Functional Anatomy and Movement Assessment

Identifying Compensation Patterns that Predict Injury

Joshua Stone, MA, ATC, NASM-CPT, PES, CES
Sports Medicine Program Manager
National Academy of Sports Medicine
To provide a fundamental overview of Human Movement System components, how they interrelate to produce functional movement.

Develop observational skills to effectively assess human movement and identify common movement compensation patterns which lead to injury.
Objectives

1. What is the Human Movement System and functional anatomy?
2. What is Human Movement Dysfunction and where does it exist?
3. What is movement compensation and how does it reveal itself?
4. How to utilize movement assessments to identify dysfunction and compensation?
Test your function

1. Perform an overhead squat (10-15 reps).
2. Observe client from the front and side. Look at foot, knee, hip, low back and shoulder movement.
3. Write findings and switch partners.
Complex, well-orchestrated system of interrelated and interdependent myofascial, neuromuscular, and articular components.
Optimal Human Movement

Length-Tension Relationships

Force-Couple Relationships

Arthrokinematics

Optimal Neuromuscular Efficiency (Function)
Muscles function in all three planes of motion:
- Sagittal
- Frontal
- Transverse

Through the entire muscle action spectrum:
- Eccentric
- Isometric
- Concentric

All freely moveable joints display movement in all three planes of motion.
- Change in alignment yields compensatory changes of other joints.
Human Movement Dysfunction

- Altered joint motion
- Altered length-tension
- Poor muscle control

Movement dysfunction and compensation
Human Movement Dysfunction

Movement Impairment Syndromes

- Structural integrity of the HMS is compromised because the components are out of alignment.
- If one segment in the HMS is out of alignment, other movement segments have to compensate in attempts to balance the weight distribution of the dysfunctional segment.

arching the low back  elevating the shoulders  knee valgus
Test your function

1. Perform an overhead squat (10-15 reps).
2. Observe client from the front and side. Look at foot, knee, hip, low back and shoulder movement.
3. Write findings and switch partners.
Did you see these compensations?

1. Feet:
   Did they externally rotate?
   Did they flatten?

2. Knee:
   Did they cave-in or adduct?
Did you see these compensations?

1. Hips and Low Back:
   - Excessive forward lean
   - Low back arch

2. Shoulders:
   - Fall Forward
Types of Movement Impairment

1. Static malalignments

2. Dynamic malalignments
   - Lower Extremity Movement Impairment Syndrome
   - Upper Extremity Movement Impairment Syndrome

3. Altered muscle activation patterns
   - Synergistic dominance
   - Altered Reciprocal inhibition
Static Malalignments

- May alter normal length-tension relationships

- Common static malalignments include:
  - Joint hypomobility
  - Myofascial adhesions
  - Poor static posture

- Certain muscles become hypertonic to prevent movement
Dynamic Malalignments

Upper Extremity Movement Impairment Syndrome
- Rounded shoulders
- Forward head posture
- Poor scapulothoracic and/or glenohumeral kinematics
- Common with pattern overload

Lower Extremity Movement Impairment Syndrome
- Foot pronation
- Knee valgus
- Increased movement at the LPHC
Altered Muscle Recruitment

- Altered Reciprocal Inhibition
  - Muscle inhibition caused by a tight /overactive muscle decreasing neural drive of its functional antagonist

- Synergistic Dominance
  - Occurs when synergists take over function for a weak or inhibited prime mover
Human Movement Dysfunction

- Malalignment
- Repetitive motion
- Altered muscle recruitment
- Movement dysfunction

Cumulative injury
Common Injuries. Coincidence?

- **Foot/Ankle**
  - Plantar fascia
  - Ankle sprains
  - Sesamoiditis
  - Achilles tendonitis
- **Lower leg**
  - MTSS
  - Post tib. Tendonitis
  - Stress Fx
- **Knee**
  - PFPS
  - ACL
  - OCD
  - Patella tendonitis
  - Osgood-Schlatter / Larsen-Johansson
  - IT Band
  - Bursitis
- **Hip**
  - Hamstring strain
  - Piriformis syndrome
  - Snapping hip
- **Low Back**
  - Chronic strains
  - SI joint pain
  - Osteitis Pubis
  - Facet syndrome
- **Shoulder**
  - Impingement syndrome
  - Biceps tendonitis
  - Rotator cuff tendonitis
  - Strain
  - Subluxation / dislocation

DYSFUNCTION PRECIPITATES INJURY
Identification = Prevention

Movement Assessments
- Done in less than 5 minutes
- Identifies movement impairment
- Identifies overactive and underactive muscle
- Identifies abnormal arthokinematics
- Correlate faulty movement patterns with:
  - Status from previous injury
  - PPE
  - Prevention of future injury
  - PPE, Post Rx
  - Rehabilitation goals
Types of Movement Assessments

1. Overhead squat Assessment
2. Single Leg Squat Assessment
3. Upper Extremity Transitional Movement
Kinetic Chain Check Points

- Deviation occurs at kinetic chain check points
  - Feet / ankles
  - Knee
  - LPHC
  - Shoulders
  - C-spine
Overhead Squat

- Assesses the following:
  - Structural alignment
  - Dynamic flexibility
  - Neuromuscular control
1. Partner up

2. P1: Perform OHS; P2: Observe from 3 angles

3. Write findings on assessment sheet

4. Switch partners

5. Cross reference with solutions sheet
Common findings

Anterior

Lateral
Common findings

Posterior
OHS Dysfunction and Injury

- Foot/Ankle
  - Plantar fascia
  - Ankle sprains
  - Sesamoiditis
  - Achilles tendonitis

- Lower leg
  - MTSS
  - Post tib. Tendonitis
  - Stress Fx

- Knee
  - PFPS
  - ACL
  - OCD
  - Patella tendonitis
  - Osgood-Schlatter / Larsen-Johansson
  - IT Band
  - Bursitis

- Hip
  - Hamstring strain
  - Piriformis syndrome
  - Snapping hip

- Low Back
  - Chronic strains
  - SI joint pain
  - Osteitis Pubis
  - Facet syndrome

- Shoulder
  - Impingement syndrome
  - Biceps tendonitis
  - Rotator cuff tendonitis
  - Strain
  - Subluxation / dislocation
OHS Questions

What did you find?
Perfect?
Poor?
Interesting?
Do you know why?
Single Leg Squat

- Designed to assess:
  - Dynamic flexibility
  - Core strength
  - Balance
  - Neuromuscular control

- Position:
  - Hands on the waist
  - Feet pointing straight ahead
  - Kinetic chain in a neutral position
SLS Practical Application

1. Partner up
2. P1: Perform SLS;  P2: Observe from front
3. Write findings on assessment sheet
4. Switch partners
5. Cross reference with solutions sheet
Common findings

Hip hike / drop

Knee moves in

Inward rotation

Outward rotation
SLS Dysfunction and Injury

- **Foot/Ankle**
  - Plantar fascia
  - Ankle sprains
  - Sesamoiditis
  - Achilles tendonitis

- **Lower leg**
  - MTSS
  - Post tib. Tendonitis
  - Stress Fx

- **Knee**
  - PFPS
  - ACL
  - OCD
  - Patella tendonitis
  - Osgood-Schlatter / Larsen-Johansson
  - IT Band
  - Bursitis

- **Hip**
  - Hamstring strain
  - Piriformis syndrome
  - Snapping hip

- **Low Back**
  - Chronic strains
  - SI joint pain
  - Osteitis Pubis
  - Facet syndrome

- **Shoulder**
  - Impingement syndrome
  - Biceps tendonitis
  - Rotator cuff tendonitis
  - Strain
  - Subluxation / dislocation
SLS Questions

What did you find?

Perfect?

Poor?

Interesting?

Do you know why?
Upper Extremity Transitional Movement

Abduction Test

Shoulder Flexion Test

Rotation Test
**UE Practical Application**

1. Partner up

2. P1: Perform UE;  P2: Observe from front

3. Switch partners

4. Cross reference with solutions sheet
Common findings

- Shoulder protraction
- Shoulder elevation
UE Dysfunction and Injury

- **Foot/Ankle**
  - Plantar fascia
  - Ankle sprains
  - Sesamoiditis
  - Achilles tendonitis
- **Lower leg**
  - MTSS
  - Post tib. Tendonitis
  - Stress Fx
- **Knee**
  - PFPS
  - ACL
  - OCD
  - Patella tendonitis
  - Osgood-Schlatter / Larsen-Johansson
  - IT Band
  - Bursitis

- **Hip**
  - Hamstring strain
  - Piriformis syndrome
  - Snapping hip
- **Low Back**
  - Chronic strains
  - SI joint pain
  - Osteitis Pubis
  - Facet syndrome
- **Shoulder**
  - Impingement syndrome
  - Biceps tendonitis
  - Rotator cuff tendonitis
  - Strain
  - Subluxation / dislocation
What did you find?

Perfect?

Poor?

Interesting?

Do you know why?
1. Pre-participation exams
2. Injury prevention
3. Rehabilitation progression
Clinical Implications - PPE

PPE Incorporation

- Part of general movement screen
  - Less than 5 minutes
- Compare with incoming athlete subjective data
- Design intervention program
Clinical Implication – Injury prevention

- In / off-season injury prevention
- Watch movement during activity
- Perform assessment on injury complaint
  - Hawkins-Kennedy = What
  - UE test = Why
- Periodic evaluations
  - Watch for change during the season
Clinical Implications - Rehabilitation

- Meeting rehab goals
  - Progression

- Performing exercise with proper form

- Can easily target problematic tissue

- Return to play readiness
Thank you.

Contact Information

- joshua.stone@nasm.org
- Facebook: NASMJosh
- Twitter: JoshNASM
- facebook.com/correctiveexercise