitative scoring systems.

Summary:

- Return-to-sport testing should be based on second ACL injury risk prediction
- Testing should consider quadriceps strength, fear of reinjury, time from surgery, and functional testing performance
- Rehabilitation programs need to ensure that athletes are adequately prepared for a safe return to sport

A stylized, light gray graphic of a person with their arms raised in a celebratory gesture, positioned on the left side of the slide. The figure is composed of simple, curved lines and an oval head.

Thank You