Mitchell J Rauh, PT, PhD, MPH FACSM  
Professor/Director  
Doctor of Physical Therapy Program  
Director, Running and Sports Injury Prevention Research Laboratory  
San Diego State University  
San Diego, CA

1) Participation in Running: Second Boom!  
- Marathon  
- Collegiate (competitive)  
- High School (competitive)

2) BAD NEWS! Increased Running = Increased Risk of Injury  
- Adult/Marathon  
- Collegiate (competitive)  
- High School (competitive)

3) STATIC measures and their association with running-related injury (RRI): equivocal results

4) What FUNCTIONAL measure should I use to examine the Runner for RTS?  
- Single Leg Squat?  
- Functional Movement Screen™?  
- SEBT/Y-Balance Test™?  
- Time to Stabilization?  
- Postural Stability Index?

5) Functional Tests and Injury Risk: Runners Discussion/Next Steps

6) Questions?

7) References
Pre-participation Screening to Identify Athletes at Risk for ACL Injury

Mark V. Paterno PT, PhD, SCS, ATC

Scientific Director, Division of Occupational Therapy and Physical Therapy

Professor, Division of Sports Medicine, Department of Pediatrics, University of Cincinnati College of Medicine

I. Screening to Prevention Primary ACL Injury
   a. Identification of primary ACL injury risk in vulnerable populations
      i. Female Athletes
      ii. Participants in pivoting and cutting sports
      iii. Prior history of ACL injury
   b. Modifiable Risk Factors to consider when screening
      i. Dynamic knee valgus with a drop vertical jump/single leg landing task
      ii. Core body control
      iii. Postural control/lower body proprioception
      iv. Neuromuscular Control Deficits
         1. Ligament Dominance
         2. Quad Dominance
         3. Limb Dominance
         4. Trunk Dominance

II. Screening to Prevent Secondary ACL Injury
   a. Risk Factors
      i. Failing to meet current RTS criteria= Increased re-injury risk
      ii. Altered Movement Quality
         1. Altered movement identified after ACLR
         2. Altered movement associated with 2nd ACL injury
            a. Paterno et al 2010
      iii. Psychological Factors
         1. Fear and 2nd ACL injury
         2. Confidence and 2nd ACL Injuries
   b. Current Return to Sport Screening Measures
      i. Strength
      ii. Functional Hop testing
      iii. Patient reported outcomes
      iv. Time
   c. Potential Screening Tools to Identify Athletes at High Risk for Future ACL Injury
      i. Quality of movement screening
      ii. Psychosocial readiness to RTS
References


Can Preparticipation Tests and Measures Identify Athletes at Risk for Injury?

Section: Lower Quadrant

1. Introduction
   Potential Role for Functional Tests/Measures in Identifying Athletes at Risk for Injury
   Overview
   “Low Tech” Options: FMS, SEBT/Y-Balance, jump/hop testing, LEFT
   “High Tech” Options: NordBord, diagnostic ultrasound, motion capture lab/ drop vertical jump
   Other Screening Options

2. Functional Movement Screen
   Kiesel et al NAJSPT 2007
   Findings from Subsequent Studies

3. Star Excursion Balance Test & the Y-Balance Test-Lower Quarter
   Plisky et al JOSPT 2006
   Butler et al Sports Health 2013
   Smith et al MSSE 2015
   Findings from Subsequent Studies for the Y-Balance Test-Lower Quarter
   Findings from Subsequent Studies for the SEBT

4. Tests from the Functional Testing Algorithm (FTA)
   Standing Long Jump
   Single Leg Hop
   Lower Extremity Functional Test
   Brumitt et al IJSPT 2013; Brumitt et al J Strength Cond Res 2018
   Findings from Subsequent Studies Utilizing Tests from the FTA

5. Linking Tests/Measures with Specific Injuries
   NordBord
   Diagnostic Ultrasound
   Male Collegiate Basketball Players
   Female Collegiate Volleyball Players
   Prior Injury History
   Drop Vertical Jump Testing in Motion Capture Lab
Drop Vertical Jump Testing and Reactive Strength Index
Potential Role of Evaluating Kinetic and Kinematic Variables

6. Clinical Recommendations
Which Test/Tests Should Physical Therapists Utilize?
Future Research

7. Questions

8. References


Functional Testing and Return to Sport for Upper Extremity
Robert C. Manske, PT, DPT, MEd, SCS, ATC, CSCS
Professor Wichita State University Department of Physical Therapy
Ascension - Via Christi Sports Physical Therapy
Twitter: @robptatcscs
Instagram: Robert_Manske
EMail: Robert.manske@wichita.edu

Clinical Decision Making

Shoulder and Elbow frequently injured during sports
Baseball – angular velocities of > 7,200 degrees/sec
Distractive forces near 100% bodyweight
NFL combine – 9.7% of athletes had some form of GH instability.
Stabilization procedures were in top 4 most commonly performed procedures

When Can I Return to Play

- Gradual progression of PT
- Asymptomatic performance of sports specific drills
  - Plyometric
  - Perturbation drills
  - End range of motion drills
- Controlled participation in practice setting
- Gradual progression
- Lower intensities initially advancing as tolerated
  - 50-60%
  - 75%
  - 80-90%
  - 100%
- Confidence and ability to tolerate full participation stress
- Appropriate time from injury/surgery
  - Successful completion of formal rehabilitation
  - Full sport specific ROM
  - Full stability
  - Strength
  - Subjective outcome scores

Clinical Decision Making

- Return to Sports…
- Very few guidelines published
- Few objective tests documented to support clinical decision making process
• Limited evidence to support our approach

  Don’t Feel Alone!

• Almost 90% of the orthopaedic literature represents research findings from non randomized study designs ranging from case series to prospective cohort studies

• If a physician, physical therapist, athletic trainer allows an athlete to return to sports they may be legally held responsible if the athlete encounters a serious injury!

Team Effort – Key Stakeholders

Functional Testing Algorithm

• Patients are initially stratified into activity levels:
  - General orthopedic patients
  - Recreational athletes
  - Competitive athletes

Increasing Accuracy

• Properly prepare the person to be tested
  1. Understand testing procedures
  2. Ability to practice unusual testing aspects beforehand
  3. Adherence to pre-testing instructions
  4. Follow protocol exactly
  5. "Trained" testers
  6. Calibration of equipment
  7. Consistent motivation from tester

Test Administration

• Warm-up
• Consistency
• Do not allow person tested to record results
• Motivation- helping person reach their full potential

Test Order

• Physical characteristics
• Power tests
• Speed and agility tests
• Strength tests
• Anaerobic tests
Cardiovascular test
Testing on separate days?
Functional testing algorithm

**Functional Testing Algorithm**
- Stratified into various activity levels
- Only tested at level that they need to return to full participation
- Quantitative and qualitative systematic form of testing and rehabilitation
- Safely progresses athlete from immediate post injury/surgery to full return
- Identifies deficits that will need addressed
- Progression to next higher level depends on passing prior testing in series
- Each testing section adds increased stress to shoulder and elbow
- If athlete does not pass test they are placed back into rehabilitation program at that level
- Tested at later time and if they pass - then they are progressed to next level of testing/rehabilitation

**Patient Reported Outcomes (PROs)**
- Patient reported (Subjective) outcomes
  - Disabilities of Arm, Shoulder and Hand (DASH)
  - Kerlen-Jobe Orthopaedic Clinic Shoulder and Elbow Score (KJOC)
  - American Shoulder and Elbow Surgeon’s Score (ASES)
  - Western Ontario Shoulder Instability Index (WOSI)

**Basic Measurements**
- Anthropometrics
- Pain
- AROM, PROM
- Flexibility
- Proprioception/kinesthesia
- Special tests- passive joint laxity

**Proprioception/Kinesthesia**
- Pacinian and Ruffini receptors, as well as GTO’s have been found in shoulder tissue
- Damage to neural tissue in the capsule, ligaments, muscles or surrounding skin is
likely to affect afferent information available for processing at the CNS

- Increased likelihood of re-injury due to inadequate restoration of the proprioceptive feedback system
- Threshold to detect passive movement
- Active joint angle replication
- Passive joint angle replication

**OKC Isokinetic Testing**
- Testing is done to find weak link in kinematic chain
- Performance of isolated testing is a key
- Weakness may be missed if only testing with functional tests
- 4 gradient submaximal tests
- 5 maximal tests
- 60/180/300 degrees per second

**HHD for Shoulder**
- Quick and easy to use
- Rank ordered strongest to weakest
  - Upper traps
  - Serratus anterior
  - Middle trapezius
  - Rhomboids
  - Lower trapezius

**Unilateral strength ratio’s**
- Elevation/depression = 2.62:1
- Protraction/retraction = 1.45:1
- Upward rotation/downward rotation = 1.23:1

**Allometric scaling (compared to bodyweight)**
- ER/IR ratio = 72-76%
- ER TBWR = 18-23%
- IR TBWR = 26-32%
Bilateral comparison of:
- ER’s 95-100%
- IR’s 100-115%

Prior to beginning ITP
- ER/IR ratio = 72-76%
- ER/ABD ratio = 68-73%
- IR = >115% of contralateral
- ER = >95% of contralateral
- Elbow Flex/Ext = 100-115% contralateral

Prior to Throwing from Mound
- ER/IR ratio = 72-76%
- ER/ABD ratio = 68-73%
- IR = >120% of contralateral
- ER = >100% of contralateral
- Elbow Flex/Ext = 110-115% contralateral
- Wrist Flex/Ext = 110-115% contralateral

CKC UE ST
Why CKC UE test; Gymnastics; Rowing; Mixed martial arts; Karate; Wrestling; Blocking in football; Military drills; Bench press/push ups
Closed Kinetic Chain Upper Extremity Stability Test
- Two lines on floor – 3 ft apart
- 4 gradient trials
- Men – push up position; Women - knees
- 15 sec test
- Touch both lines as many times as possible
- 45 seconds rest between bouts; 3 sets
- Average of three for score
- Males = 21 touches; Females = 23 touches

One Arm Seated Shot Put Test
First study in 1987
- Used to look at UE power
- At that time not used in rehabilitation
- 8# shot put
- 6# medicine ball
- Placed in single hand
- Back against wall, knees bent
- Palm up with zero degree of shoulder abduction
- 4 gradient submax to max throws
- 3 maximal throws; Average distance to nearest meter

- Reliability ICCs
  - Dominant = .99
  - ND arm = .97

- MDC
  - Dominant = 17”
  - ND arm = 18”

**Functional Throwing Performance Index**

- Line 15 ft from wall; One foot square on wall
- 4 ft from floor; 4 gradient submax warm up throws
- Maximum number of accurate throws in 30 sec
- 3 sets; Total # of throws divided by # accurate throws x 100
- Reliability with one month between tests was above .80

**Underkoeffler OH Softball Throw for Distance**

- Maximal effort test for softball throw distance
- Uses multiple joints of the body
- OH throw with crow hop
- Should use 4 gradient submax to max throws
- Reliability > 0.90

**Sports Specific Testing**

- Final tests will be individualized to the patient and his/her specific recreation or competitive sports.

- Testing for outcomes can take many forms
  - Self reported measures
  - Impairment based measures
  - Physical performance measures
- Use of cluster
• Use of continuum of tests
• FPT algorithm

**Conclusion**

• No one specific type of testing, or specific “functional” test has been proven superior
• Most authors agree that a comprehensive, systematic evaluation of the athlete is necessary for the most successful return to the athletic arena
• Does the test battery determine dysfunction?
• Step by step testing with successive advancement protects not only the athlete but the clinician as well
• The best testing may be actually “breaking down” their specific sport and position in that sport