Return to Sports Participation and Discharge Testing

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My Background

- Originally from Warren, PA
- Bachelors in Sport and Exercise Science, Gannon University, Erie, PA
- Doctorate in Physical Therapy, University of Southern California, Los Angeles, CA
- Orthopedic Physical Therapy Residency, University of Southern California, Los Angeles, CA

Disclosures

- I have nothing to Disclose

Objectives

- Discuss the components of functional testing for lower extremity injuries
- Identify the criteria that athletes must meet to return to their sport
- Describe strategies to transition between formal rehabilitation and performance training

Recognizing the current limitations

- Return to Sport (RTS) testing is common, however, it is variable, not standardized, and continuing to evolve

Why Do We Test?

- Return to Sport Testing is an important process with regards to readiness for participation in high level activities in order to decrease risk of re-injury or secondary injury
- Risk Factors for Injury: **Previous Injury**, Asymmetry, and Fatigue
  - Following ankle sprains, up to 75% of individuals will suffer a recurrent sprain, with up to 70% of those patients developing chronic instability (Hubbard and Wikstrom 2010)
  - 30% of patients with non-contact ACL tear could have a second ACL tear within 2 years, up to 6x more likely to have an ACL tear compared to healthy controls (Paterno 2014)

Who Do We Test?

- Elite Athletes, Recreational Athletes, Tactical Athletes (Military, Police, EMS)
- Post-Surgical Patients
  - This is relatively common (not-standardized) area of Return to Sport Testing, especially in ACL-R Rehabilitation
- Non-Surgical Patients
  - Muscle Strains
    - Hamstring strains most common
  - Sprains

RTS Decision Making

- Time vs. Medical Examination vs. Return to Sport Testing
  - Clinical Exam Clearance with same relative risk when compared to Y-Bal/FMS, however, do not necessarily test/clear to same patients (Mayer et al. 2015)
  - Recent researchers suggest that time may be most significant factor associated with re-injury/secondary injury (ACL-R), and advisable wait time up to 2 years (Paterno et al 2014)
  - Generalizing data, desired LSI is at least 90% across the board

RTS Decision Making – Functional Outcome Measures

- Hip
  - Lower Extremity Functional Scale (LEFS), Hip Outcome Score (HOS), Harris Hip Score, Patient Specific Functional Scale (PSFS)
- Knee
  - LEFS, Knee Outcome Score (KOS), International Knee Documentation Committee Subjective Knee Evaluation (IKDC), PSFS
- Foot/Ankle
  - LEFS, Foot and Ankle Outcomes Questionnaire, PSFS

RTS Testing: What makes a good test?

- Reliable – the degree to which a test produces consistent results
- Reproducible – in the research, the methods described in such completeness that the study can be re-created exactly as done by original researchers
- Predictive of Injury
- Valid – it tests what it is supposed to
- Feasible – taking account cost, the test materials, space, time needed, as well as many other factors, is it possible for you to do?

Levels of Assessment: Return to Sport Testing

- Clinical Examination
- Limb Symmetry Index (LSI) Testing
  - Basic Functional/Early Clinical Tests
  - Transitional Strength/Endurance/Technique
  - Power/Control/Deceleration
- Endurance Testing
- Advanced Agility/Field Tests
- Re-integration into each facet of sport leading up to full clearance – On Field Progression

RTS Decision Making – Clinical Exam

- Goal prior to progressing to more rigorous RTS Testing is that the patient pass a Clinical Exam, with satisfactory scores in regards to:
  - Pain
  - Swelling
  - Range of Motion/Flexibility
  - Strength
  - Gait
- Successful re-integration back to ADL

Limb Symmetry Index Testing

- Limb Symmetry Index (LSI) Testing
  - Basic Functional/Early Clinical Tests
    - Functional Movement Screen (FMS)
    - Y-Balance/Star Excursion Balance Test (SEBT)
    - Isokinetic Testing
  - Transitional Strength/Endurance/Technique
    - Vail Sport Cord Test
  - Power/Control/Deceleration
    - Hop Testing

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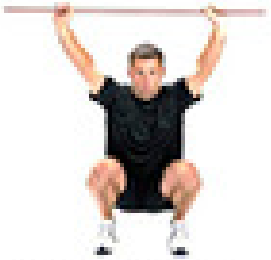
Functional Movement Screen

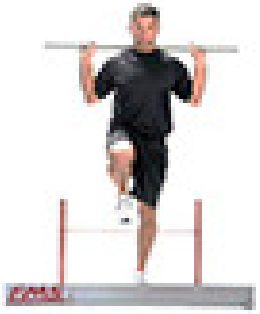
- Screening tool created by Cook et el. in 1997
- Goal to identify asymmetries which result in movement deficiencies
- Numerous Studies to demonstrate Reliability/Validity (Cook et al 1998, Teyhen et al 2012, Parenteau 2013)
- Consists of Seven Movement Patterns Graded from 0-3 Points (21 points possible)
  - 3/3 No Compensations
  - 2/3 Able to Perform movement with Compensations
  - 1/3 Unable to Perform Movement
  - 0/3 Pain during attempted movement
- Cut-Off Score of 14/21

FMS

The Functional Movement Screen



1. Squatting



2. Stepping

3. Lunging

4. Reaching

5. Leg Raising

6. Push-up

7. Rotary Stability

FUNCTIONAL MOVEMENT SYSTEMS FMS FUNCTIONALMOVEMENT.COM

Y-Balance / SEBT

- Y-Balance Test derived from Star Excursion Balance Test first described by Gary Gray in 1995
  - SEBT: 8 Directions, 6 Practice Trials, 3 Measurements, 144 Repetitions
  - Y-Balance: 3 Reaches, Anterior, Posterior-Medial, and Posterior-Lateral
  - Tests dynamic balance at the limits of stability

Lower Quarter Y-Balance

Anterior Reach

Posterior Medial Reach

Posterior Lateral Reach

https://www.functionalmovement.com/Store/23/y-balance_test_kit

Lower Quarter Y-Balance

- Used to assess dynamic strength/balance at limits of stability
- Measures Limb Symmetry as well as Composite Score:
  - (Ant Reach + PM Reach + PL Reach) / 3x Limb Length x 100
- Different scores predictive for different populations
  - Butler et al. established Composition Cut-Off of 89% for College Football Players
  - Plisky et al. demonstrated Composition Cut-Off of 94% for High School Basketball Players

Lower Quarter Y-Balance

- 4cm Difference L/R Difference Anterior Reach results in 2.5x increased risk for injury – Plisky et al 2006
- Better Posterior-Lateral Reach decreases risk for ankle sprains – de Noronha et al 2012

Isokinetic Testing

- Isokinetics have been around since 1950s
- Isokinetic Testing measures various factors of muscle activation/strength for a designated(set) speed of movement
- Data for nearly all body regions, with most proliferative area being the knee

Isokinetic Testing

- Common Velocities tested: 60/180/300 deg/sec
- Goal of at least 85-90% Symmetry
- Common Variables Evaluated:
  - Peak Torque (Most Common in literature per Davies et al)
  - Torque/Body Weight Ratio
  - Angle Specific Torque
  - Total Work
  - Average Power
  - Rate of Force Development
  - Quadriceps/Hamstrings Ratio

Limb Symmetry Index Testing

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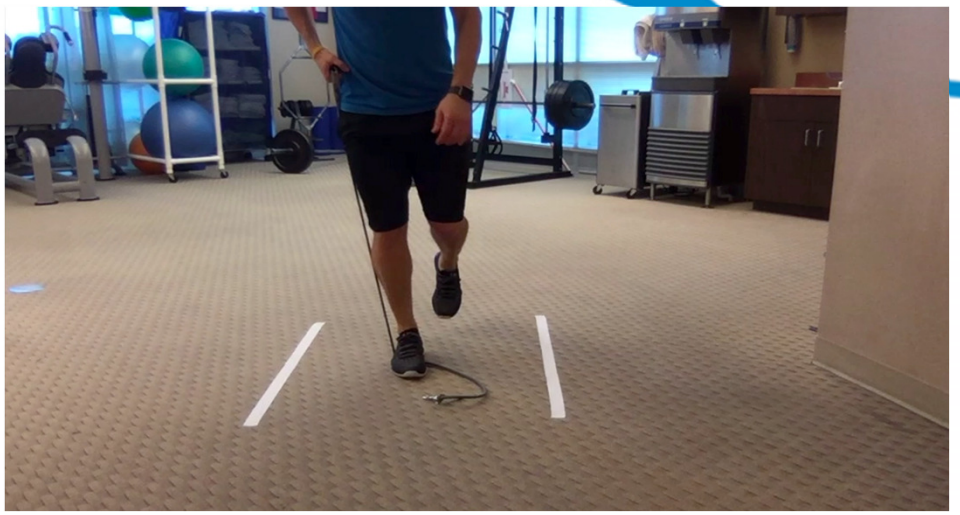
  - Transitional Strength/Endurance/Technique
    - Vail Sport Cord Test
  - Power/Control/Deceleration
    - Hop Testing

Vail Sport Cord Test

- Functional Test that evaluates muscle strength, endurance, power, and movement quality
- Originally described by Garrison et al 2012
- 4 Components – Possible 54 Total Points - 46/54 Considered Passing Score (85%)
  - Single Leg Squat – 3 min – Possible 15 Points
  - Lateral Bounding – 90 sec – Possible 15 Points
  - Forward Jogging – 2 min – Possible 12 Points
  - Backward Jogging – 2 min – Possible 12 Points
- **Also a Hip Version**

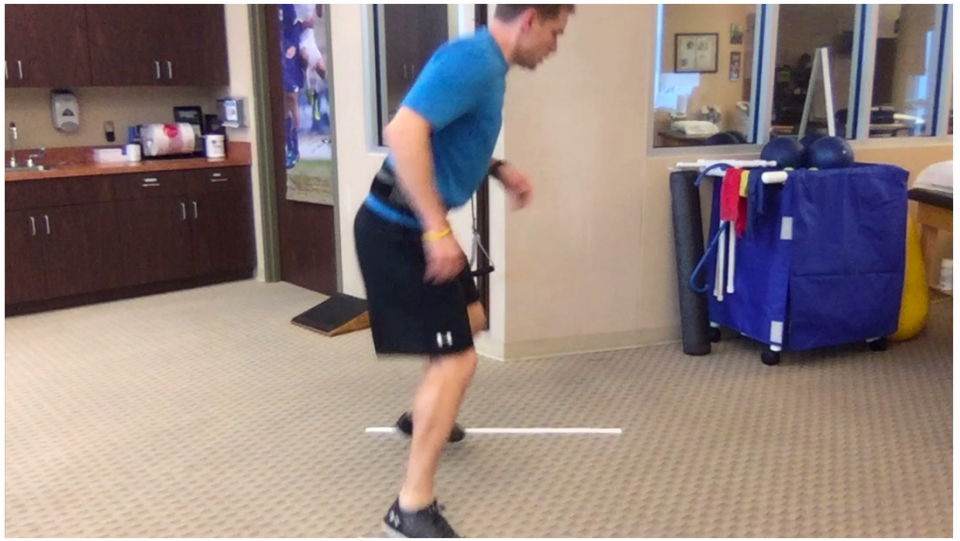
Vail Sport Cord Test

- **Single Leg Squat (goal: 3 minutes)**
- 1. Knee flexion angle between 30 and 60° Yes (1) No (0)
- 2. Patient performs repetitions without dynamic knee valgus *knee valgus = patella falls medial to the great toe
- Yes (1) No (0)
  3. Patient avoids locking knee during extension
- Yes (1) No (0)
  4. Patient avoids patella extending past the toe during knee flexion
- Yes (1) No (0)
  5. Patient maintains upright trunk during knee flexion
- Yes (1) No (0)
  Minute 1 _____ Minute 2 _____ Minute 3 _____
- Single Leg Squat Total Points: _____/15
- • If patient repeats error on 3 consecutive repetitions after correction, they are not eligible to receive a point for that particular standard (within each 1 minute timeframe).

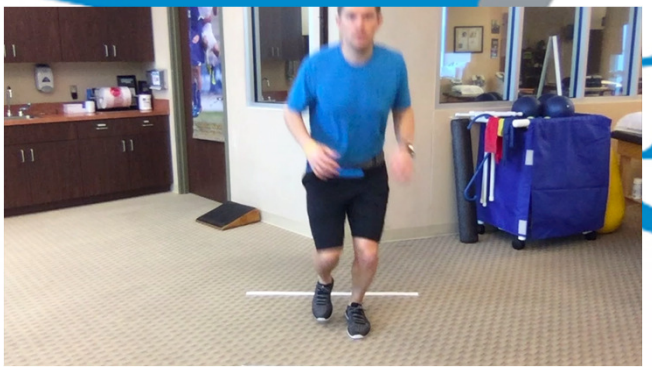


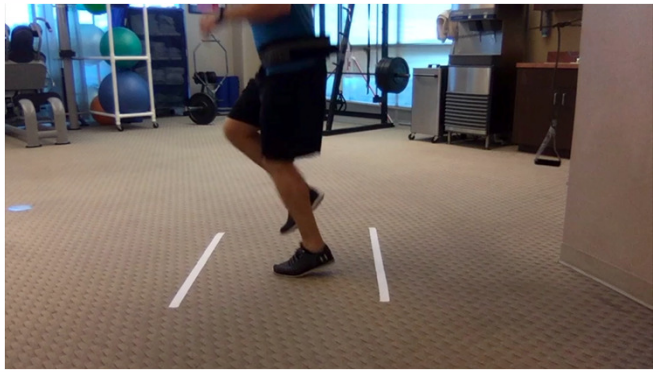
Vail Sport Cord Test

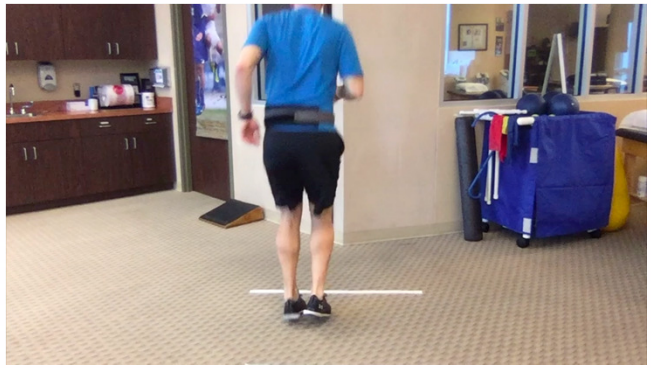
- **Lateral Bounding (goal: 90 seconds)**
- 1. Knee flexion angle is 30° or greater during landing Yes (1) No (0)
- 2. Patient performs repetitions without dynamic knee valgus *knee valgus = patella falls medial to the great toe
- Yes (1) No (0)
  3. Patient performs repetitions within landing boundaries
- Yes (1) No (0)
  4. Landing phase does not exceed 1 second in duration
- Yes (1) No (0)
- 5. Patient maintains upright trunk during knee flexion Yes (1) No (0)
- 1st 30 sec _____ 2nd 30 sec _____ 3rd 30 sec _____ Lateral Bounding Total Points _____/15
- • If patient repeats error on 3 consecutive repetitions after correction, they are not eligible to receive a point for that particular standard (within each 30 second timeframe).



Vail Sport Cord Test







- **Forward Jogging/Backward Jogging (goal: 2 minutes)**
- 1. Knee flexion angle between 30 and 60° Yes (1) No (0)
- 2. Patient performs repetitions within landing boundaries Yes (1) No (0)
- 3. Patient performs repetitions without dynamic knee valgus * knee valgus = patella falls medial to the great toe
- Yes (1) No (0)
- 4. Patient avoids locking knee during extension Yes (1) No (0)
- 5. Landing phase does not exceed 1 second in duration Yes (1) No (0)
- 6. Patient maintains upright trunk during knee flexion
- Yes (1) No (0)
  Minute 1 _____ Minute 2 _____
- Forward Jogging Total Points _____/12
- Backward Jogging Total Points _____/12
- • If patient repeats error on 3 consecutive repetitions after correction, they are not eligible to receive a point for that particular standard (within each 1 minute timeframe).

Vail Hip Sport Cord Test

- Single Leg Squat – 3 min – Possible 6 Points
- Lateral Bounding – 100 sec – Possible 5 Points
- Diagonal Bounding – 100 sec – Possible 5 Points
- Forward Box Lunge – 2 min – Possible 4 Points
- 20 points Total

Limb Symmetry Index Testing

- Limb Symmetry Index (LSI) Testing
  - Basic Functional/Early Clinical Tests
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    - Hop Testing

Hop Testing

- Noyes Hop Tests
  - Single Leg Hop
  - Single Leg Triple Hop
  - Single Leg Triple Cross-Over Hop
  - 6 Meter Timed Hop
- Drop Jump (LESS)
- Tuck Jump
- Vertical Jump
- “Back in Action” Testing Battery
- Functional Lower Extremity Evaluation (FLEE) Testing Battery

Noyes Hop Tests

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  - Single Leg Hop
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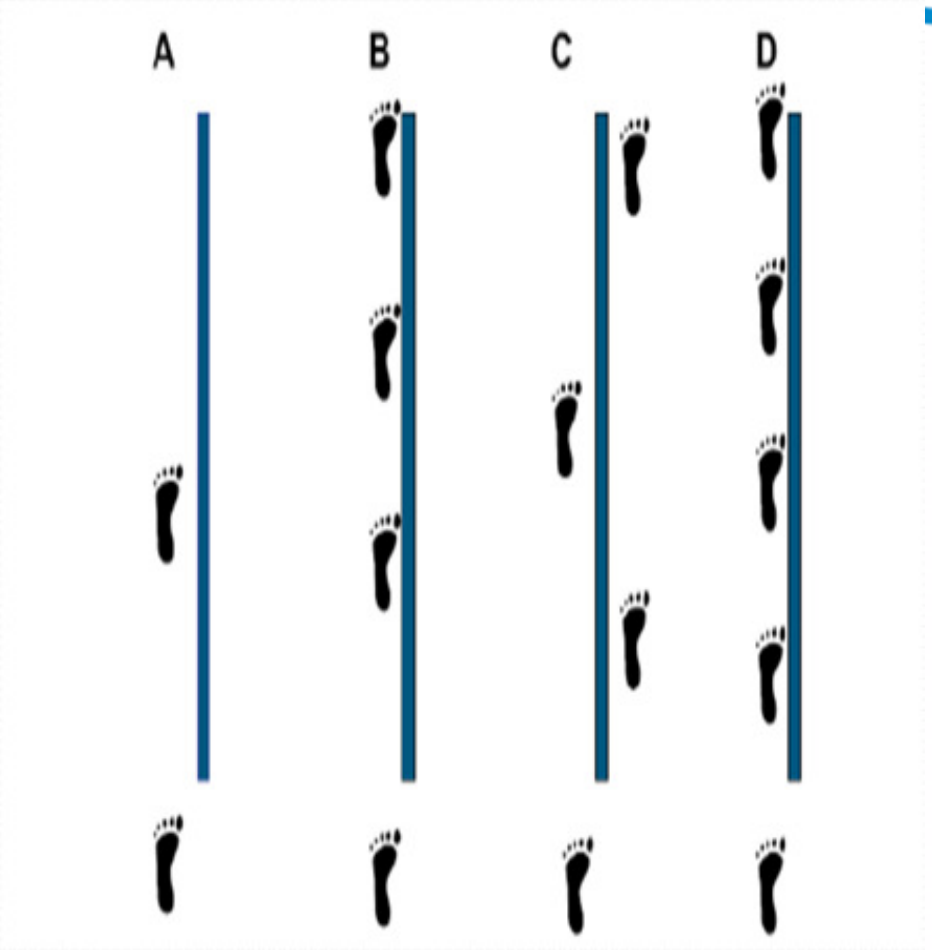


Noyes Hop Tests

- Single Leg Hop For Distance
  - *<85% Limb Symmetry found to be abnormal (ACL Deficiency), Noyes et al (1991)*
  - *Munro and Herrington(2011) on Healthy Recreational Athletes*
    - *100% participants had LSI >90%*
    - ***73% had LSI >95%***
  - *Logersted et al. (2012)*
    - LSI of at least 89.3% found to be optimum

Noyes Hop Tests

- Triple Hop For Distance
  - *<85% Limb Symmetry found to be abnormal (ACL Deficiency), Noyes et al (1991)*
  - *Munro and Herrington(2011) on Healthy Recreational Athletes*
    - *100% participants had LSI >90%*
    - ***68% had LSI >95%***
  - *Logersted et al. (2012)*
    - LSI of at least 95.2% found to be optimum

Noyes Hop Tests

- Cross Over Hop
  - *<85% Limb Symmetry found to be abnormal (ACL Deficiency), Noyes et al (1991)*
  - *Munro and Herrington(2011) on Healthy Recreational Athletes*
    - *100% participants had LSI >90%*
    - ***64% had LSI >95%***
  - *Logersted et al. (2012)*
    - LSI of at least 94.9% found to be optimum

Noyes Hop Tests

- 6 Meter Timed Hop
  - *<85% Limb Symmetry found to be abnormal (ACL Deficiency), Noyes et al (1991)*
  - *Munro and Herrington(2011) on Healthy Recreational Athletes*
    - *100% participants had LSI >90%*
    - ***86% had LSI >95%***
  - *Logersted et al. (2012)*
    - LSI of at least 87.7% found to be optimum

Hop Tests Continued

- Drop Jump (LESS)
- Tuck Jump
- Vertical Jump

Drop Jump – Landing Error Scoring System

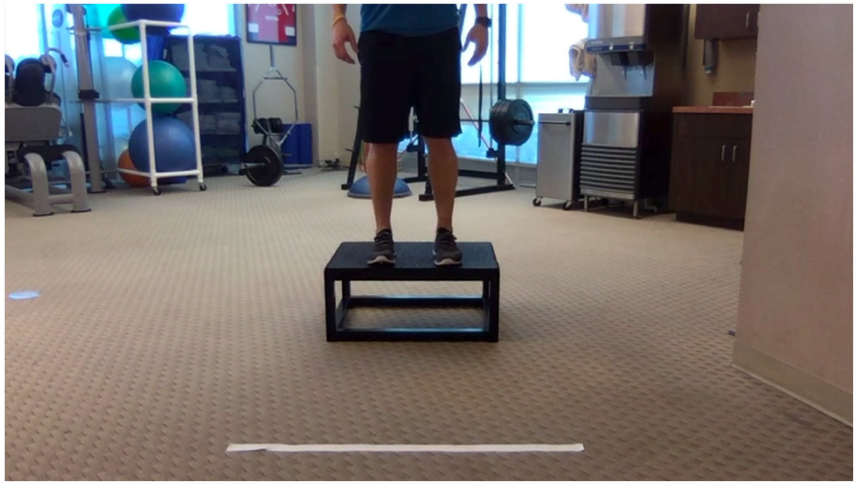
- Patient jumps from 30cm box, landing on both feet at a distance ½ of their height way from the box, then immediately performs a maximal vertical jump
- Scored out of 19 Points - Higher Scores reflect poor technique and indicate Higher Risk for Injury
- Valid, Reliable, Predictive (Padua 2009, 2015)
- Scores <5 Indicate Low Risk for ACL Injury (Fox et al 2016)

LESS Scoring Sheet

Table 1. Operational Definitions for Individual Landing Error Scoring System Items

Landing Error Scoring System Item	Operational Definition of Error	Scoring
Knee flexion: initial contact	The knee is flexed less than 30° at initial contact.	0 = Absent 1 = Present
Hip flexion: initial contact	The thigh is in line with the trunk at initial contact.	0 = Absent 1 = Present
Trunk flexion: initial contact	The trunk is vertical or extended on the hips at initial contact.	0 = Absent 1 = Present
Ankle plantar flexion: initial contact	The foot lands heel to toe or with a flat foot at initial contact.	0 = Absent 1 = Present
Medial knee position: initial contact	The center of the patella is medial to the midfoot at initial contact.	0 = Absent 1 = Present
Lateral trunk flexion: initial contact	The midline of the trunk is flexed to the left or the right side of the body at initial contact.	0 = Absent 1 = Present
Stance width: wide	The feet are positioned greater than shoulder width apart (acromion processes) at initial contact.	0 = Absent 1 = Present
Stance width: narrow	The feet are positioned less than shoulder width apart (acromion processes) at initial contact.	0 = Absent 1 = Present
Foot position: external rotation	The foot is externally rotated more than 30° between initial contact and maximum knee flexion.	0 = Absent 1 = Present
Foot position: internal rotation	The foot is internally rotated more than 30° between initial contact and maximum knee flexion.	0 = Absent 1 = Present
Symmetric initial foot contact: initial contact	One foot lands before the other foot or 1 foot lands heel to toe and the other foot lands toe to heel.	0 = Absent 1 = Present
Knee-flexion displacement	The knee flexes less than 45° between initial contact and maximum knee flexion.	0 = Absent 1 = Present
Hip-flexion displacement	The thigh does not flex more on the trunk between initial contact and maximum knee flexion.	0 = Absent 1 = Present
Trunk-flexion displacement	The trunk does not flex more between initial contact and maximum knee flexion.	0 = Absent 1 = Present
Medial-knee displacement	At the point of maximum medial knee position, the center of the patella is medial to the midfoot.	0 = Absent 1 = Present
Joint displacement	Soft: the participant demonstrates a large amount of trunk, hip, and knee displacement. Average: the participant has some, but not a large amount of, trunk, hip, and knee displacement. Stiff: the participant goes through very little, if any, trunk, hip, and knee displacement.	0 = Soft 1 = Average 2 = Stiff
Overall impression	Excellent: the participant displays a soft landing with no frontal-plane or transverse-plane motion. Average: all other landings. Poor: the participant displays large frontal-plane or transverse-plane motion, or the participant displays a stiff landing with some frontal-plane or transverse-plane motion.	0 = Excellent 1 = Average 2 = Poor

LESS Demonstration Video



Tuck Jump

- Introduced by Myer et al in 2008 as a “Clinician Friendly Plyometric Assessment…”
- Patient performs repeated Tuck Jumps over the duration of 10 seconds, and is graded according to movement flaws that exist
- 10 potential flaws assessed, in addition to number of jumps per test
  - Higher score = more flaws present
- Conflicting data regarding reliability, with studies suggesting a steep learning curve with assessment
  - Video Analysis could be helpful in this area
- Useful test to help educate patient and guide treatment

Tuck Jump Assessment

Tuck Jump Assessment	Pre	Mid	Post	Comments
Knee and Thigh Motion				
① Lower extremity valgus at landing	❑	❑	❑	
② Thighs do not reach parallel (peak of jump)	❑	❑	❑	
③ Thighs not equal side-to-side (during flight)	❑	❑	❑	
Foot Position During Landing				
④ Foot placement not shoulder width apart	❑	❑	❑	
⑤ Foot placement not parallel (front to back)	❑	❑	❑	
⑥ Foot contact timing not equal	❑	❑	❑	
7. Excessive landing contact noise	❑	❑	❑	
Plyometric Technique				
8. Pause between jumps	❑	❑	❑	
9. Technique declines prior to 10 seconds	❑	❑	❑	
10. Does not land in same footprint (excessive in-flight motion)	❑	❑	❑	
	Total _____	Total _____	Total _____	

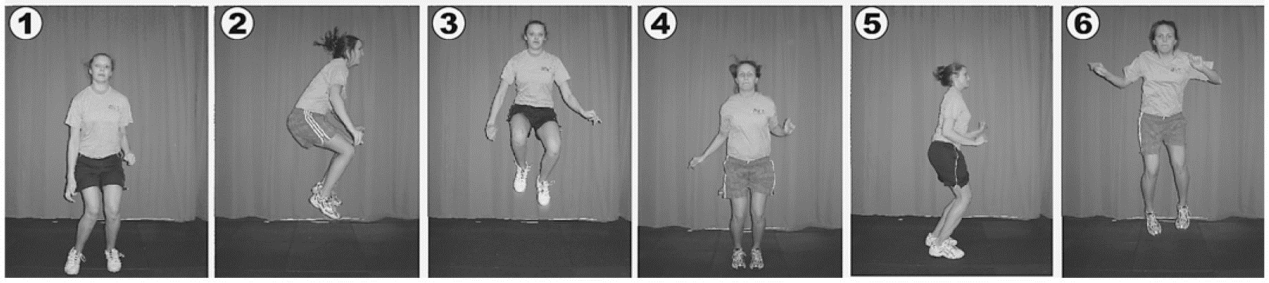


Figure 2 Tuck Jump Assessment: Six common mistakes that clinicians should aim to correct for their athletes while they perform the tuck jump exercise: (1) athletes display unwanted medial knee collapse, (2) athletes do not achieve the desired knees parallel position at top of flight, (3) athletes do not displayed synchronized lower limb positions during flight, (4) athletes land with their feet too close together, (5) athletes land in undesirable staggered position, and (6) athletes do not land with both feet at the same time.

Read et al. 2016

Vertical Jump

- Used to Assess Lower Extremity Power
- Double Leg and Single Leg Jumping
  - Goal to achieve at least 85% LSI
- Petshnig et al. (1998) found that at 1 year out, only Single Leg Vertical Jump was found to be less than 85% LSI when Isokinetic testing, SL Hop for Distance, and SL Triple Hop for Distance were over 85% LSI
  - Utilized Jump Plate, 10 seconds of repeated jumping, with instructions to have shortest possible amount of contact time
- Lee 2018 felt that LSI goal of 89% appropriate, with correlations to passing scores with SL Hop and Isokinetic Testing (peak extensor torque and extensor strength deficit)

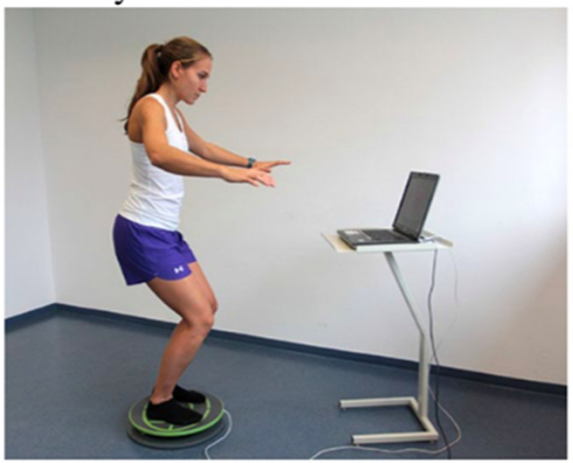
Testing Batteries

- "Back In Action" Test Battery
  - Blend of tests which utilize technology to aide in risk stratification, some of which are newly established tasks
- Functional Lower Extremity Evaluation – FLEE
  - Utilizes more established functional tests
- Kyritsis et al. "Six"
  - Likelihood of ACL graft rupture increased with patients not meeting six clinical discharge criteria before return to sport and is associated with a four times greater risk of rupture (2016)
    - Isokinetic Testing: Quadriceps deficit < 10% at 60 deg/sec)
    - Noyes Hop Testing at least 90% LSI
    - Running T-Test <11 Seconds
    - Completed On-Field Sports Specific Rehab

“Back in Action” Test Battery

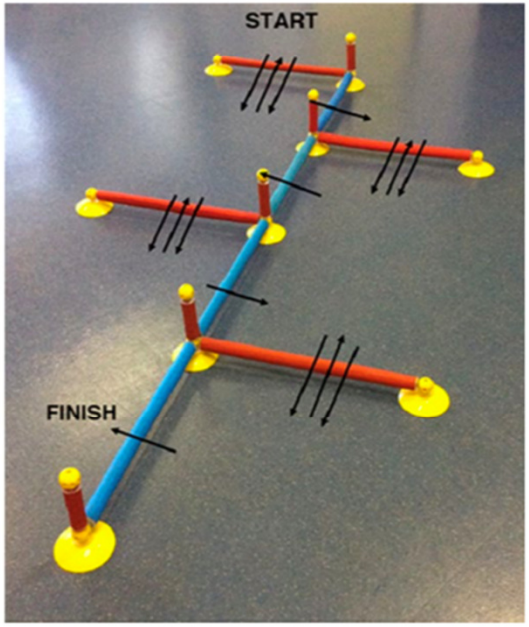
- Introduced by Hildebrandt et al. (2015)
  - Moderate to Good Reliability for each test
- Devoloped by CoRehab (Trento, Italy)
- Seven Functional Tests:
  - Two-Leg Stability Test
  - One-Leg Stability Test
  - Two-Leg Counter-Movement Jump
  - One-Leg Counter-Movement Jump
  - Plyometric Jumps
  - Speedy Test
  - Quick Feet Test
- Utilizing Data from Test, compiled results described on scale from ”Very Weak” to ”Very Good”

Stability test

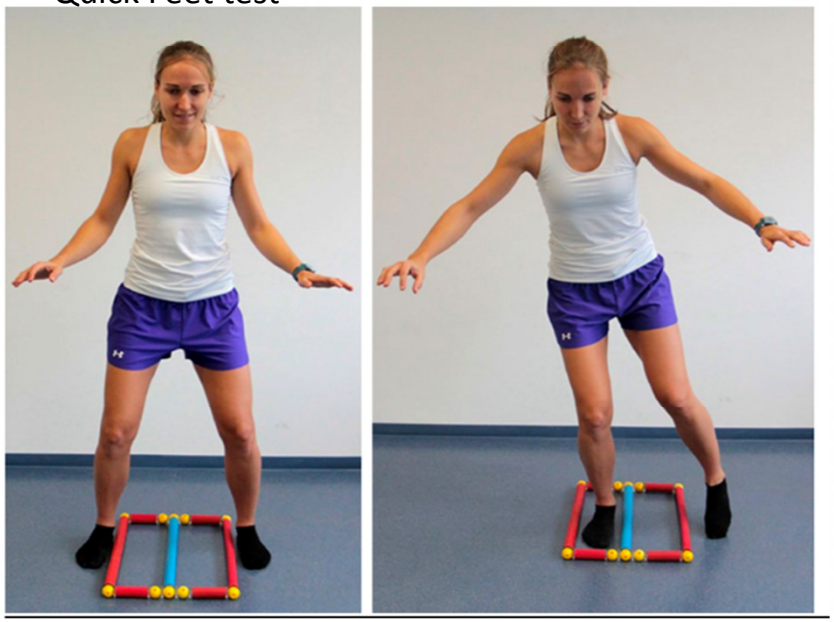


Jumping test

Speedy Jump test



Quick Feet test



Functional Lower Extremity Evaluation - FLEE

- Described by Haitz et al in 2014
- Moderate to Excellent Test-Retest Reliability, High to Excellent Interrater Reliability (Haitz et al 2014)
- Test Battery Consisting of 8 Performance tests
  - 3 Sub Test Clusters: Control, Hop, Endurance
  - Control Sequence:
    - Timed Lateral Step Down
    - Timed Leap and Catch
  - Hop Sequence:
    - Single Leg Hop for Distance
    - Single Leg Triple Hop for Distance
    - Single Leg Triple Cross-Over for Distance
    - Single Leg 6 Meter Timed Hop
  - Endurance Sequence:
    - Square Hop Test
    - LEFT – Lower Extremity Functional Test (a cone agility test)
- Scores based on normative data as well as LSI

FLEE – Control Sequence

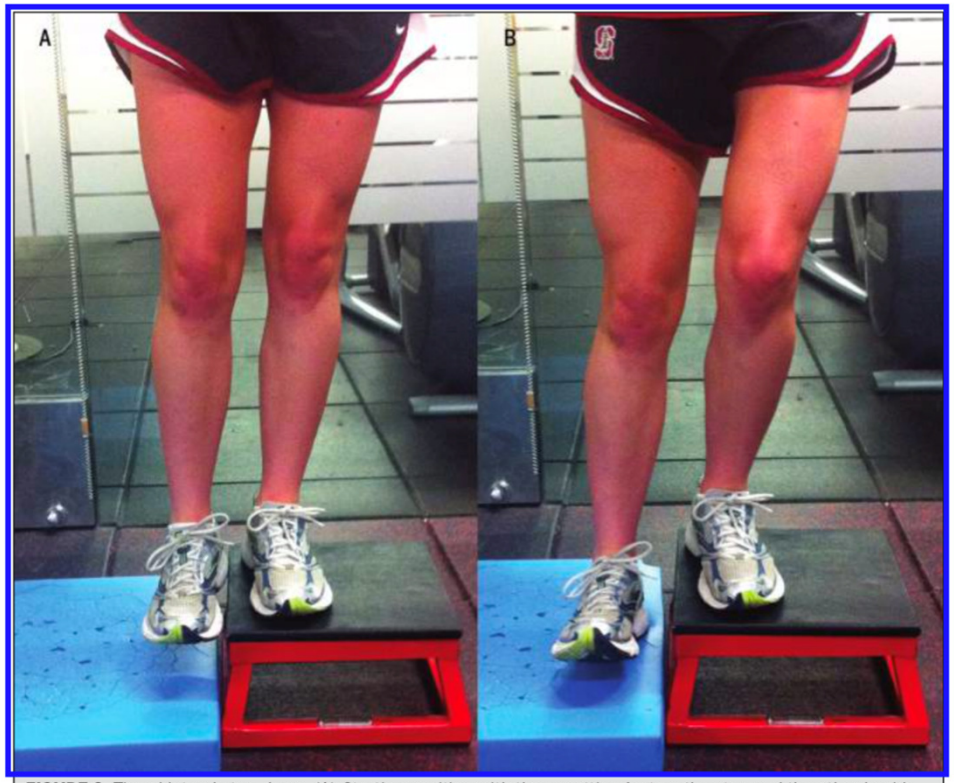
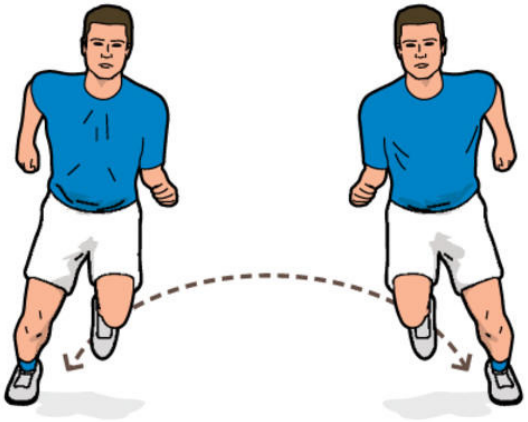


FIGURE 2. Timed lateral step-down. (A) Starting position with the squatting foot on the step and the other beside it. (B) Squat position with the nonsquatting heel lightly tapping the foam mat (or ground). The athlete alternates between positions A and B each time the metronome clicks (at 80 bpm).

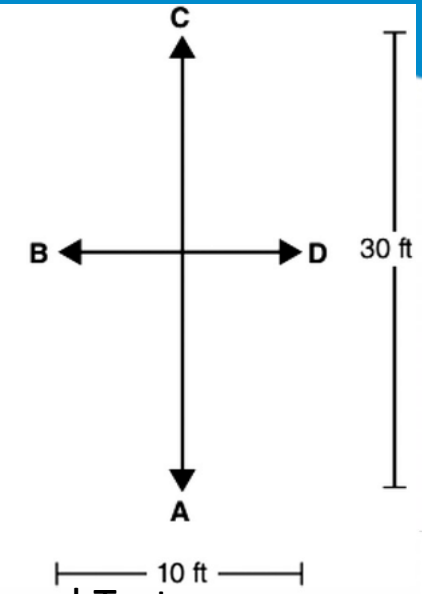
Timed Lateral Step Down

Timed Leap and Catch



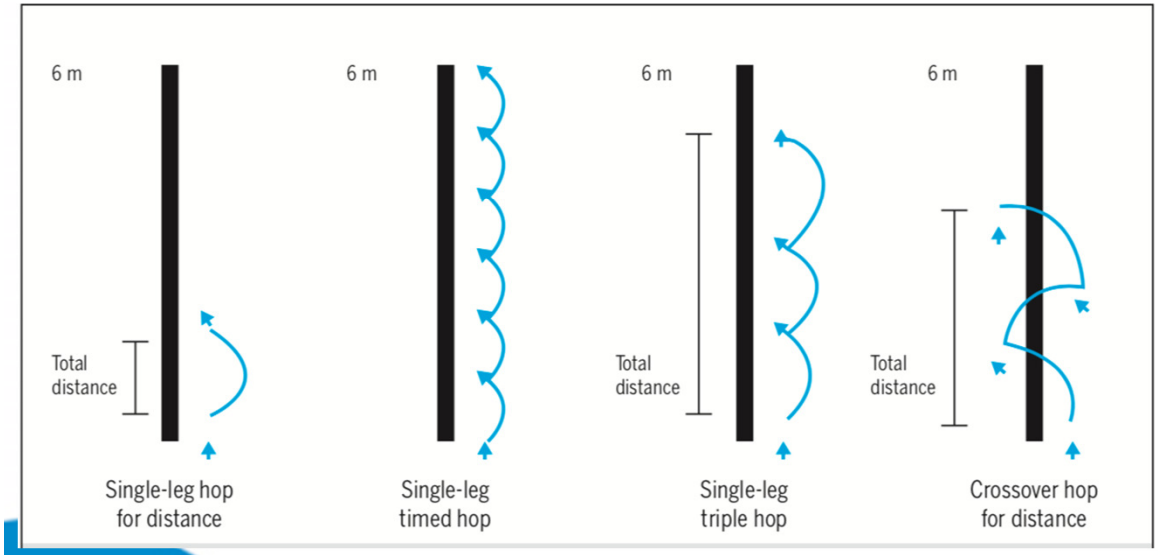
FLEE – Hop Sequence / Endurance Sequence

1. Forward sprint (A-C-A)
2. Retro sprint (A-C-A)
3. Side shuffle right – face in (A-D-C-B-A)
4. Side shuffle left – face in (A-B-C-D-A)
5. Cariocas right – face in (A-D-C-B-A)
6. Cariocas left – face in (A-B-C-D-A)
7. Figure 8s right (A-D-C-B-A)
8. Figure 8s left (A-B-C-D-A)
9. 45° Cuts right – plant outside foot (A-D-C-B-A)
10. 45° Cuts left – plant outside foot (A-B-C-D-A)
11. 90° Cuts right – plant outisde foot (A-D-B-A)
12. 90° Cuts left – plant outside foot (A-B-D-A)
13. Crossover 90° cuts right – plant inside foot (A-D-B-A)
14. Crossover 90° cuts left – plant inside foot (A-B-D-A)
15. Forward sprint (A-C-A)
16. Retro sprint (A-C-A)

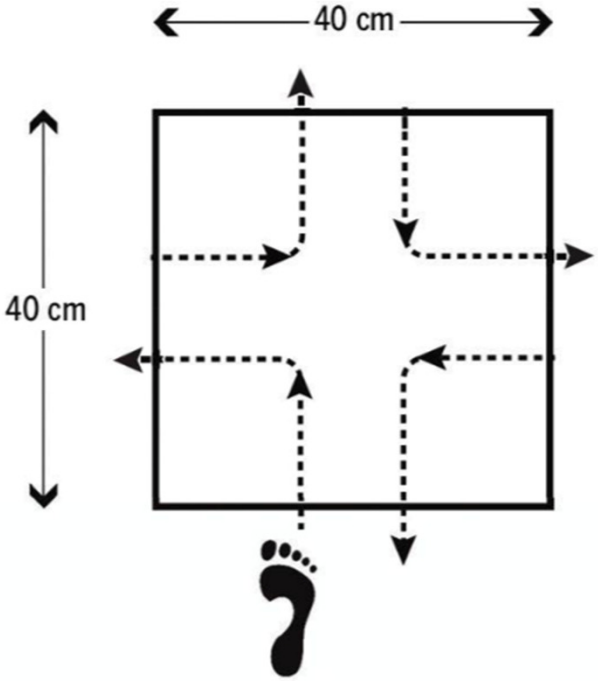


Brummit et al 2016

LEFT – Lower Extremity Functional Test



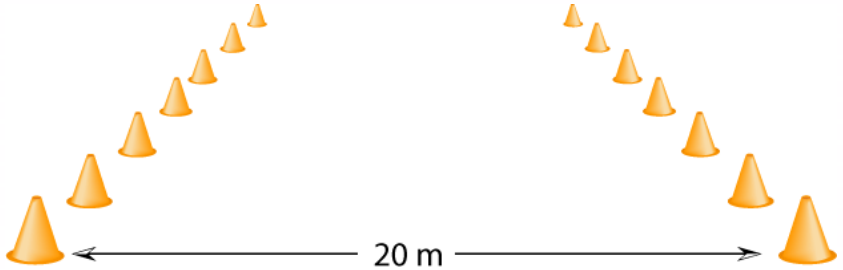
Noyes et al 1991



Caffrey et al 2009

Endurance Testing

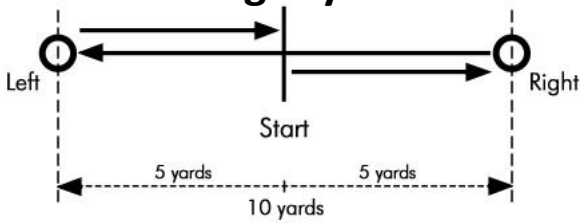
- Yo-Yo Endurance Test (Beep Test)
  - Developed by Danish physiologist Jens Bangsbo
  - Several testing variations, all with normative data
- Cooper Test
  - 2 Main Variations
    - 12 Minute Run (Scored by Distance)
    - 1.5 Mile Run (Scored by time)



Field Tests / Advanced Agility

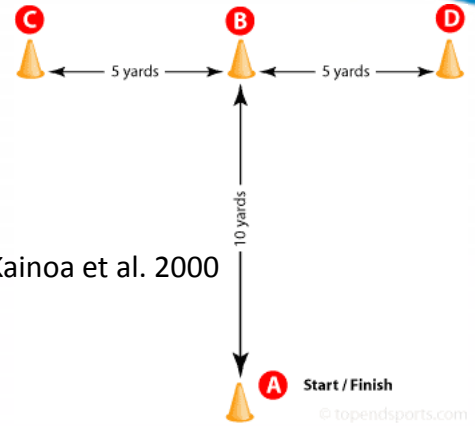
- 40 Yard Dash
  - Usually patients have baseline of scores if they play football
- Pro Agility (5-*10-5)*
  - Popular test that measures pre-planned change of direction speed
- T-Test and Modified T-Test
  - Agility test that involves running forward, lateral shuffle, backward running, with changes in directions
  - Modified T-Test shortens distances, which can more helpful for sports which require short bursts (Tennis, Baseball Infielder)
- 3 Cone Agility – L-Test
  - Replaced Box Drill at NFL Combine
    - Normative Data Available
- Illinois Agility
  - Forward running agility test with cutting
    - Normative Data Available
- Barrow Test
  - Common Agility test used in soccer, forward running test with varying degrees of cutting
    - Normative Data Available

Pro Agility Test



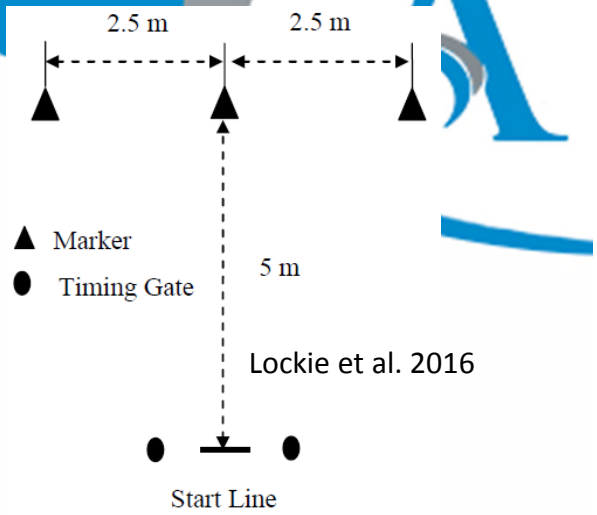
Bayraktar 2017

T-Test



Kainoa et al. 2000

Modified T-Test



Lockie et al. 2016

3-Cone Agility

Wood 2008

Barrow Test

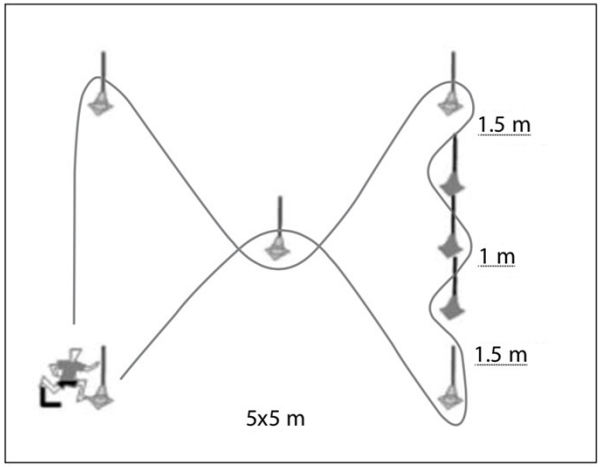
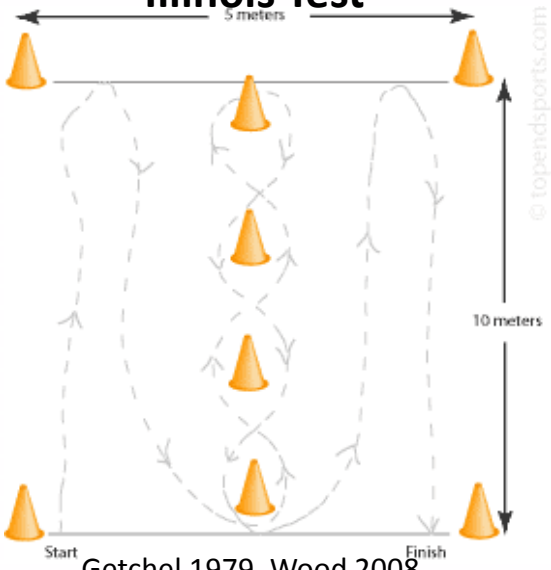


Figure 1. Schematic representation of the modified Barrow agility test.

Bidaurrazaga et al. 2015

Illinois Test



Getchel 1979, Wood 2008

Hitting our Check-Points to Stay on Track

- It is often helpful to decide upon Initial Evaluation which tests are going to be the most appropriate for your patients
  - Examples: Type of Injury, Surgical/Non-Surgical, Age, Sport, Professional/Elite Youth/Recreational Levels, Previous Sport Testing (40YD, Yo-Yo Test, etc), Coach/ATC/Personal Trainer involvement, Insurance Limitations
- Based on those decisions, you can have pre-planned “check-points” in regards to what you want to test, and when (time point or functional criteria met)

Hitting our Check-Points to Stay on Track

- Often easier to plan check-points when surgical such as with ACL-R
  - Example:
    - 12 Weeks: Goal to pass clinical Exam, Perform FMS/Y-Balance to assess for impairments
    - 4 Months: Isokinetic Testing initiated, If no isokinetic testing available, consider Vail Sport Cord Test, or “Control Sequence” of FLEE
    - 4-6 Months: Hop testing
    - 6-12 Months: Conditioning/Agility Testing
- This timeline of Check-Points will be significantly altered with non-contact such as lateral ankle sprain or a hamstring strain, especially when considering the degree of injury and whether or not they are in their primary season

Technology

- Recently, there has been a big push to move toward technologically assisted assessments due to the ability of technology to capture so much data in a short amount of time
- Examples include both wearable and external equipment:
  - Force Plates
  - Accelerometers
  - Motion Capture Cameras
- There are various companies which utilize technology and software to help risk stratify
  - ”CoRehab’s ‘Back in Action’”, 3-Planes Movement Specialists, Sparta Science
- There is also Risk Stratification Software which allows tester to enter data from tests performed
  - For example: Move 2 Perform
- Technology will play a big part in the future of Return to Sport Testing

The Psychological Aspect of Returning to Sport

- Kinesiophobia – a primary psychosocial construct which refers to the fear of movement/re-injury
- ”fear of reinjury can adversely result in both physiological (such as muscular guarding) and psychological changes (such as distraction and lack of trust in the injured site) that can affect rehabilitation outcomes..”
- Following ACL-R: fear of re-injury appears to be phase specific (depending on time-frame)
  - Inconsistent early on, but later in rehab, Increased fear is associated with decreased Self-Reported Function
- Following Achilles Ruptures: Increased fear associated with decreased function

Hsu et al. 2017

The Psychological Aspect of Returning to Sport

Table 1. Overview of all selected self-report questionnaires

Questionnaire	Population	Key Construct	Score
Emotional Responses of Athletes to Injury Questionnaire (ERAIQ)[77]	Athletes	Emotions after injury Perceptions of recovery	Open-ended questions
Return to Sport After Serious Injury Questionnaire (RSSIQ)[66]	Athletes	Perceived psychological outcomes of returning to sports	7-point Likert-type scale
ACL-Quality of Life (ACL-QoL)[54]	ACL injury	Symptoms and physical complaints Work-related concerns Recreational activities and sports participation Lifestyle Social and emotional feelings	100-mm visual analog scale
ACL-Return to Sport after Injury (ACL-RSI)[89]	ACL injury	Emotions Confidence in performance Risk appraisal	0- to 100-point scale with 10-point increments
Tampa Scale for Kinesiophobia (TSK)[84]	Chronic pain	Fear of movement/reinjury	4-point Likert-type scale

ACL, anterior cruciate ligament.

Hsu et al. 2017

The Psychological Aspect of Returning to Sport

Table 2. Common psychosocial interventions

Intervention	Theoretical Basis	Selected Studies
Education	Better knowledge of process reduces anxiety	Francis et al[25] O'Connor et al[61]
Goal setting	Provides direction Specific, measurable goals Perception of increased treatment effectiveness	Vitali and Recupero[83] Hamson-Utley and Vazquez[31] Evans and Hardy[21]
Imagery	In rehabilitation setting, anticipation of pain Physiologic effect to reduce stress hormones	McKinney et al[54] Cupal and Brewer[18] Maddison et al[50]
Self-talk	Help athletes recognize and change negative thoughts	Podlog et al[63]
Graded exposure	Expose patients to fearful situations to show no more harm	Woods and Asmundson[95]
Social support	Increased support enhances coping strategies	Rees et al[70] Hogan et al[36]
Relaxation	Reduce tension and anxiety	Johnson[37] Cupal and Brewer[18]

Hsu et al. 2017

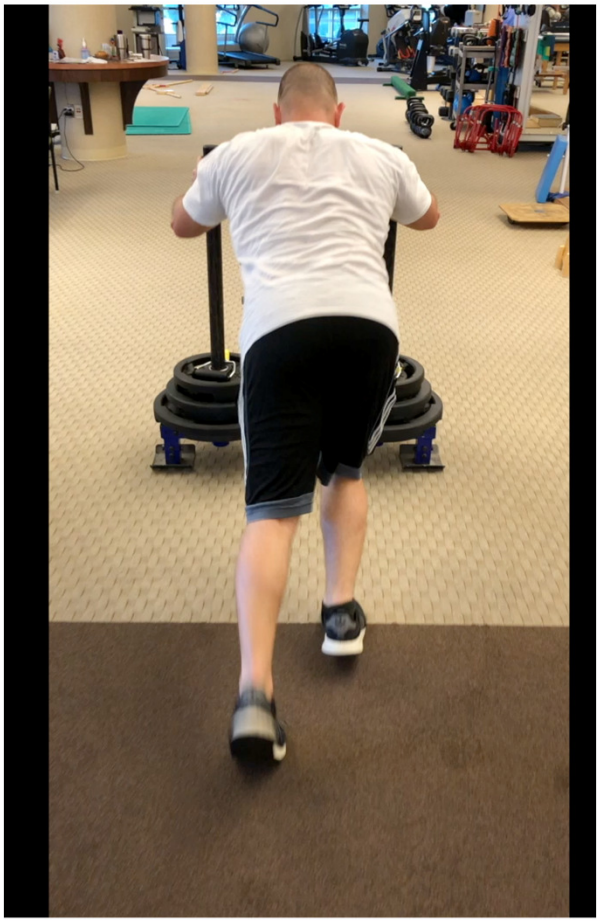
Communication Between Professionals with Return to Sport as Goal

- Who are the Facilitators for Return to Sport Testing
  - Physicians, Physical Therapists, Athletic Trainers, Coaches, Performance Coaches
- Excellent Communication between Facilitators is needed to help minimize the risk of returning a previously injured athlete back to performance
  - Physicians often want to know from the Rehab Professionals what the patient's clinical exam looks like, where they are in regards to functional demands, and whether there is limb symmetry
  - Rehab Professionals often want to know from Physician where the patient stands in regards to tissue healing, and when functional tasks/tests can be performed, and then when they are comfortable with more impact related testing
  - Performance Staff/Coaches often want to know from Rehab Professionals what they are "cleared" to do: Weightlifting, Conditioning, Skills, Non-Contact vs. Contact Practice, Live Competition

Transitioning from Formal Rehabilitation to Performance Training

- Using movement analysis in early stages of rehab can help guide the patient's motor programming as they move toward performance (if they demonstrate a movement dysfunction at a slower speed, you can bet that they demonstrate it at a faster speed, even if you can't see it)
- Patients who are returning to high level sports must understand the underlying concepts of the exercises they are performing
  - Alignment and shock absorption with numerous variables manipulated:
    - Single vs. Multiplanar, Loaded vs Unloaded, Speed, Amplitude, Acceleration vs Deceleration, Multi-step exercises (Run, Cut, Jump combinations)
  - From Simple Pre-planned moving toward Complex Reactive tasks

Examples of Early Movement Faults



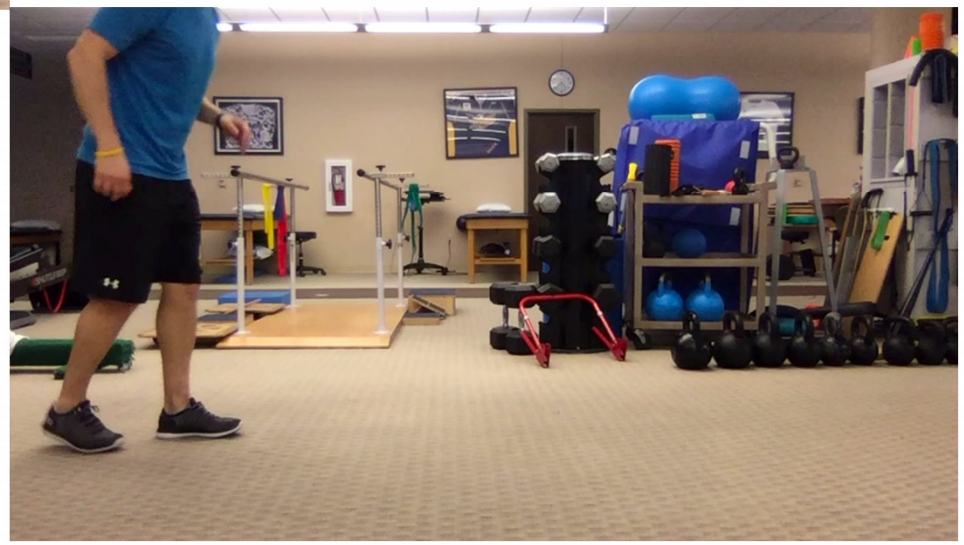
←Sled Push – L LE: Extensor Thrust, Heel Drop, Hip Pop

↑Sled Pull – L LE: Decreased Knee Extension, Shorter Stance Phase

Examples of Early Movement Faults

←Ladder “Icky” Shuffle - L LE: Dec Shock absorption, Dec Eccentric knee flexion, Inc Trunk Lean (Tibia/Trunk not parallel)

Hop and Stick – L LE: Dec Shock absorption, Dec Eccentric knee flexion, Inc Trunk Lean (Tibia/Trunk not parallel), → Rapid Trunk Extension “Whip” to generate momentum to return to start



Take Home Points

- Return to Sport Testing/Screening is important for all injuries that result in time-loss, not just surgical cases
- In order to be ready to Return to Sport, the Athlete first needs to feel ready. In order to be Cleared for Return to Sport, they need to Prove they are ready
- Clusters of tests are more powerful than individual tests, and each test has a purpose. An appropriate cluster incorporates the tests most appropriate for each patient.

Take Home Points

- Clinicians should begin to decide early on which RTS Tests the patient should pass, so the treatment plan/direction can be reflected by those goals, and all appropriate communication between facilitators can be achieved
- Don’t miss an opportunity to improve a patient’s future performance training with appropriate coaching during rehab

Thank You!

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