

Sport Specific Testing for the Lower Extremity in Athletes: Criteria to Return to Sports

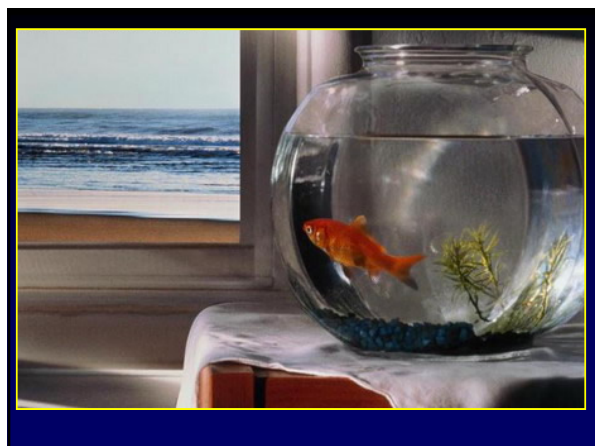
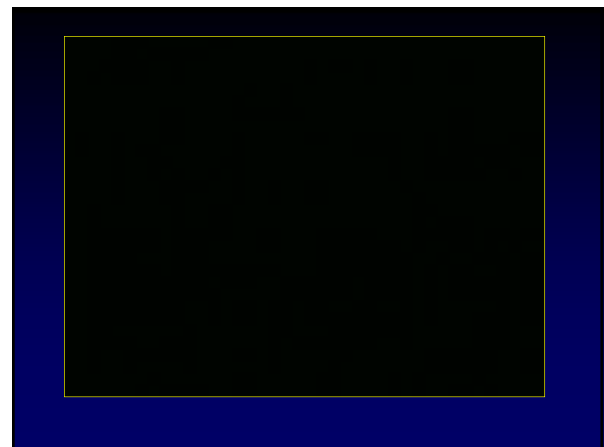
Kevin E Wilk, PT, DPT, FAPTA
www.kevinwilk.com



I (and/or my co-authors) have something to disclose.

Detailed disclosure information is available via:

- Printed Final Agenda
- Meeting Website
<http://metcalfmeeting.org/>
or
- AAOS Orthopaedic Disclosure Program on the AAOS website at
<http://www.aaos.org/disclosure>



Sport Specific Testing for the LE Athletes
My Message: Objectivity

- ✓ Objective information is best
- ✓ Assess specific structures & systems
- ✓ *Test not only functional movements but what allows/ promotes the specific movement or skill (willingness to perform)*
- ✓ Specific tests – Objective data
- ✓ Physical - Psychological Component




Highly Skilled Movements ≠ Test Well (Function)

Sport Specific Testing for the LE Athletes

Points of Discussion

- ✓ What specific tests are used
- ✓ Which specific tests are best & why
- ✓ What should we use/consider
- ✓ Do these specific tests work
- ✓ What's the most important parameters to look at
- ✓ What do I use & why




Which Tests Should You Use

Criteria to Return to Play

What Do We Use

- ✓ Clinical Examination
- ✓ Subjective Knee Assessment
- ✓ KT test or similar
- ✓ Strength testing (objective)
- ✓ Functional testing:
 - ✓ Hop test
 - ✓ Jump down test
 - ✓ Y balance
 - ✓ Shuttle runs
 - ✓ Star Excursion
 - ✓ Step down test
 - ✓ Agility L run
 - ✓ 4 corners drill
 - ✓ FMS
 - ✓ Fusionetics



Sport Specific Testing LE

~~2001, 07, 09, 12, 17~~

- ✓ Subjective Patient Assessment
- ✓ Isokinetics
- ✓ KT testing
- ✓ Hop testing
- ✓ Front step down
- ✓ Jump down
- ✓ Agility L run
- ✓ 4 corners
- ✓ Y balance
- ✓ FMS
- ✓ Shuttles runs






Barber-Westin et al: Arthroscopy '11

- Factors used to determine return to unrestricted sports activities after ACLR
 - » Subjective questionnaires
 - » Clinical exam
 - » Isokinetic muscle strength testing
 - » Functional hop testing
- ✓ <10% bilateral quad & hamstring strength
- ✓ < 15% on hop tests
- ✓ 3mm displacement or less knee arthrometer
- ✓ Full knee ROM , no pain activities

Criteria to Return to Play

Why Do We Need This ?

- ✓ Objective Testing is useful:
 - ✓ report card to patient – motivate
 - ✓ gives clinician info on program
 - ✓ outcome data



Wilk et al: JOSPT '93

- ✓ Correlation between isokinetics, functional testing & function

Grindem et al: BJSM '16

- ✓ passed RTS criteria – 84% lower reinjury rate
- ✓ symmetrical quads – reduced re-injury rate

Only 24% passed RTS Criteria

Post-Op ACL Reconstruction

Return to Play Criteria

- ✓ 3 P Program:
 - ✓ Performance
 - ✓ Practice
 - ✓ Play





Sport Specific Testing LE

Things We Like: Front Jump Down



ACL INJURIES

Introduction

- ACL injuries common in sports & strenuous work
 - *So frequent that the seriousness is often forgotten*
- Totally disrupted more than any other knee ligament
- ✓ 200,000 ACL injuries annually
Fu: AJSM '99
- ✓ 148,714 ACL surgeries in 2013
- ✓ 20 yrs: 58% increase in number ACL surgeries
Wilk: JOSPT '15








Evidence Based Rehab & **Return to Normal Function**



ACL INJURIES

Introduction



- 35 out of 100,000 people
Gianotti et al: J Sci Med Sports '09
Walden et al: Knee Surg Spts Trauma Arthro '10
- Females are 4-6 times higher risk of ACL injury
- ✓ ACL outcomes (IKDC scores) 61-67%/100
Biau et al: CORR '07
- ✓ 40-90% of ACL patients exhibit radiographic knee OA 7-12 yrs following surgery
Pinczewski et al: AJSM '07
Liden et al: Arthroscopy '08
- ✓ 50x greater risk LFC damage post ACL injury
Potter et al: AJSM '12


Return to Play Criteria

Introduction

- Return to Play
- Often difficult decision – when is the patient ready to resume **normal unrestricted** athletics ?
- ✓ *Combination of subjective, clinical exam & functional tests*
Wilk et al: JOSPT '94

Return to Play Commonly Considered Indicator of Successful Outcome

ACL Injuries

Return to Play

- ✓ 78% of NBA players returned to play following ACL surgery
- ✓ Of the players returning: 44% experienced a decrease in in standard statistical categories & player efficiency ratings

Busfield et al: Arthroscopy '09





2007










2007 **2017**





Carey et al: AJSM '06

- Effects of ACL injury on running backs & wide receivers in the NFL players (N=33)
- ✓ 80% returned to NFL play
- ✓ Performance of those returning – performance was reduced by 1/3

McCullough, et al: AJSM '11

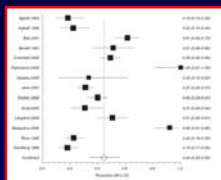
- Return to High School & College Level Football following ACLR: MOON study
- 147 players (68 high school, 26 college)
- Return to play rates: college athletes 69%, 43% high school athletes
- Player perception: 43% were able to return at pre-injury level, 27% did not perform at same level, & 30% unable to return to play

Return to Sports

After ACL Reconstruction:

- Systematic review of 48 studies reporting return to sports of 5770 individuals after ACL reconstruction at mean follow-up of 41.5 months

Return to Some Form of Sports	82% (95% CI 73 to 90%)
Return to Pre-Injury Level of Sports	63% (95% CI 54 to 71%)
Return to Competitive Sports	44% (95% CI 34 to 56%)



Men > Woman
Seasonal Sports > Year round sports
85-90% Normal Near Norm IKDC

Ardern CL et al. AJSM '11
Ardern et al. BJSM '11

Sport Specific Testing LE



How do you clear a player?

- What should you do & use to clear a player



Return to Sports

- Reasons for reduced sports participation for those that did not return to prior level:
 - Fear of re-injury (19%)
 - Problems with structure/function of knee (13%)
 - Family commitments or lifestyle changes (11%)

Ardern, BJSM: 2011



Kinesiophobia

- Fear of movement/reinjury
 - "I'm afraid that I might injure myself if I play a sport or exercise"
 - Tampa scale for kinesiophobia
 - Woby et al: Pain '05
- Interventions which improve self efficacy may improve knee function short term
 - Chmielewski et al: JOSPT '08
 - Chmielewski et al: Phys Ther '11
 - Lentz et al: AJSM '15 & JOSPT '12

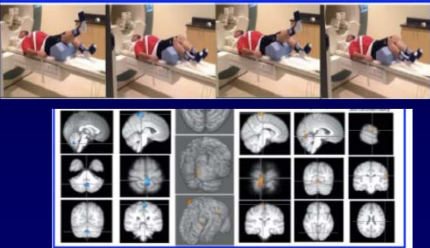
Neuroplasticity associated with Anterior Cruciate Ligament Reconstruction

¹Dennis R. Grooms, ²Stephen J. Page, ³Deborah S. Nichols-Larson, ⁴Aji M.W. Chandrasekhar, ⁵Susan E. White, ⁶James A. Oatis

¹Ohio University, College of Health Sciences and Professions, School of Applied Health Sciences and Wellness, Division of Athletic Training, Athens, Ohio USA

²Ohio Musculoskeletal & Neurological Institute, Ohio University, Athens, Ohio USA

³The Ohio State University, College of Medicine, School of Health and Rehabilitation Sciences, Columbus, Ohio USA




How Do You Know When Your ACL Patient is Ready to Run? Return to Sports?




How Do You Know When Your ACL Patient is Ready to Run? Return to Sports?




No Association of Time From Surgery With Functional Deficits in Athletes After Anterior Cruciate Ligament Reconstruction

Evidence for Objective Return-to-Sport Criteria

AJSM '12

Gregory D. Myer,^{1,11,12} PhD, FACSM, CSCS[®]D, Larry Martin Jr.,¹² PhD, Kevin R. Ford,^{1,11,12} PhD, Mark W. Paterno,^{1,11,12} PhD, SCES, ATC, Laura C. Schmitt,^{1,11,12} PT, MPT, PhD, Robert S. Heits Jr.,¹ MD, FACS, Angelo Colella,¹² MD, and Timothy E. Hewett,^{1,11,12} PhD
Investigation performed at Cincinnati Children's Hospital Medical Center



Category	Vertical Jump Height (cm)	Horizontal Jump (cm)
Vertical jump height	~100	~100
Horizontal jump	~100	~100

Specific Sport Testing LE Athletes

Return to Sports

- ✓ Decision is based on numerous factors:
- ✓ Type of sports returning to:
 - ✓ High risk sports
 - ✓ Moderate risk sports
 - ✓ Low risk sports
- ✓ Position ??
- ✓ Type of player (wreckless, cautious)
- ✓ Age of the patient
- ✓ Condition of the knee (art. cart., meniscus, etc)
- ✓ ACL Surgery (graft type: auto vs allo, PTG vs STG)




ACL Rehabilitation

Return to Play Guidelines/Criteria






Specific Sport Testing LE Athletes

Decision Based On: What We Use

- Criteria based on the following:
 - ✓ Subjective knee score (CKRS, IKDC)
 - ✓ Knee laxity testing (manual & mechanical)
 - ✓ Isokinetic testing
 - ✓ Hop test
 - ✓ Functional run test
 - ✓ Sport specific testing
 - ✓ Psychological component (limb confidence)
 - ✓ FMS & Y Balance
 - ✓ Rehabilitation progression

Specific Sport Testing LE Athletes

Decision Based On:

- What do we use:
- Combination of objective & subjective factors
- These include the following:
 - ✓ Time frames from injury/surgery (healing constraints)
 - ✓ Subjective factors
 - ✓ Objective data

Numerous Tangible & Intangible Factors to Consider When Making this Decision

Subjective Knee Assessment

Introduction

- CKRS – Cincinnati Knee rating Score
Barber & Noyes: AJSM '99
Noyes & Barber: JBJS '90
- IKDC – International Knee Documentation
Irrgang et al: AJSM '01
Irrgang et al: AJSM '06

Subjective Knee Assessment Introduction-CKRS

PLEASE CHECK THE STATEMENT THAT BEST DESCRIBES THE CONDITION OF YOUR KNEE

PAIN

1. I experience no pain in my knee.

2. There is occasional pain with strenuous sports or heavy work. I don't think that my knee is being put to any special test.

3. There is occasional pain in my knee with light recreational sports or moderate work. I have pain brought on by sports, light recreational activities or moderate work. Occasionally pain is brought on by daily activities such as standing or kneeling.

4. The pain I have in my knee is a significant problem with activities as simple as walking. My pain is constant for most of my waking hours.

5. I have pain in my knee at all times, even during walking, standing, or light work.

STABILITY

1. I experience no swelling in my knee.

2. I have occasional swelling on my knee with strenuous sports or heavy work.

3. There is occasional swelling with light recreational activities or moderate work, swelling limits my participation in sports or moderate work. Occurs infrequently with simple walking or light work. Occasionally with simple walking or light work about a week or more.

4. The knee swells after simple walking activities, light work. The swelling is returned to its normal size within a few days.

5. I have severe swelling with simple walking activities. The swelling is returned by rest.

STABILITY

1. My knee does not give out.

2. My knee gives out only with strenuous sports or heavy work.

3. My knee gives out with light recreational activities or moderate work. It hinders my recreational activities, sports or heavy work.

4. Because my knee gives out, it limits all sports & moderate work. It occasionally gives me trouble with walking or light work.

5. My knee gives out frequently with simple activities such as walking. I must guard my knee at all times.

6. I have serious problems with my knee giving out. I can't turn or walk without my knee giving out.

STABILITY

1. I have no problems with my knee giving out. I can't turn or walk without my knee giving out.

2. I have serious problems with my knee giving out. I can't turn or walk without my knee giving out.

3. I have serious problems with my knee giving out. I can't turn or walk without my knee giving out.

4. I have serious problems with my knee giving out. I can't turn or walk without my knee giving out.

5. I have serious problems with my knee giving out. I can't turn or walk without my knee giving out.

OVERALL ACTIVITY LEVEL

1. No limitation. I have a normal knee and I am able to do everything including strenuous sports and heavy labor.

2. I can participate in sports including strenuous ones but at a lower level. I must guard my knee and limit the amount of heavy labor or sports.

3. Light recreational activities are possible with knee questions. I am limited to light work.

4. No sports or recreational activities are possible. Working activities are possible with knee questions. I am limited to light work.

5. Walking activities and daily living cause moderate problems and persistent symptoms. Working and other daily activities cause severe problems.

WALKING

1. Normal, unaided.

2. Slight, mild problems.

3. Moderate problems, flat surface up to half mile.

4. Severe problems, only 2 to 3 blocks.

5. Severe problems, need cane or crutches.

STAIRS

1. Normal, unaided.

2. Slight, mild problems.

3. Moderate problems, only 10 to 15 steps possible.

4. Severe problems, need railing or support.

5. Severe problems, only 1 to 2 steps with support.

RUNNING

1. Normal, fully competitive.

2. Slight, mild problems, not at all fast.

3. Moderate problems, only 1 to 2 miles possible.

4. Severe problems, only 1 to 3 blocks possible.

5. Severe problems, only a few steps.

SKIPPING AND JUMPING

1. Normal, fully competitive.

2. Slight, mild problems, some jumping.

3. Moderate problems, just up strenuous jumps.



4. Severe problems, affects all sports, always guarding.

5. Severe problems, only light activity possible (golf/tennis).

If I had to give my knee a grade from 1 to 100, with 100 being the best, I would give my knee a _____.

Knee Arthrometer Testing What Values Do We Use

- Looking at side to side difference: **(I-U=X)**
- <2.5 difference
Shelbourne: AJSM '91
- Classification system:

Subjective Knee Assessment Introduction-ICKDC

Page 1 - 2000 BUCK SUBJECTIVE KNEE EVALUATION FORM

1. What is the highest level of activity you can perform without significant knee pain?

2. During the week, how often do you have knee pain?

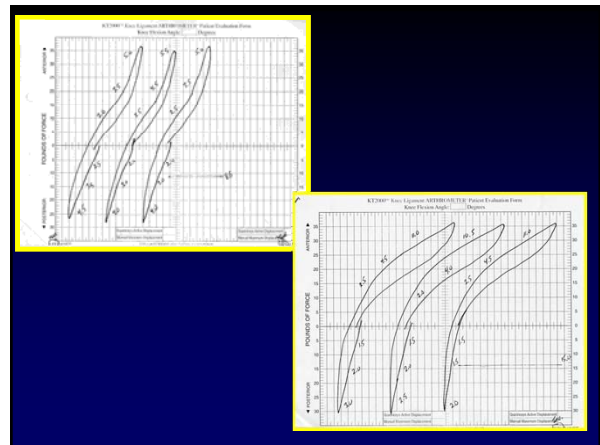
3. How often does your knee give out?

4. During the week, how often do you have knee pain?

5. What is the highest level of activity you can perform without significant swelling in your knee?

6. During the week, how often do you have knee pain?



7. What is the highest level of activity you can perform without significant guarding in your knee?



Knee Arthrometer Testing Introduction

- Measures total displacement (A-P)
- KT 1000 or 2000
- Force & displacement
- Objective measurement

Daniels et al: AJSM '85

KT 1000 KNEE ARTHROMETER MEASUREMENTS											
PATIENT		R NUMBER		R NUMBER		R NUMBER		R NUMBER		R NUMBER	
ANTERIOR		POSTERIOR		TOTAL		ANTERIOR		POSTERIOR		TOTAL	
1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

KT 2000 KNEE ARTHROMETER MEASUREMENTS											
PATIENT		R NUMBER		R NUMBER		R NUMBER		R NUMBER		R NUMBER	
ANTERIOR		POSTERIOR		TOTAL		ANTERIOR		POSTERIOR		TOTAL	
2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000



Isokinetic Testing

Interpretation Data

- ✓ **Q PT / BW ratio: (180°/sec)**
Males: 60-65% ←
- ✓ **H/Q ratio: (180°/sec)**
Males: 66-72% ←
Females: 75% >
- ✓ **HPT / BW ratio: (180°/sec)**
Males: 40-43%
Females: 37-40%

Isokinetic Testing

Overview

- **Biodex system**
- Full ROM: 100° – 0°
- Distal pad placement
- Speeds: **180 & 300°/sec**
- Repetitions 10 & 15
- Standardized warm-up

Isokinetic Testing

Interpretation of Data

- **Bilateral comparison**
75-80% ???
- ✓ **Endurance ratio (300°/sec)**
Extensors: 12% or less
Flexors: 9% or less
- ✓ **Acceleration rates (180°/sec):**
QPT at .2 sec
80% or greater PT
- **Acceleration rates (180°/sec)**
HPT at .2 sec (females)

ACL Injuries

- **Not an isolated injury**
 - ✓ Injury affects both extremities
 - ✓ **Quadriceps weakness & activation failure following ACL injury &/or reconstruction bilaterally**

Hart et al: J Athletic Trn '10
Chmielewski: J Orthop Res '04
Farquhar: Muscle Nerve '05
Holder-Powell: Eur J Appl Physiol 01

Quadriceps Activation Following Knee Injuries: A Systematic Review
Joseph M. Hart, PhD, ATC, Brian Patterson, PhD, ATC, Jay Heiser, PhD, PT, Phyllis Poole, Christopher D. Ingram, PhD, ATC, Chad LaFollette
Journal of Athletic Training, 2010, 45(4), 311-318

ISOKINETIC TEST SUMMARY

NAME: [REDACTED] DATE: [REDACTED]
 JOINT: KNEE DOB: 4/11/...
 DIAGNOSIS: ACL Injury? S/P: ACL/PTL
 REFERRAL: Anterior Tester: [REDACTED]

MOTION	SPEED	%		PERCENTILE
		UNLADDED	LOADED	
EXT	180°/s	187	194	76%
	300°/s	191	119	89%
FLEX TORQUE	180°/s	126	100	84%
	300°/s	91	91	100%
EXT	180°/s	196	193	77%
	300°/s	183	161	83%
TOTAL MUSC	180°/s	191	127	83%
	300°/s	97	97	97%
SUMMARY: PEAK TORQUE/180° EXT: ① 81% ② 66%				
MUSC/180° EXT: ① 92% ② 70%				
HAM/QUAD RATIO: ① 67% ② 78%				
COMMENTS: 60% FLEXION @ 0.2 85% @ 0.1 11%				
70% @ 0.2 84% @ 0.1 91% @ 0.1 84%				

Wilk, Soscia, Romaniello, et al: JOSPT: 94

- ✓ **Correlation of function to isokinetics & functional (hop) testing**
- ✓ Positive correlation between Quad Peak Torque (180 deg/sec) & functional hop test
- ✓ Cross over, timed hop were the best
- ✓ No positive correlation with HPT
- ✓ Acceleration rate (QPT) at .2 sec high correlation with hop test & subjective knee scores (>85% PT)

Sport Specific testing LE

Tests That People Use:



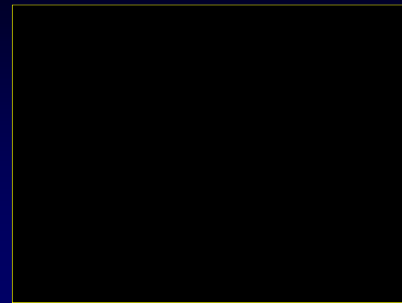
Sport Specific testing LE

Tests That People Use:



Sport Specific Testing LE

FMS - Motion Capture Device



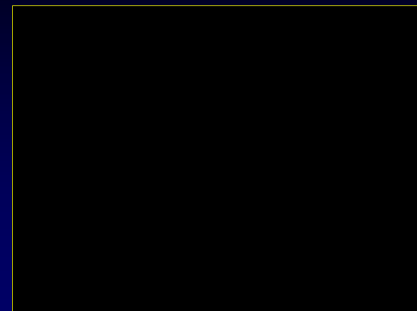
Post-Op ACL Reconstruction

Functional Screening Test

- **Clearance for Running:**
 - ✓ 30 step & holds: pass or fail (w/o loss of balance or excessive motion, straight)
 - ✓ 10 single leg squats: pass or fail (to 45 deg w/o loss of balance or excessive)
 - ✓ 1 RM leg press: $\geq 70\%$
 - ✓ 15 min fast treadmill walking

Sport Specific Testing LE

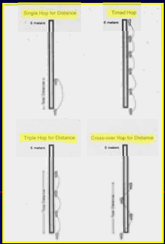
Front Step Down - Single Leg Squat



Noyes et al: AJSM '91

- Abnormal limb symmetry determined by function hop tests in ACL injured 67 subjects
 - Single leg hop
 - Single cross over hop
 - Triple hop
 - 6 m timed hop

✓ **Abnormal LSI: <85%**



Logerstedt et al: AJSM '12


- Single legged hop tests as predictors of self reported knee function following ACLR
- 85 subjects s/p ACLR
- Compared hop tests to IKDC

✓ **Cross over hop & 6m timed hop test were strongest predictors of knee function at 1 yr (0.90)**

✓ **Cross over hop most indicative of normal function**

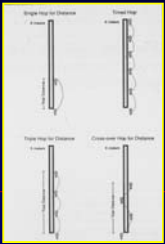
✓ **Subjects with abnormal knee function LSI <88%**

✓ **Subjects with normal knee function LSI >95%**



Bolgia et al: JOSPT '97

- Reliability of LE function hop tests in 20 non-injured subjects
 - Single leg hop = .96
 - Single cross over hop = .96
 - Triple hop = .95
 - 6 m timed hop = .66


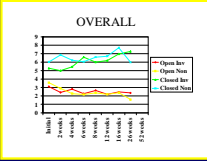


ACL Injuries


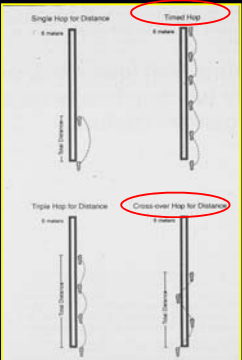
- Not an isolated injury**
 - Injury affects both extremities
 - For at least 3.6 mos
- Alters firing mechanism

Wilk, et al: CSM '03

Wojtys, Huston: AJSM '94

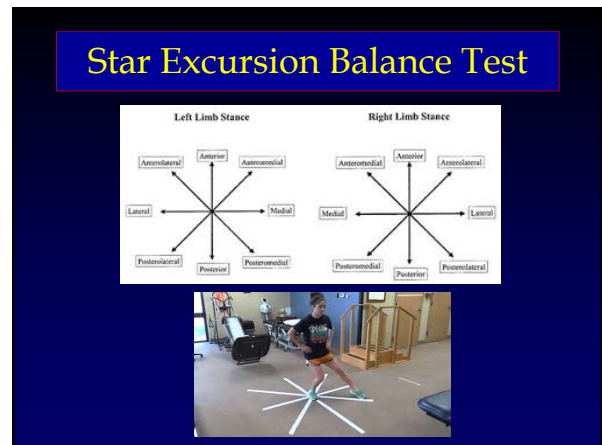
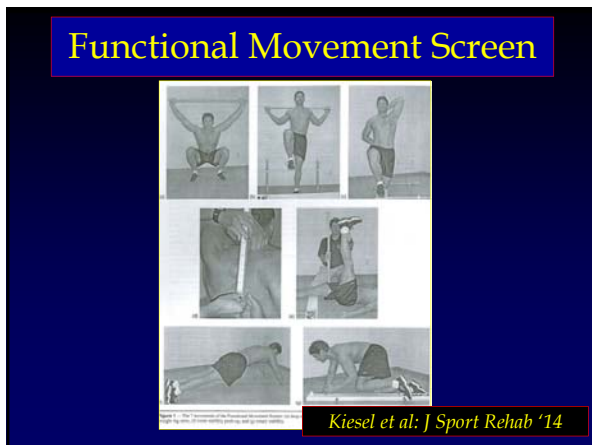
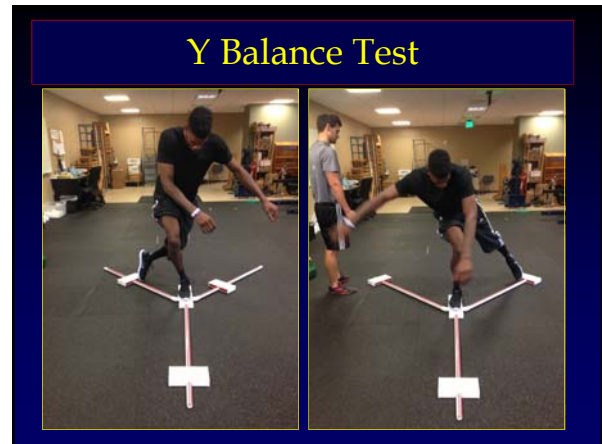



Neuromuscular Performance Characteristics in Elite Female Athletes*
From MedSport, Section of Orthopaedic Surgery at the University of Michigan, Ann Arbor, Michigan

Functional Movement Screen FMS





Functional Movement Screen

- Developed by Cook (*NAJSPT '06*)
- 7 different movements/test
- Score for each movement (0 to 3)
- Intra-rater reliability 0.98 (*Anstee: NATA '03*)
- ✓ *Score of ≤ 14 predict serious injury*
 - ✓ *Specificity: 0.91, sensitivity: 0.54*
- Kiesel, Plisky, Voight: NAJSPT '07*
- ✓ *Combination of low score & asymmetry displayed relative risk of injury*
- Kiesel, Butler, Plisky: J Sport Rehab '14*

Star Excursion Testing

Herrington et al: Knee '09

- ✓ *ACL deficient knee subjects to normal grp (N=25)*
- ✓ *No sign diff b/t Inj limb & Non Inj limb in ACL*
- ✓ *Sign diff b/t ACL def group & normal group*

Plisky et al: JOSPT '06

- ✓ *Star excursion test on high school basketball play*
- ✓ *235 athletes (130 males 105 females)*
- ✓ *Females w composite reach <94% limb length (6.5x greater risk)*
- ✓ *Players w anterior reach difference >4cm – 2.5x risk*

Sport Specific testing LE

Tests That People Use:

Myer et al: JOSPT '11

Modified agility T test

Modified Pro Shuttle test

Modified Long Shuttle

NFL Combine

Myer et al: JOSPT '11

- Utilization of modified NFL combine testing to identify functional deficits in athletes following ACL reconstruction
- 18 athletes (ACLR) compared to control
- DL broad jump, vertical jump, modified DL tests T test, pro shuttle, long shuttle & SL hop tests
- ✓ *Double Leg tests did not show differences*
- ✓ *S Leg sensitive enough to find limb asymmetry*
- ✓ *Uninvolved limb may mask deficits during DL tests*

Myer et al: JOSPT '11

- Utilization of modified NFL combine testing to identify functional deficits in athletes following ACL reconstruction
- 18 athletes (ACLR) compared to control
- DL broad jump, vertical jump, modified DL tests T test, pro shuttle, long shuttle & SL hop tests

Sport Specific Testing LE

NFLE & NFL Test - Shuttle Run

Sport Specific Testing LE

Perturbation Tests

- ✓ No published paper on data or criteria for perturbation testing
- ✓ We do tilt board testing
- ✓ Ability to correct board

“Reactive Neuromuscular Control”

- ✓ Subjective assessment
- ✓ We need objective studies



Important Component to Injury Prevention

Sport Specific Testing LE

Key Points

- *When can a patient/athlete return to running, jumping, & then sports ?*
- **When they are ready !!**
- Physically – specific tests
- Psychologically – limb confidence

Chmielewski: Phys Ther '11
Chmielewski: JOSPT '11
Lentz: J Sports Health '07
Ardern et al: BJSM '11




Sport Specific Testing LE

Specific Tests I Use:

- ✓ Subjective Patient Assessment
- ✓ Isokinetics, KT, & Hop test, FMS
- ✓ **Sport Specific:**
 - ✓ Front step down
 - ✓ Jump down
 - ✓ Agility L run
 - ✓ 4 corners
 - ✓ Reaction drill
 - ✓ V test
 - ✓ Sport & position specific tests




Sport Specific Testing LE

Conclusions

- ✓ Combination of factors determines patient ability to return to sports
- ✓ *Factors include: physical & psychological*
- ✓ *I prefer (as much) objective data as possible*
- ✓ Sport specific, position specific tests are important




Long way to go on this !!



Wilk-Return to Play Criteria 2017 Metcalf Meeting 2017 Snowbird, UTAH

FUNCTIONAL JUMP SCORE

NAME: CLAYTON DATE: _____

PROFESSION: Coach SEX: Male HT: 5'11" WT: 180

HEIGHT: 5'11"

WEIGHT: 180

AGE: 47

SEX: M

HT: 5'

WT: 180

Goal: 85-90%

SINGLE LEB. DISTANCE -- Inches			
1"	2"	3"	
MIN	82	80	AVE = 81.11
10V	77	82	AVE = 79.54
MIN - 10V =	5		PERCENTILE = 76%

SINGLE LEB. STAIRS -- Inches			
TOTAL DISTANCE = 7yds / 21 ST. / 312"			
1"	2"	3"	
MIN	111	108	AVE = 109
10V	110	118	AVE = 114
MIN - 10V =	0.05		PERCENTILE = 76%

SINGLE LEB. 3 JUMP DISTANCE			
1"	2"	3"	
MIN	267	277	AVE = 272.27
10V	257	280	AVE = 268.67
MIN - 10V =	10		PERCENTILE = 76%

