Functional and Postural Assessments for Low Back Maladies: An Evidence-Based Approach to Integrated Training

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Learning Objectives

• Upon completion of this course the participant will:
  – Have a comprehensive understanding of the rationale for performance enhancement training and injury prevention
  – Understand the components of performance enhancement training and injury prevention
  – Be aware of the available evidence to support performance enhancement training and injury prevention
  – Be able to apply corrective strategies to correct movement imbalances
Who Needs Performance Enhancement?

- Youth Athletes
- High School Athletes
- Collegiate Athletes
- Professional Athletes
- Recreational Athletes
Introduction

• The health and fitness industry is overwhelmed with information on training for strength, hypertrophy, power, and endurance
Introduction

• In the face of all of this information, how does the performance enhancement professional tell the difference between authority-based guidelines and sound evidence-based principles that will enhance performance and decrease injury?
What is Performance Enhancement?

• A comprehensive training approach that strives to improve all components necessary to allow each individual to achieve optimum performance (Clark 2000, Kraemer 2004)
  – Flexibility
  – Core Strength
  – Neuromuscular Efficiency
  – Power
  – Strength
  – Cardiorespiratory Efficiency
What is the goal of Performance Enhancement Training? (Kraemer 2004)

- Injury Prevention
- Improved Performance
- Physiological Adaptations
- Physical Adaptations
Is there evidence to support the concepts and implementation of injury prevention and performance enhancement training?
Show me the Evidence

• Hewett TE, 1999 et al in a prospective study with 41 female athletes demonstrated that a combination of flexibility, core, balance, plyometrics, and strength training could decrease the incidence of ACL injuries by 2-8 times compared to a control group
Show me the Evidence

• Hewett 1996 et al, demonstrated a statistically significant improvement in hamstring strength and power, decreased peak landing forces and improved hamstring to quadriceps ratio following a program that incorporated (stretching, plyometrics, and strength training)
Show me the Evidence

• Carrafa 1996 et al, in a prospective controlled study demonstrated a 7-fold decrease in ACL injuries compared to the control group utilizing balance board training
Show me the Evidence

• Mandelbaum et al demonstrated an 83% decrease in ACL injuries in the studied group (1041 female soccer players) compared to a control group (1902 soccer players that were age and skill matched)
  – The above program incorporated a comprehensive, systematic, progressive performance enhancement and injury prevention program that included:
    • Flexibility
    • Plyometrics
    • Speed, agility and quickness
    • Strength Training
Show me the Evidence

• Junge 2002, in a prospective cohort study with 194 soccer players performed over 2 years with an intervention group and a control group demonstrated 20% less injuries and 36% decreased rate of injury per player
  – The program that was used incorporated sport specific warm-up, core, balance, plyometrics, speed-agility-quickness, and strength
Show me the Evidence

• Paterno 2004 et al in a controlled single-group pretest/posttest design (41 healthy female high school athletes) demonstrated that a 6 week “neuromuscular training program” improves objective measures of single-limb postural stability
  – This program consisted of:
    • Core and Balance Training
    • Plyometric and Dynamic Movement Training
    • Resistance Training
Show me the Evidence

• Kovacs 2004 et al in a randomized controlled trial of neuromuscular vs basic off-ice training programs with 44 young, healthy figure skaters suggest that a 4 week neuromuscular training program leads to greater improvements in postural control than basic training programs
  – This training program incorporated:
    • Flexibility
    • Core and Balance Training
    • Reactive neuromuscular training
Paradigm Shift

• Injury prevention is the primary goal of all performance enhancement programs
  – The primary emphasis of traditional “Sports Conditioning” programs has been on concentric force production (how much can you lift) primarily in the sagittal plane, in a controlled environment
    • This may not be the best way to prevent injuries
  – Also, many athletes have pre-existing injuries that must be addressed prior to advanced performance enhancement training
Is this the Typical Athlete?

Musculoskeletal Imbalances

Gait Homonculous Observed Relational Tabulator (GHORT).

Pelvic tilt short leg syndrome.
What are the most common imbalances that athletes present with??
Foot and Ankle Imbalances

• Lateral ankle sprains are the most common injury suffered in sports during sports participation (Safran, 1999)
  – Denegar, et al 2002 in a retrospective study demonstrated altered arthrokinematic movement of the talus (decreased posterior glide) even though range of motion was restored
  – This is very important because limited posterior glide of the talus may lead to decreased dorsiflexion
    • Limited dorsiflexion may lead to other compensations
Foot and Ankle Imbalances

• Bullock-Saxton et al 1994 demonstrated decreased gluteus maximus muscle activation post ankle sprain
  – If an athlete begins an integrated training program and has muscle imbalances in the hip complex secondary to an ankle sprain, then further compensations and possible injury may occur
Foot and Ankle Imbalances

• Beckman et al 1995 demonstrated decreased gluteus medius muscle activation post ankle sprain
  – If an athlete begins an integrated training program and has muscle imbalances in the hip complex secondary to an ankle sprain, then further compensations and possible injury may occur
Knee and Hip Imbalances

• It has been recognized that the patellofemoral joint may be influenced by the segmental interactions of the lower extremity (Fredericson, Powers)
  – Abnormal motions of the tibia and femur in the transverse and frontal planes are believed to have an effect on the patellofemoral joint (Ford, Nyland)
  – This abnormal motion may be caused by weakness in the hip abductors and external rotators (Ireland)
Knee and Hip Imbalance

- Recent kinetic analysis of running reveals that, although the knee joint primarily moves in the sagittal plane, the knee is also subject to significant frontal and transverse plane moments (McClay)
  - In the absence of sufficient proximal hip strength, the femur may adduct and internally rotate, further increasing the lateral patellar contact pressure (Lee)
  - (Fredericson) demonstrated that distance runners with ITB Syndrome had weaker hip abduction strength than the control group and their unaffected leg
  - (Ford and Hewett) demonstrated that female athletes landed with greater total valgus (femur adduction and tibia abduction) than male athletes and may lead to ACL Tears
Lumbo-Pelvic-Hip Complex Imbalance

• Low back pain is very common in the active population (Nadler)
  – In a cross-sectional study of 100 patients (Cibulka) demonstrated unilateral hip rotation ROM asymmetry in patients with SI joint regional pain
  – Hodges and Richardson 1996 reported that slow speed of contraction of the transverse abdominus during arm and leg movements was well correlated with LBP
  – O’Sullivan et al 1997 found that synergist substitution of the rectus abdominus for the agonist transverse abdominus during the abdominal drawing-in maneuver suggesting less efficient intersegmental stabilizing mechanisms and greater shear forces at the intervertebral joints
  – Hides et al 1994 demonstrated unilateral atrophy of the multifidus in patients with low back pain
What is the solution?
I DON'T GOT A TON OF EDUCATION CUZ I SPEND ALL MY TIME PICKING UP HEAVY STUFF — IS THERE A JOB WHERE MAYBE I COULD TEACH OTHER PEOPLE HOW TO PICK UP HEAVY STUFF?

Is this the answer?
The Future of Sports Medicine
Integrated Training Guidelines

1. Identify all kinetic-chain imbalances.

2. Correct all kinetic chain imbalances

3. Develop proper structural integrity of the kinetic chain before activity-specific training.

4. Integrate functional movements in the plane of motion, range of motion and speed of motion that replicates the training activity
Integrated Training Principles

- Integrated Performance Paradigm
- Integrated Training Continuum
- Multiplanar Training
- Training with Optimum Posture
- Training for Optimum Balance
- Training for Optimum Function
- Training the Complete Muscle Contraction Spectrum
Integrated Movement Paradigm

Eccentric (Force Reduction)

Core Stabilization + Balance = Efficient Movement

Concentric (Force Production)

Neumann, 2002
Integrated Training Continuum

- STABILIZATION
- STRENGTH
- POWER
Multiplanar Training

- All functional activities occur in all three planes of motion
  - (Neumann)
- Injuries may occur in the frontal and transverse planes
  - (Ford, Ireland, McClay)
Training with Optimum Posture

- Optimum alignment of each component of the kinetic chain is a cornerstone to any integrated training program
  - (Kovacs, Neumann, Edgerton)
Training for Optimum Muscle Balance

- Muscles function optimally from a pre-determined length (LTR) – (Neumann)

- Muscle imbalances may lead to
  - Reciprocal Inhibition
  - Synergistic Dominance – (Edgerton)
Training for Optimum Muscle Function

Traditional approach = Segment Isolation
Integrated Approach = Integration of movement segments

(Nicholas, Neumann)
Training the Complete Muscle Contraction Spectrum

- Muscles contract eccentrically, isometrically and concentrically in all three planes of motion.
  - Therefore, all programs must include these contraction modes
  - (Neumann)
Training the Speed Continuum

- Rate of force production is one of the most indicative characteristics of improved performance
  - (Luebbers)
Where do you begin?

• Kinetic chain assessment (functional profile)
  – Identify imbalances that may lead to injury or decrease performance (Nadler)

• Integrated Program Design
  – Be specific for the activity
  – Be specific for the person

• Exercise Execution
  – Proper execution is critical for optimum results
Kinetic Chain

Myofascial  Articular  Neural

Sensorimotor Integration

Neuromuscular Efficiency
Functional Profile

• Nadler et al 2002 in a Case Control Study of 213 Division I NCAA athletes found that kinetic chain deficits existed long after symptomatic recovery from injury, resulting in functional deficits, which may be missed on a standard physical assessment
  – This study may support residual functional deficits in athletes that suffer from a primary injury and are cleared for sports participation

• Cibulka demonstrated unilateral hip rotation asymmetry in patients with low back pain in a Cross Sectional Study of 100 patients

• The above evidence helps to lead us to the conclusion that we may want to implement valid and reliable functional tests with our athletes prior to initiating a comprehensive, integrated training program
Understanding Human Movement

• Length-Tension Relationships
  – Torque (T) = Force (F) x Moment Arm (MA)

• Force Couple Relationships
  – Torque (T) = Force (F) x Moment Arm (MA)

• Joint Arthrokinematics
  – Torque (T) = Force (F) x Moment Arm (MA)
Understanding Muscle Function

• Stabilization Group
  – Local Stabilizers
  – Global Stabilizers

• Movement Group
  – Global Mobilizers
Understanding Muscle Function

• Stabilization Group
  – Local Stabilizers
    • Muscles
      – MFS
      – TVA
      – Deep Neck Flexors
  • Function
    – Neuromuscular control (Proprioception)
    – Continuous activity throughout movement
    – Independent of direction of movement
    – Stabilization (Isometric) contraction (minimal length change)
    – Controls neutral positions
Understanding Muscle Function

• Stabilization Group
  – Global Stabilizers
    • Muscles
      – Internal Oblique
      – Quadratus Lumborum
      – Gluteus Medius
      – Gluteus Maximus

• Function
  – Generates force to control ROM
    » Low load eccentric deceleration
  – Non-continuous activity
  – Activity is direction dependent
Understanding Muscle Function

• Movement Group
  – Global Mobilizers
    • Muscles
      – Rectus Abdominus
      – Erector Spinae
      – Quadriceps
      – Hamstrings
      – Latissimus Dorsi
  • Function
    – Force production/torque production (Concentric)
    – Concentric acceleration (Primarily sagittal plane)
    – Non-continuous (Phasic)
    – Direction dependent
RESULTS OF KINETIC CHAIN DYSFUNCTIONS

• Reciprocal Inhibition
• Synergistic Dominance
• Arthrokinetic Inhibition
• Relative Flexibility
• Pattern Overload
What is the Solution?

Correct Weak Links

Identify Causative Factors

Recondition

Bigger Engines or Better Brakes
Optimal Functional Ability

Integrated Program

Client Education

Corrective Exercise (stretch/strengthen)

Assessment (identify causative factors)

Flexibility

Core

Balance

Power

Speed

Strength
Uncovering Roadblocks:
Identifying the Weak Link:

- Posture
- Gait
- Flexibility assessment
- Neuromuscular assessment
- Overhead-squat test
- Single-leg balance excursion
- Single-leg squat test
- Multiplanar lunge test
- Multiplanar step-up test
- Push-up test
- Overhead medicine-ball throw
- Multiplanar vertical jump/hop
- Multiplanar horizontal jump/hop
- Shark skill test
- Multiplanar cone jump/hop test
- Speed tests
  - Straight-ahead speed
  - Lateral speed and agility
  - Sport-specific
  - Speed endurance
Kinetic Chain Assessment

- Static Postural Assessment
- Transitional Movement Assessment
- Dynamic Assessment
Static Postural Assessment

Lower Crossed

Upper Crossed

Pronation Distortion
Transitional Movement Assessment

• Overhead Squat Assessment
  – Double-leg
  – Single-leg

• Body Map, reliable assessment tool
Foot Turns Out: Note the 1st MTP Joint in relation to the medial malleolus. In a normal foot the 1st MTP joint will appear along the same plane as the medial malleolus. However in a foot that is turned out the 1st MTP joint will appear lateral to the medial malleolus.
Foot Flattens: Note the height of the longitudinal arch of the foot. It should be in a neutral position with a slight curve distinguishable and if the foot flattens it will appear to be flat along the floor. Another indicator of the foot flattening is the Achilles tendon. Note in the neutral picture how the tendon is straight, however when the foot flattens note the lateral angle that is produced by the Achilles tendon.
Foot & Ankle: Heel of Foot Rises

**Heel of Foot Rises:** Note the heel of the foot rising off of the floor. If the heel stays firmly planted on the floor then there is no abnormality. However any rise of the foot from the floor indicates an abnormal movement pattern.
Foot Flattens Single-leg: Note the height of the longitudinal arch of the foot. It should be in a neutral position with a slight curve distinguishable and if the foot flattens it will appear to be flat along the floor. Another indicator of the foot flattening is the medial malleolus will appear larger than the lateral malleolus. In the neutral picture both medial and lateral malleolus are even.
Knee: Moves Inward

Knee Moves Inward: Note a line drawn from the patellar tendon which bisects the ankle. This line should be perpendicular to the ground. If the line is leaning toward the midline of the body then the knee is moving inward.
Knee Moves Outward: Note a line drawn from the patellar tendon which bisects the ankle. This line should be perpendicular to the ground. If the line is leaning away from the midline of the body then the knee is moving outward.
Knee: Single-leg Moves Inward

Single-leg Knee Moves Inward: Note a line drawn from the patellar tendon which bisects the ankle. This line should be perpendicular to the ground. If the line is leaning toward the midline of the body then the knee is moving inward.
**Knee: Single-leg Moves Outward**

**Single-leg Knee Moves Outward:** Note a line drawn from the patellar tendon which bisects the ankle. This line should be perpendicular to the ground. If the line is leaning away from the midline of the body then the knee is moving outward.
Low Back Rounds: Take notice of the area from approximately the mid back through the Sacral Complex. If the area is rounding then this area will appear as a thoracic or convex curve.
LPHC: Low Back Arches

Low Back Arches: Take notice of the area from approximately the mid back through the Sacral Complex. If the area is arched then this area will appear with an excessive lumbar or convex curve.
LPHC: Excessive Forward Lean

**Excessive Forward Lean:** Imaginary lines that are created by the shins and torso of the client if extended out should remain parallel. If these lines would cross immediately or shortly after extending them then the person does have excessive forward lean.
**Weight Shift:** Taking a line extending from the cervical spine through the thoracic and lumbar spine that is parallel to the ground should bisect the LPHC resulting in equal parts falling on either side of the line. If the LPHC is split unevenly resulting in a larger percentage on one side of the line then there is a weight shift on the side of the line that has the larger percentage of the LPHC.
LPHC: Single-leg Lateral Hip Shift

Single-leg Lateral Hip Shift: Taking a line originating from the patellar tendon and bisecting the quadriceps should be parallel to the ground. If the line moves away from the midline then there is a lateral hip shift.
Upper Body: Arms Fall Forward

**Arms Fall Forward:** A line bisecting the torso and head should be noted. If this line travels parallel along the arms and the arms cover the ears of the subject then there are no abnormalities present. If the line does not parallel the arms and you can see the ears then the arms have fallen forward.
Upper Body: Shoulder Elevation

Shoulder Elevation: In a normal movement observation the arms will maintain a relatively equal amount of distance from the arms. If there is a decrease of the amount of space from the ears to the arm in relation to the opposite side then there is an abnormal movement pattern indicating shoulder elevation on the side of the decreased ear to arm space.
Dynamic Assessments
So, once you find it...how will you address it?
FUNCTIONAL PROFILE: Valid and Reliable Tests

- Orthopedic Assessment (Magee)
- Muscle length assessment with Goniometer (Brosseau, Norkin)
- Single-leg Balance Excursion Test (Olmsted)
- Overhead Medicine Ball Throw (Stockburger)
- Vertical Jump (Manske)
- Single Leg Vertical Hop (Manske)
- Horizontal Jump (Manske)
- Single Leg horizontal hop (Manske)
Foot & Ankle: Foot Flattens

No Compensation  Feet Flatten  No Compensation
Corrective Flexibility for Flattened Feet

SMR Gastroc/Soleus

Static Lateral Gastroc/Peroneals

Static Soleus
Corrective Exercise for Flattened Feet

Medial Gastroc

Anterior Tibialis

Posterior Tibialis

Single Leg Squat Touchdown
Foot & Ankle: Foot Turns Out

No Compensation  No Compensation  Feet Turn Out
Feet Externally Rotate

Probable Shortened Muscles:
• Lateral Gastrocnemius
• Soleus
• Short Head Bicep Femoris

Probable Weakened Muscles:
• Medial Gastrocnemius
• Pes Anserine Complex
  • Semitendinosus
  • Gracilis
  • Sartorius
Corrective Flexibility for Externally Rotated Feet

SMR Gastroc/Soleus

Static Lateral Gastroc

Static Soleus

Bicep Femoris
Corrective Exercise for Externally Rotated Feet

Medial Gastroc

Medial Hamstring

Gracilis/Pectineus

Single Leg Squat
Foot & Ankle: Heel of Foot Rises

No Compensation  Heels Rise  No Compensation
Adducted Knees

Probable Shortened Muscles:
- Adductor Complex
- Gluteus Minimus
- Anterior Gluteus Medius
- TFL/ITB Complex

Probable Weakened Muscles:
- Gluteus Medius
- Gluteus Maximus
Corrective Flexibility for Adducted Knees

SMR Adductors

SMR TFL

SMR IT-Band

Static Adductor Ball Stretch

Static Standing Adductor Stretch

Static TFL Stretch
Corrective Exercise for Adducted Knees

Gluteus Medius

Gluteus Maximus

Tube Walking

Single Leg Squat
Knee: Moves Outward

Knees Abduct  No Compensation  No Compensation
Abducted/ER Knees

Probable Shortened Muscles:
• Posterior Gluteus Medius
• Piriformis
• Biceps Femoris
• Deep Hip Rotators

Probable Weakened Muscles:
• Adductor Complex
• Pes Anserine
Corrective Flexibility for Abducted Knees

SMR Hamstrings

Piriformis Stretch

Static Track Stretch

SMR Piriformis

Psoas Stretch
Corrective Exercise for Abducted Knees

Isolated Gracilis

Isolated Pectineus

Isolated Adductor Magnus

Single Leg Squat Touchdown
L-P-H-C: Low Back Arches

No Compensation

No Compensation

Low Back Arches
Probable Shortened Muscles:
- Iliopsoas Complex
- Erector Spinae
- Latissimus Dorsi

Probable Weakened Muscles:
- Rectus Abdominis
- External Oblique
- Gluteus Maximus
- Proximal Hamstrings
- Intrinsic Stabilizers

Lumbo-Pelvic-Hip Extension
Corrective Flexibility for Excessive LPHC Extension

- SMR Quads
- SMR Thoracic Spine
- SMR Lats
- Psoas Stretch
- Static Lat Stretch
- Rectus Femoris Stretch
Corrective Exercise for Excessive LPHC Extension

- Ball Bridge
- Ball Reverse Crunch w/ Rotation
- Ball Crunch
- Ball Push-up
L-P-H-C: Low Back Rounds

Low Back Rounds  No Compensation  No Compensation
LPHC Flexion

Probable Shortened Muscles:
• Hamstrings
• Rectus Abdominals
• External Obliques
• Gluteus Maximus

Probable Weakened Muscles:
• Iliopsoas Complex
• Erector Spinae
• Intrinsic Stabilizers
Corrective Flexibility for Excessive Lumbar Flexion

SMR Hamstrings

SMR Piriformis/Glutes

Static Abdominal Stretch

Track Stretch

Piriformis Stretch
Corrective Exercise for Excessive LPHC Flexion

- Isolated Psoas
- Ball DB 2-Arm Row
- Ball Cobra
- Ball Back Extension
L-P-H-C: Weight Shift

No Compensation  No Compensation  Weight Shift
L-P-H-C: Forward Lean

Forward Lean

No Compensation

No Compensation
LPHC Flexes Forward

Probable Shortened Muscles:
• Hip Flexor Complex
• Abdominal Complex

Probable Weakened Muscles:
• Erector Spinae
• Gluteus Maximus
• Intrinsic Core
Corrective Flexibility for Excessive Hip Flexion

- SMR Quads
- SMR IT-Band
- Static Psoas Stretch
- Static TFL Stretch
- Static Abdominal Stretch
- Rectus Femoris Stretch
Corrective Exercise for Excessive Hip Flexion

- Isolated Gluteus Maximus
- Back Extension
- Ball Bridge
- Squat/Press/Curl
Upper Body: Arms Fall Forward

No Compensation | Arms Fall Forward | No Compensation
Shoulders Extend

Probable Shortened Muscles:
• Pectorals
• Latissimus Dorsi
• Subscapularis
• Teres Major

Probable Weakened Muscles:
• Rhomboids
• Lower Trapezius
• Middle Trapezius
Corrective Flexibility for Shoulder Extension

SMR Pectorals

SMR Lats

SMR Rotator Cuff

Pec Major Stretch

Pec Minor Stretch

Lat Stretch
Corrective Exercise for Shoulder Extension

Ball Combo I

Shoulder Horn

Ball Combo II

Ball DB 2-Arm Row
Upper Body: Shoulders Elevate

Shoudlers Elevate  
No Compensation  
No Compensation

NASM
(NATIONAL ACADEMY OF SPORTS MEDICINE)
Overhead Squat: Modified
Case Reviews
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<thead>
<tr>
<th>Region</th>
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<tbody>
<tr>
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<td>3°</td>
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<tr>
<td>Hip Flexion / Knee Extension</td>
<td>41°</td>
<td>46°</td>
</tr>
<tr>
<td>Hip Internal Rotation</td>
<td>25°</td>
<td>22°</td>
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<tr>
<td>Hip External Rotation</td>
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<tr>
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<td>Movement</td>
<td>Right</td>
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<tr>
<td>Hip Extension</td>
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### Putting it All Together

#### Kinetic Chain Checklist

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<thead>
<tr>
<th>Movement Observation</th>
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<tbody>
<tr>
<td>Foot</td>
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<tr>
<td>Knee</td>
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<td></td>
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<tr>
<td>Hips</td>
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#### Exercise Descriptions

1. **Calve Complex Stretch: Side Bend**
   - **Exercise Description:** Standing on a side bend, place one leg forward while the rear leg is bent approximately 30 degrees. Lean forward while keeping the rear feet flat until slight tension to feel. Do not allow the foot to collapse inward. Hold stretch position for 30 seconds.

2. **Adductor Stretch: Ball Lunge**
   - **Exercise Description:** Kneel on an appropriate size ball, assume a side lunge position with heel pointed straight ahead. Swing the left leg straight with weight on left leg. Slowly shift to bent leg until stretch force is felt on straight leg. Hold stretch position for 30 seconds.

3. **Hip Flexor Stretch: Standing Pose**
   - **Exercise Description:** Begin in a standing position with stretch leg rotated inward and behind forward leg. To reach the stretch, lift leg up towards abdomen and rotate over pelvis. Do not maintain any upright posture. Slowly, bend forward until tension is felt. Hold stretch for 30 seconds.

4. **Bridge: Ball / Two Legs**
   - **Exercise Description:** Lie on back with an appropriate size ball between shoulder blades. Allow knees to bend while keeping feet pointed straight ahead and shoulder widths apart. Draw shoulders inward. Extend buttocks and lift pelvis upward as far as possible without lumbar movement. Slowly return to start position maintaining spinal alignment.
THE OPT™ MODEL
PUTTING “IT” ALL TOGETHER

**National Academy of Sports Medicine**
Optimum Performance Training™ Programming Template

<table>
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<th>Name:</th>
<th>Date: Wednesday</th>
<th>Phase: IST</th>
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<td></td>
<td></td>
</tr>
<tr>
<td>Objective:</td>
<td></td>
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</tr>
</tbody>
</table>

**Warm-Up: CV:** Precor, Tube-Walking, Walking Lunge Twist, Flexibility, Other:

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<tr>
<th>CST / NIST:</th>
<th>Sets</th>
<th>Reps</th>
<th>Intensity</th>
<th>Tempo</th>
<th>Rest Interval</th>
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<tbody>
<tr>
<td>1. Medicine Ball Rotation</td>
<td>3</td>
<td>10</td>
<td>60-70%</td>
<td>2-1-1</td>
<td>(See Notes)</td>
</tr>
<tr>
<td>2. Medicine Ball Flexion/Extension &amp; Rotation</td>
<td>3</td>
<td>10</td>
<td>60-70%</td>
<td>2-1-1</td>
<td>(See Notes)</td>
</tr>
<tr>
<td>3. Medicine Ball PNF</td>
<td>3</td>
<td>10</td>
<td>60-70%</td>
<td>2-1-1</td>
<td>(See Notes)</td>
</tr>
<tr>
<td>4. Single Leg Romanian Deadlift</td>
<td>3</td>
<td>10</td>
<td>60-70%</td>
<td>2-1-1</td>
<td>(See Notes)</td>
</tr>
<tr>
<td>5. Single Leg Windmill</td>
<td>3</td>
<td>10</td>
<td>60-70%</td>
<td>2-1-1</td>
<td>(See Notes)</td>
</tr>
</tbody>
</table>

**RNT: Sets | Reps | Intensity | Tempo | Rest Interval**

1. 
2. 
3. 

**Speed:** Straight Ahead Speed, Lateral Speed & Agility, Ladder x 2-3

**Strength:** Exercises | Sets | Reps | Intensity | Tempo | Rest Interval

**TOTAL BODY**

| CHEST | Ball Alternate Arm DB Chest Press | 2-3 | 15,12,10 | 60-70% | 4-2-0 | 60-90 sec |
| BACK  | Ball Alternate Arm DB Row         | 2-3 | 15,12,10 | 60-70% | 4-2-0 | 60-90 sec |
| SHOULDERS | Ball Alternate Arm DB Shoulder Press | 2-3 | 15,12,10 | 60-70% | 4-2-0 | 60-90 sec |
| BICEPS |                               |     |         |       |       |          |
| TRICEPS |                              |     |         |       |       |          |
| LEGS   | DB Lunge Matnx                  | 2-3 | 15,12,10 | 60-70% | 4-2-0 | 60-90 sec |

**Cool Down:** Self MFR, Corrective Flexibility, Active Flexibility, Functional Flexibility, Integrated Manual Therapy

**NOTES**
Perform CST/NST exercises in a vertically loaded progression.
Only take the minimum rest required to move to the next exercise.
Summary

- Must appreciate movement as a whole
- Identify the weak link
- Provide isolated exercise to increase motor unit recruitment
  - Can only recruit motor units to the degree of dynamic joint stabilization
- Integrate to CNS by
  - MP
  - Speed
  - ROM
  - Resistance (mode, frequency)
  - Acute variables (reps, sets, intensity, tempo, rest interval)
- Progress in training systematically to safely achieve goals
THANK YOU

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