Objective

- Discuss reliability of FMS and selected movement screens
- Discuss the meaning of FMS composite score results
- Discuss Deep Squat dysfunction
- Discuss screening in a case

What is the FMS?

A battery of 7 “fundamental” movement patterns (tests) designed to evaluate movement dysfunction and asymmetries.
- Deep squat
- Hurdle Step
- Inline Lunge
- Shoulder Mobility
- Active Straight Leg Raise
- Trunk Stability Pushup
- Rotary Stability

FMS Scoring

In general:
3 = Able to perform the test correctly
2 = Able to perform the test correctly in a modified position or able to partially complete the test
1 = Unable to successfully complete the test
0 = Pain during the test or clearing test

FMS Scoring

- Take highest score from three trials
  - Ex. Trial 1 = 2, Trial 2 = 1, Trial 3 = 3
  - Score the test a 3
- When testing bilaterally, take the LOWEST score between sides
  - Ex. Right = 3, Left = 2
  - Score the test a 2
- When in doubt, score low
Reliability of the FMS

Reliability
- Mixed results
- Strong between novice and expert raters (Minick et al., 2010)
- Mixed between disciplines (AT, EX, PT) (Sciubek et al., 2013)
- Professional education may influence reliability of FMS tests (Sciubek et al., 2013)
- Composite score reliability ranges from poor to excellent

FMS and Injury

Prediction of Injury by Limited and Asymmetrical Fundamental Movement Patterns in American Football Players

Kyle B. Kiesel, Robert J. Butler, and Philip J. Pinsky

- 238 NFL players
- Players with CS ≤ 14 = 1.87 relative risk related to injury
- Players with at least one asymmetry = 1.80 relative risk related to injury
- Specificity for low composite and asymmetry = 0.87

FMS and Injury in “Tactical Athletes”

Can injury in major junior hockey players be predicted by a pre-season functional movement screen – a prospective cohort study

Kyle Kiesel, PT, PhD, ATC, OCS
Phillip J. Pinsky, PT, DSc, OCS, ATC
Michael L. Vogt, PT, DPhD, OCS, OCS, ABP

- 20 Major junior hockey players
- Average FMS score = 14.7 ± 2.57
- Score ≤ 14 no more likely to sustain an injury
- Injured athletes mean CS = 15
- Non-injured mean CS = 14.4
- Inconsistent in methods...

FMS and Injury

Can Serious Injury in Professional Football be Predicted by a Preseason Functional Movement Screen?

Kyle Kiesel, PT, PhD, ATC, OCS
Phillip J. Pinsky, PT, DSc, OCS, ATC
Michael L. Vogt, PT, DPhD, OCS, OCS, ABP

- 46 NFL players
- No demographic data
- FMS done during preseason
- ROC curve analyzed and cut point set at 14
- Score ≤ 14 results in 11.6x greater chance of injury

FMS and Injury

Relationship Between Functional Movement Screening Score and History of Injury

Annie Lamontagne
Michelle Huston
Samantha M. Martz
Ellen J. Kho

- 100 physically active students
- 35 sustained lower extremity injury
- ROC curve sets cutoff at 17
- Score ≤ 17 results in 4.7x greater chance of injury

FMS and Injury

Firefighters with CS ≤ 14 at increased risk of injury (Butler et al., 2012)

- Firefighters with history of injury have 1.68x greater risk of sustaining injury
- Following intervention, lost time injuries reduced by 62%
- Cut point set at 16 (Peate, 2007)
- Military recruits with slow run times and low CS at increased risk of injury (Lisman et al., 2013)
The strength of association between FMS composite scores and subsequent injury does not support its use as an injury prediction tool

Do Functional Movement Screen (FMS) composite scores predict subsequent injury? A systematic review with meta-analysis
Robert W Moran, Anthony G Schneider, Jesse Mason, John Sullivan

FMS Pros and Cons

**PROS**
- Potential to identify individuals at risk
- It is the best of what we have...right now
- Time

**CONS**
- Time
- The evidence is not overwhelming
- Is not a predictor of athletic performance
- Do we need all tests for all populations?
- Some tests are difficult to assess

Should we use the FMS?

The short answer...
**YES!!!**

Validity of the FMS

- Does not predict performance among healthy individuals and golfers (Okada, Parchman)
- FMS scores may predict future improvement in performance in track athletes from one season to the next (Chapman 2014)
- Scores can improve with training (Kiesel 2011)
- Training to correct FMS deficits have shown improvement in strength and flexibility in elite HS baseball players (Song 2014)

What do we do with the FMS?

- "An athlete’s ability to follow directions is as important as their physical ability to successfully complete the FMS tests."
- After testing, dig deeper
- ROM, strength, use other screens/tests
- Keep asking questions and contribute to the body of evidence

Deep Squat

The Functional Movement Screen (FMS) and the Selective Functional Movement Assessment (SFMA) are tools used to assess an athlete's movement patterns and identify areas of dysfunction. These assessments can help in the prevention of injury and in identifying areas for improvement. The Deep Squat is one of the tests included in the FMS.

Sacred Heart University
### Scoring Criteria (FMS)

- Torso/Tibia Parallel
- Femur parallel or below
- Knees over the toes
- Dowel move beyond toes
- Asymmetry
- Feet ER

### Frequency of Deep Squat Errors

<table>
<thead>
<tr>
<th>Error Description</th>
<th>Frequency</th>
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</thead>
<tbody>
<tr>
<td>Bar beyond toes</td>
<td>92.3%</td>
</tr>
<tr>
<td>Torso parallel with tibia</td>
<td>76.9%</td>
</tr>
<tr>
<td>Femur parallel</td>
<td>50%</td>
</tr>
<tr>
<td>Medial Knee Displacement (MKD)</td>
<td>26.9%</td>
</tr>
</tbody>
</table>

1 – Knee displacement, 2 – Torso and tibia do not remain parallel, 3 – Femur does not reach horizontal, 4 – Bar extends beyond toes.

### DS Reliability

- Very mixed
- Ranges from Poor to Good/Excellent (H. Gulgin & Hoogenboom, 2014; Merick et al., 2012; Chan et al., 2012; Scibek, Edmond, & Moran, 2012; Smith, Chimera, Wright, & Warren, 2013; Teyhen et al., 2012)
- Variability between Novice and Expert (Merick et al., 2012; Chan et al., 2012; Smith et al., 2012)
- Variability across the movement sciences (Scibek et al., 2013)

### What does the research say? (kinematics)

- Kinematic differences between 1, 2, 3
- Peak DF excursion is greater in those that score 3 (Butler et al., 2010)
- Those that score 3 have significantly greater peak knee flexion and knee flexion excursion than those that score 2
- Those that score 3 or 2 have greater peak hip flexion
- Mauntel et al., 2015
  - Differences between males and females
  - Males = greater knee valgus!!
  - Males = Greater hip flexion → protective mechanism

- Dill et al., 2014
  - No difference when classified by normal or limited ankle ROM
  - Sig. difference when reclassified by weight bearing lunge performance
    - Greater knee flexion displacement
    - Greater ankle DF
What does the research say?

- EMG
  - Compare those with MKD and those without
    - Bell et al., 2012 = Significantly greater hip ADD in MKD group
    - Padua et al., 2012 = Significant increase in hip ADD, gastroc., and tib. ant. activation
    - Elevate heels → decrease in glut max, hip ADD, tib ant., and gastroc activation

Effect of ROM on the DS

- Decreased DF with knee extended may contribute to MKD (Bell et al., 2012)
- Bell et al., 2008 found no difference in squat when assessing passive DF knee ext
  - Approached sig. when DF assessed with knee in slight flexion
    - Maybe “clinical significance”??? → 20% difference in DF between conditions
    - MKD group did have sig. dif. hip ER

Effect of Strength on DS

- Bell et al., 2008
  - Greater normalized isometric hip extension and external rotation strength in MKD group
  - What is interesting about these findings?
  - Bell et al. 2012
  - No difference in concentric and eccentric hip strength between MKD and control

DS and Performance

- Does not have strong predictive value in regard to sport performance (Lockie et al., 2015)
- Some prediction on Vert Jump – Deeper squat = Greater Glut Max activation??
- 54% of golfers with DS fault had loss of posture during swing, 29% demonstrate a “slide” dysfunction during swing (Gulgin et al., 2014)
  - These lead to inconsistent performance
  - Track athletes that score a “3” on DS have greater longitudinal performance (Chapman et al., 2014)

DS and Injury

- DS demonstrates minimal injury predictive value in firefighters and military recruits (Butler et al, 2015, Bushman et al., 2015)
  - Use caution when using this test alone for predictive value (Bushman et al., 2015)
  - Use of DS and ASLR has predictive value in runners...better than entire FMS (Hotta et al., 2015)
What do we do with DS results

- Determine NM vs ROM
- Unload the squat
- Check PROM & AROM
- Check closed chain dorsiflexion
- Assess Strength
- Heels elevated or not?
- Do they know how to squat???
- Select other tests/screens
- Correct identified dysfunction

Case

You perform a Functional Movement Screen on a 20 year old female Division I soccer player. She has had ankle sprains in HS, but otherwise no significant history of injury. Additionally she has limited resistance training experience. She was a three sport athlete in HS (Soccer, Basketball, Softball).

Case Cont.

- Her scores are as follows
  - DS – 1 (MKD, forward trunk lean, inability to reach parallel)
  - ILL – 2 (Left front heel comes off ground, forward lean. Right side only has a forward lean)
  - HS – 2 (Left foot kicks hurdle on the way over, Right = 2)
  - ASLR – 2 (both sides)
  - SM – 3
  - Push up – 1
  - Rotary stability – 2
  - What is the Composite Score & does she have an increased risk of injury???
  - Maybe, maybe not...
  - What do we do next?

Case Cont. – Focus on DS

- Mobility vs Stability
- Unload the squat
  - Do they have ROM in unloaded position?
- Assess squat with arms down
- Assess ROM of ankle, knee, & hip
- Assess strength at hip and knee
- Single Leg Squat
- Step up/Step down

Case Cont.

1. Eliminate tests that you do not need
   a) Shoulder Mobility
2. Identify tests that are a 1 and work to identify dysfunctions
   a) DS, HS, Push Up
3. Identify other tests/screens that may help guide corrective exercise plan

Thank you!

Questions?

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Coming June, 2017