Practical Implementations of Movement Screening

EATA 2016
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• Lock Haven University
  – BS, Health Science/Athletic Training
• Salisbury University
  – MS, Applied Health Physiology
• CSCS, National Strength and Conditioning Association
• FMS, Functional Movement Systems
  • Level 1 and 2 certifications
Disclosures

• No compensation from any company or group discussed in the presentation.
• Nothing in this session is designed to sell any item or property.
Screening Movement

• Confusing at times
  – A lot out there
  – We will only discuss and perform a few

• Definite value
  – Prevent vs Treat
  – Industrial/Corporate/Emerging settings and traditional

• Develop a system and work with it
  – Redevelop and work with it
Types of Movement Assessments

• Dynamic vs Transitional (Clark)
  – Transitional are those movement without a change in one’s base of support
    • squatting, pushing, pulling
  – Dynamic refers to the change in base of support for a particular movement
    • Walking, jumping
Screens that we will perform

• Landing Error Scoring System-Real Time
• Tuck Jump Test
• Functional Movement Screen
Landing Error Scoring System- Real Time

• Landing Error Scoring System
  – Clinical assessment tool that has demonstrated concurrent validity against 3D motion analysis (Padua, DA)
  – Good interrater and intrarater reliability (Padua, DA)
  – In study with youth soccer players somewhat of a predictive evidence for identifying individuals who are a high risk for injury, namely ACL injury. (DiStefano, LJ)
LESS vs LESS-RT

- LESS-RT was developed to be a more clinician friendly tool. LESS great in a lab with motion analysis but not very functional for the everyday AT.

- LESS-RT has comparable reliability to the LESS validity to the LESS is still being studied (Padua, DA)

- LESS-RT has 10 jump-landing characteristics
LESS-RT

• According to Padua, DA – Reliability of the LESS-RT, a clinical assessment tool
• High LESS Scores = Poor Jump-landing technique
• Low LESS Scores = Excellent Jump – Landing Technique
Set-up

• Procedure
  – Scorer stands approx 10 feet away
  – Participant should wear comfortable clothing but allows necessary areas to be seen
  – 30 inch box height and target line approx ½ the participants height
  – 4 Trials
    • 1 (anterior) items 1-3 LESS-RT
    • 2 (anterior) items 4-5 LESS-RT
    • 3 (lateral) items 6-7 LESS-RT
    • 4 (lateral) item 8 LESS-RT
      – Items 9-10 are overall impressions of the 4 trials
1. The individual is instructed to “jump forward from the box with both feet so that you land with both feet just after the line” and “as soon as you land, jump up for maximum height and land back down.”

**Landing Error Scoring System (LESS) Test**

- Start
- Jump
- Land
- Jump
Table 1  Operational Definitions of Individual Items on the Landing Error Scoring System Real-Time (LESS-RT)

<table>
<thead>
<tr>
<th>LESS-RT item</th>
<th>Operational definition</th>
<th>Rater view</th>
<th>Jump # from which item is scored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stance width</td>
<td>If the subject lands with a wide or narrow stance when evaluated from the frontal plane, he/she receives an error. An error is only scored if the stance is observed to be very wide or very narrow (+1).</td>
<td>Front</td>
<td>1</td>
</tr>
<tr>
<td>Maximum foot-rotation position</td>
<td>If a subject’s feet are moderately externally rotated or slightly internally rotated at any point during the jump landing, he/she receives an error (+1).</td>
<td>Front</td>
<td>1</td>
</tr>
<tr>
<td>Initial foot-contact symmetry</td>
<td>If 1 foot lands before the other or if 1 foot lands heel-to-toe and the other lands toe-to-heel, the subject receives an error (+1).</td>
<td>Front</td>
<td>1</td>
</tr>
<tr>
<td>Maximum knee-valgus angle</td>
<td>If the subject moves into a small amount of knee valgus, he/she receives an error (+1).</td>
<td>Front</td>
<td>2</td>
</tr>
<tr>
<td>Amount of lateral trunk flexion</td>
<td>If the subject is leaning to the right or left side so that the trunk is not vertical in the frontal plane, he/she receives an error (+1).</td>
<td>Front</td>
<td>2</td>
</tr>
<tr>
<td>Initial landing of feet</td>
<td>If the subject lands heel to toe or with a flat foot, he/she receives an error (+1).</td>
<td>Side</td>
<td>3</td>
</tr>
<tr>
<td>Amount of knee-flexion displacement</td>
<td>If the subject goes through a small (+2) or average amount (+1) of knee-flexion displacement, he/she receives an error.</td>
<td>Side</td>
<td>3</td>
</tr>
<tr>
<td>Amount of trunk-flexion displacement</td>
<td>If the subject goes through a small (+2) or average amount (+1) of trunk-flexion displacement, he/she receives an error.</td>
<td>Side</td>
<td>4</td>
</tr>
<tr>
<td>Total joint displacement in the sagittal plane</td>
<td>If the subject goes through large displacement of the trunk and knees, then score soft (0). If the subject goes through an average amount of trunk and knee displacement, then score average (+1). If the subject goes through a small amount of any trunk and knee displacement, then score stiff (+2).</td>
<td>Side</td>
<td>All</td>
</tr>
<tr>
<td>Overall impression</td>
<td>Score excellent (0) if the subject displays a soft landing and no frontal-plane motion at the knee. Score poor (+2) if the subject displays a stiff landing and large frontal-plane motion at the knee, or only large frontal-plane motion at the knee. All other landings, score average (+1).</td>
<td>N/A</td>
<td>All</td>
</tr>
</tbody>
</table>

LESS-RT Scoring Sheet

<table>
<thead>
<tr>
<th>Frontal-Plane Motion</th>
<th>Sagittal-Plane Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Stance width</td>
<td>6. Initial landing of feet</td>
</tr>
<tr>
<td>□ Normal (0)</td>
<td>□ Toe to heel (0)</td>
</tr>
<tr>
<td>□ Wide (1)</td>
<td>□ Heel to toe (1)</td>
</tr>
<tr>
<td>□ Narrow (1)</td>
<td>□ Flat (1)</td>
</tr>
<tr>
<td>□ Normal (0)</td>
<td>□ Large (0)</td>
</tr>
<tr>
<td>□ Externally rotated (1)</td>
<td>□ Average (1)</td>
</tr>
<tr>
<td>□ Internally rotated (1)</td>
<td>□ Small (2)</td>
</tr>
<tr>
<td>3. Initial foot contact</td>
<td>8. Amount of trunk-flexion displacement</td>
</tr>
<tr>
<td>□ Symmetric (0)</td>
<td>□ Large (0)</td>
</tr>
<tr>
<td>□ Not symmetric (1)</td>
<td>□ Average (1)</td>
</tr>
<tr>
<td>4. Maximum knee-valgus angle</td>
<td>□ Small (2)</td>
</tr>
<tr>
<td>□ None (0)</td>
<td>□ Soft (0)</td>
</tr>
<tr>
<td>□ Small (1)</td>
<td>□ Average (1)</td>
</tr>
<tr>
<td>□ Large (2)</td>
<td>□ Stiff (2)</td>
</tr>
<tr>
<td>5. Amount of lateral trunk flexion</td>
<td>10. Overall impression</td>
</tr>
<tr>
<td>□ None (0)</td>
<td>□ Excellent (0)</td>
</tr>
<tr>
<td>□ Small to moderate (1)</td>
<td>□ Average (1)</td>
</tr>
<tr>
<td></td>
<td>□ Poor (2)</td>
</tr>
</tbody>
</table>

**Figure 2** — Scoring sheet for the Landing Error Scoring System-Real Time (LESS-RT) assessment tool.

Tuck Jump Test

• Tuck Jump Test may be useful to the health and fitness professional for the identification of lower extremity technical flaws during plyometric activity. (Myer)

• High amount of effort is required by the athlete to perform

• Can be utilized pre, mid and post training
Set up and test

• Performs repeated tuck jumps for 10 seconds
• Checklist – checked or not
• Final assessment score
  – Participants who do not improve their scores or demonstrate 6 or more flawed techniques should be targeted for further technique training
• Myer suggests using test to check technique through out season
Tuck Jump Test

Tuck Jump Test

Marking criteria
If the participant fails to meet the criteria below then they score 1, if they meet the criteria they score 0 for the respective category.

Knee & Thigh Motion
1. Knee valgus on landing
   - Hip, knee and foot aligned, no collapse of the knee inwards
2. Thighs not reaching parallel (peak of jump)
3. Thighs not equal side to side (during flight)

Foot position during landing
4. Foot placement not shoulder width apart
   - Inside of tape marks
5. Foot placement not parallel (front to back)
6. Foot contact timing not equal
   - Asymmetrical landing
7. Does not land in same footprint
   - Consistent point of landing
8. Excessive landing contact noise

Plyometric technique
9. Pause between jumps
10. Technique declines prior to 10 seconds

# Tuck Jump Test

<table>
<thead>
<tr>
<th>Name:</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee &amp; thigh motion</td>
<td></td>
</tr>
<tr>
<td>Knee valgus on landing</td>
<td></td>
</tr>
<tr>
<td>Thighs not reaching parallel (peak of jump)</td>
<td></td>
</tr>
<tr>
<td>Thighs not equal side to side (during flight)</td>
<td></td>
</tr>
<tr>
<td><strong>Foot position during landing</strong></td>
<td></td>
</tr>
<tr>
<td>Foot placement not shoulder width apart</td>
<td></td>
</tr>
<tr>
<td>Foot placement not parallel (front to back)</td>
<td></td>
</tr>
<tr>
<td>Foot contact timing not equal</td>
<td></td>
</tr>
<tr>
<td>Does not land in same foot print</td>
<td></td>
</tr>
<tr>
<td>Excessive landing contact noise</td>
<td></td>
</tr>
<tr>
<td><strong>Plyometric technique</strong></td>
<td></td>
</tr>
<tr>
<td>Pause between jumps</td>
<td></td>
</tr>
<tr>
<td>Technique declines prior to 10 seconds</td>
<td></td>
</tr>
</tbody>
</table>

**Total Score**
What is FMS?

• is a ranking and grading system that documents movement patterns that are key to normal function.
• identifies areas of poor mobility and/or stability
• Safety → what should you NOT do
• Provides a hierarchy to simplify the corrective process
• Functional baseline → check progress
• Perform before injury/activity (SCREEN)
Reliability

- Overall studies show that there is a significant reliability within and between raters for the FMS
- Scores also tend to be in agreement for individuals tests within the screen.

Predictability

• If the goal is to predict if someone will become injured then studies suggest FMS score should be used in conjunction with other evidence based risk factors

  
  • Lehr ME, Plisky PJ, Kiesel KB, Butler RJ, Fink, M, Underwood FB. Field Expedient Screening and Injury risk Algorithm Categories as Predictors of non-contact Lower Extremity Injury. *Scan J Med Sci Sport*. 2013; 23(4); e225-32
  
What is SFMA?

• 7 full body movements that assess fundamental patterns of movement
• Regional Interdependence
• Sequential road map to distinguishing between mobility and stability
  – Tight hamstrings?
• PAIN – After injury
Terminology

- Stability
- Mobility
- Functional = Fundamental
- Regional Interdependence
  - The whole is greater than the sum of its parts
- Screen
  - Cardiovascular vs Movement
Principles of FMS

• Basic bodyweight movement patterns should not provoke pain.
  – Compensation
  – Altered movement patterns
    • i.e. ankle sprain → limp
Principles of FMS

• Gross limitation of fundamental movement patterns, even if pain-free, can cause compensation and substitution leading to poor efficiency, secondary problems and increased injury risk in active populations.
  – Repetitive micro-trauma
  – Recovery

Principles of FMS

• Fundamental movement patterns involving the body’s left and right sides should be mostly symmetrical.
  – Core Stability vs. Distal Mobility

• Fundamental movement capability should precede performance-based capability.
  – Don’t put fitness on top of dysfunction

• Fundamental movement capability should mostly precede complex movement activity or complex skill training.

DEEP SQUAT

Upper torso is parallel with tibia or toward vertical | Femur below horizontal
Knees are aligned over feet | Dowel aligned over feet

1

Tibia and upper torso are not parallel | Femur is not below horizontal
Knees are not aligned over feet | Lumbar flexion is noted

The athlete receives a score of zero if pain is associated with any portion of this test.
A medical professional should perform a thorough evaluation of the painful area.
HURDLE STEP

1. Contact between foot and hurdle occurs | Loss of balance is noted

2. Alignment is lost between hips, knees and ankles | Movement is noted in lumbar spine 
Dowel and hurdle do not remain parallel

3. Hips, knees and ankles remain aligned in the sagittal plane 
Minimal to no movement is noted in lumbar spine | Dowel and hurdle remain parallel

The athlete receives a score of zero if pain is associated with any portion of this test. 
A medical professional should perform a thorough evaluation of the painful area.
INLINE LUNGE

Dowel contacts maintained | Dowel remains vertical | No torso movement noted
Dowel and feet remain in sagittal plane | Knee touches board behind heel of front foot

Dowel contacts not maintained | Dowel does not remain vertical | Movement noted in torso
Dowel and feet do not remain in sagittal plane | Knee does not touch behind heel of front foot

Loss of balance is noted

The athlete receives a score of zero if pain is associated with any portion of this test. A medical professional should perform a thorough evaluation of the painful area.

Excerpted from the book, Movement: Functional Movement Systems—Screening, Assessment, Corrective Strategies
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SHOULDER MOBILITY

1

Fists are not within one and half hand lengths

2

Fists are within one-and-a-half hand lengths

3

Fists are within one hand length

The athlete will receive a score of zero if pain is associated with any portion of this test. A medical professional should perform a thorough evaluation of the painful area.

CLEARING TEST

Perform this clearing test bilaterally. If the individual does receive a positive score, document both scores for future reference. If there is pain associated with this movement, give a score of zero and perform a thorough evaluation of the shoulder or refer out.

Excerpted from the book, Movement: Functional Movement Systems—Screening, Assessment, Corrective Strategies
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ACTIVE STRAIGHT-LEG RAISE

1
Vertical line of the malleolus resides below joint line
The non-moving limb remains in neutral position

2
Vertical line of the malleolus resides between mid-thigh and joint line
The non-moving limb remains in neutral position

3
Vertical line of the malleolus resides between mid-thigh and ASIS
The non-moving limb remains in neutral position

The athlete will receive a score of zero if pain is associated with any portion of this test.
A medical professional should perform a thorough evaluation of the painful area.
TRUNK STABILITY PUSHUP

1
Men are unable to perform a repetition with hands aligned with the chin
Women unable with thumbs aligned with the clavicle

The athlete receives a score of zero if pain is associated with any portion of this test. A medical professional should perform a thorough evaluation of the painful area.

2
The body lifts as a unit with no lag in the spine
Men perform a repetition with thumbs aligned with the chin
Women perform a repetition with thumbs aligned with the clavicle

3
The body lifts as a unit with no lag in the spine

SPINAL EXTENSION CLEARING TEST
Spinal extension is cleared by performing a press-up in the pushup position. If there is pain associated with this motion, give a zero and perform a more thorough evaluation or refer out. If the individual does receive a positive score, document both scores for future reference.
Performs a correct unilateral repetition

Performs a correct diagonal repetition

Inability to perform a diagonal repetition

The athlete receives a score of zero if pain is associated with any portion of this test. A medical professional should perform a thorough evaluation of the painful area.

Spinal Flexion Clearing Test

Spinal flexion can be cleared by first assuming a quadruped position, then rocking back and touching the buttocks to the heels and the chest to the thighs. The hands should remain in front of the body, reaching out as far as possible. If there is pain associated with this motion, give a zero and perform a more thorough evaluation or refer out. If the individual receives a positive score, document both scores for future reference.

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### FMS Scoring

**Scoring Sheet**

<table>
<thead>
<tr>
<th>NAME</th>
<th>DATE</th>
<th>DOB</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CITY, STATE, ZIP</td>
<td>PHONE</td>
<td></td>
</tr>
<tr>
<td>SCHOOL/AFFILIATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSN</td>
<td>HEIGHT</td>
<td>WEIGHT</td>
</tr>
<tr>
<td>PRIMARY SPORT</td>
<td>PRIMARY POSITION</td>
<td></td>
</tr>
<tr>
<td>HAND/LEG DOMINANCE</td>
<td>PREVIOUS TEST SCORE</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST</th>
<th>RAW SCORE</th>
<th>FINAL SCORE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEEP SQUAT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HURDLE STEP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INLINE LUNGE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHOULDER MOBILITY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMPINGEMENT CLEARING TEST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACTIVE STRAIGHT-LEG RAISE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRUNK STABILITY PUSHUP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRESS-UP CLEARING TEST</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>ROTARY STABILITY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POSTERIOR ROCKING CLEARING TEST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Raw Score:** This score is used to denote right and left side scoring. The right and left sides are scored in five of the seven tests and both are documented in this space.

**Final Score:** This score is used to denote the overall score for the test. The lowest score for the raw score (each side) is carried over to give a final score for the test. A person who scores a three on the right and a two on the left would receive a final score of two. The final score is then summarized and used as a total score.

Joint by Joint Approach

The Arch

• NEEDS STABILITY
The Ankle

• NEEDS MOBILITY
  – Dorsiflexion
  – Closed Chain Dorsiflexion = 4-5 inches over toes

The Knee

• NEEDS STABILITY
  – Ankle mobility or core/hip stability?
The Hip

• NEEDS MOBILITY
  – Flexion/extension
  – ADD/ABD
  – IR/ER

The Lumbar Spine

• NEEDS STABILITY
  – True Core Stability
  – Intra-Abdominal Pressure
  – Diaphragmatic Breathing
The Thoracic Spine

• NEEDS MOBILITY
  – Extension and Rotation
  – Flexion
  – Foundation for Scapular Stability
The Shoulder (glenohumeral joint)

• NEEDS MOBILITY
  – Flexion/Extension
  – ADD/ABD
  – IR/ER
Corrective Exercise

• SFMA Hierarchy (mobility before stability)
  – Most Dysfunctional *Non-painful* pattern
  – Cervical/Shoulder
  – MS Flexion, Extension, Rotation
  – SLS and OHDS

• FMS Hierarchy (mobility before stability)
  • ASLR, Shoulder Mobility
  • Push Up, Rotary Stability
  • Lunge, Hurdle Step, Squat
FMS Hierarchy

• First start with any score of zero.
  – This area must be evaluated by an AT or healthcare provider. Once the area is cleared, re-test that part of the FMS.
• Asymmetries from left to right in which one side scores a 1.
  – A score of 1 on the right and 3 on the left is an asymmetry that must be addressed first.
• If the athlete does not have any 1-2 or 1-3 R/L differences, then go to a bilateral score of 1. Once all the 1s are addressed and have retested at a 2 or 3, then look for imbalances with a 2 from R/L (2-3s).
• After these are addressed, look for areas that have bilateral 2s.
• The goal is to find the weakest link
• Make sure to re-test throughout the process.
FMS Hierarchy

– Fundamental Mobility
  • ASLR, Shoulder Mobility

– Sub-Maximum Stabilization
  • Rotary Stability

– High-Threshold Stabilization
  • Pushup

– Functional Movement Patterns
  • Lunge, Hurdle Step, Squat
Corrective Exercise

• MOBILITY
  – Soft Tissue Extensibility
    • Self Myofascial Release
      – Foam Rolling, Massage Stick, Lacrosse Ball
    • Massage
    • Active Release Technique
    • Instrument Assisted Soft Tissue Mobilization
    • Static Stretching
    • Active Isolated Stretching
    • Dynamic Stretching
    • PNF Stretching
Corrective Exercise

• MOBILITY
  – Joint Capsule Restrictions
    • Joint Mobilization and High Velocity Thrust Mobilizations (often referred to as Manipulations)
    • Mulligan NAGS, sustained natural apophyseal glides (SNAGS), Mobilizations with Movement (MWM)
Corrective Exercise

STABILITY = motor control ≠ strength
Corrective Exercise

• STABILITY
  – Coaching/Cueing***
    • Internal vs. External
  – Reflex Stability
  – Reactive Neuromuscular Training (RNT)
    • Feed the mistake
  – Proprioceptive Neuromuscular Facilitation (PNF)
    • Compression
    • Distraction
    • Touch
Corrective Exercise

• STABILITY
  – 4x4 Matrix
    • Neurodevelopmental Sequence
    • Prone/Supine
      – Rolling, Dead Bug Exercises, Breathing
    • Quadruped
      – Crawling
    • Kneeling (Transitional)
      – Tall/Half
  • Standing
    – Bilateral
    – Split
    – Single Leg

• 4x4 Matrix
  – Assisted - unloaded
  – Unloaded
  – Assisted - loaded
  – Loaded
Neurodevelopmental Sequence
Corrective Exercise

• Prone/Supine
  – Deadbugs

– Rolling Patterns
  • http://www.youtube.com/watch?v=btzkT1mSY3E

Corrective Exercise

• Quadruped

Corrective Exercise

• Kneeling

Corrective Exercise

- Standing

Other Screens

- Upper Extremity Davies Test
- Gait: Treadmill Walking
- Upper Extremity Transitional Assessments
- Star Excursion Balance Test
- Standing Over Head Dumbbell Press
- Standing Row Assessment
- Push-Ups Assessment
- Single Leg Squat Assessment
- Overhead Squat Assessment
- And others still.......
Ideas for Implementations

• After injury
  – All ACL “rehabbers” must complete LESS-RT, FMS, or Tuck Jump Test with certain score to progress.

• Before injury
  – All athletes screened baseline
    • Preseason
    • Multiple stations, multiple assessors

• A plyometric training program produced kinematic and kinetic changes at the knee joint only where as the core stability program produced changes at both the hip and the knee joints. (Pfile)
Ideas for Implementations

• Get entire AT staff on board
• Get strength and conditioning staff on board
• Work together to develop criteria with coaches.... Can you get your coaches on board
• All of these individuals can help you with the prevention aspects of injury.
References


• Lehr ME, Plisky PJ, Kiesel KB, Butler RJ, Fink, M, Underwood FB. Field Expedient Screening and Injury risk Algorithm Categories as Predictors of non-contact Lower Extremity Injury. *Scan J Med Sci Sport*. 2013; 23(4); e225-32

