Lab:

MOTOR PATTERN ASSESSMENT SCREENING & DIAGNOSIS

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Goals

• To review the concepts of Motor Control provided by Vladimir Janda, MD and integrated by Phil Greenman, DO

• To review the developments of motor control in last 25 years

• To correlate the concepts Dr Janda based on what we know today

• For you to THINK & TREAT functionally & integratively to the systemic responses of the human body to injury when dealing with athletes
Historical Development of the Influence of Muscle Function on Movement and Performance

Stretching & Strengthening

Traditional Strength
Overload training for power & endurance

Core Strength
Overload training of trunk & girdle

Core Strengthening
McGill

Assessment of Muscle Function
Kendall & McCreary

Sahrmann
Global – whole body

Hodges, Richardson, Hides, Jull
Global Trunk Stability – local spinal motor control stability

Janda
Global – trunk & limbs

O’Sullivan
Integration of trunk stability into function

Alternative Therapies & approaches
Global – trunk & limbs

Integrative Assessment of Motor Patterns

Kinetic Control
Comerford & Mottram
Evidenced based synthesis – whole body
Local & global motor control Test & Rx

Functional Movement Systems
Grey Cook
Evidenced based synthesis – whole body
Motor pattern Test & Rx – SFMA, FMS

Leibenson
Magnificent 7
Evidenced based synthesis – whole body

Lewit

Kolar
DNS

Global – trunk & limbs

Global – whole body
Recruitment Changes Associated with Inhibition

In Stability Dysfunction:

**INHIBITION:**

- can be identified as failure of normal recruitment
- **poor recruitment under low load stimulus**
  - evidence in both local & global system
- **delayed recruitment timing**
  - evidence in the local system
- **altered recruitment sequencing**
  - evidence in global system

Mounting evidence that the failure of low load recruitment efficiency is the most consistent & reliable indicator of recurrence injury & pain


PROBLEM: timing on order of millisec (60-150)
Principles of Motor Pattern Teaching & Learning

Principle 1: TRAIN THE BRAIN, Stop training muscles

Principle 2: TRAIN RANDOMLY, Reduce Block Training

Principle 3: Allow patients to learn from mistakes, don’t overdue feedback
Causes of Restricted Mobility

1) Soft-Tissue Dysfunction
   Generally identifies multi-articular dysfunction
   - Fascial tension
   - Neural tension
   - Muscle shortening
   - Hypertrophy
   - Active/Passive muscle insufficiency
   - Trigger Points
   - Type I SDs
   - Scarring & fibrosis

2) Joint Dysfunction
   Generally identifies single-segmented dysfunction
   - Type II SDs
   - Articular Restrictions
   - Subluxation / Dislocation
   - Adhesive Cap
   - Osteoarthritis
   - Fusion or Instrumentation

3) Stability / Motor Control Dysfunction
   Generally identifies multi-segmented dysfunction
   - Brain problem
   - Not local issue
   - Can resolve with treatment of local resisted pathologies
   - Can persist despite lack local pathologies
How do we assess motor patterns ??
Normal sequence of learning movement follows:

- Breathing
- Grasping / Gripping
- Head & Eye Movement
- Limb Movement
- Rolling
- Crawling
- Kneeling
- Transitional Movements
- Standing

Tree of Growth

https://www.youtube.com/watch?v=elkRygLpcNk
https://www.youtube.com/watch?v=8zuUV6fz-iU
Selective Functional Movement Assessment (SFMA)
Grey Cook MSPT, OCS, CSCS

- is … Qualitative assessment tool for evaluating pain and injury
- is … Functional Movement Ranking System
- consists … Top tier screen and Second tier breakdowns
- guides treatment by localizing mobility restrictions vs motor control impairments
- FMS – Functional Movement Screen – used for evaluation of functional movement in nonpainful patients to assess performance
Selective Functional Movement Assessment (SFMA)

Grey Cook MSPT, OCS, CSCS

- Based … compensations usually cause poor motor control and poor motor behavior
- Based … brain will commonly give up stability at one segment when mobility at another segment is deficient
Scoring the SFMA

FN
Functional
Non-painful

FP
Functional
Painful

DP
Dysfunctional
Painful

DN
Dysfunctional
Non-painful

Rules for Screening

• No warm up
• No shoes
• If it looks abnormal, its abnormal
• Be picky, if your debating, its abnormal
• Not bad … is not good
The Selective Functional Movement Assessment
Top Tier Screen

<table>
<thead>
<tr>
<th>No.</th>
<th>Test Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Active Cervical ROM</strong></td>
</tr>
<tr>
<td></td>
<td>Active Cervical Flexion</td>
</tr>
<tr>
<td></td>
<td>Active Cervical Extension</td>
</tr>
<tr>
<td></td>
<td>Active Cervical Rotation</td>
</tr>
<tr>
<td>2</td>
<td><strong>Upper Extremity Patterns</strong></td>
</tr>
<tr>
<td></td>
<td>Pattern 1: MRE -</td>
</tr>
<tr>
<td></td>
<td>Pattern 2: LRF -</td>
</tr>
<tr>
<td>3</td>
<td><strong>Multi-Segmental Flexion</strong></td>
</tr>
<tr>
<td></td>
<td>(Touch your Toes)</td>
</tr>
<tr>
<td>4</td>
<td><strong>Multi-Segmental Extension</strong></td>
</tr>
<tr>
<td></td>
<td>(Hands overhead Backward Bend)</td>
</tr>
<tr>
<td>5</td>
<td><strong>Multi-Segmental Rotation</strong></td>
</tr>
<tr>
<td></td>
<td>(Standing Rotation Test)</td>
</tr>
<tr>
<td>6</td>
<td><strong>Single Leg Stance</strong></td>
</tr>
<tr>
<td>7</td>
<td><strong>Overhead Deep Squat</strong></td>
</tr>
</tbody>
</table>

Increasing Neurodevelopmental Order
The Selective Functional Movement Assessment
Second Tier Breakouts

Mobility Restriction or Stability/Motor Control Impairment

Logic used:

- Ask what local joint movements are required for each movement pattern?
- Can you eliminate a body part? Unilateral vs Bilateral
- Can you change the stability requirements? Loaded vs Unloaded
- Confirm – compare Active vs Passive ROM
The Selective Functional Movement Assessment
Second Tier Breakouts

Example:

Logic used:

- Ask what local joint movements are required for each movement pattern?
- Can you eliminate a body part? Unilateral vs Bilateral
- Can you change the stability requirements? Loaded vs Unloaded
- Confirm – compare Active vs Passive ROM
SFMA Rehabilitative Approach

Laws of SFMA:

- Treat Mobility problems BEFORE stability correction
- Treat DN’s before DP’s
- Treat DP’s before FP’s
- Treat T-spine mobility problems before shoulder
- Treat T-spine mobility problems before lumbar

Once mobility problems are eliminated, If a stability problem still exists, must first do a fundamental test to r/o fundamental pattern problem

- Supine & Prone, Upper & Lower Body Rolling Tests
<table>
<thead>
<tr>
<th></th>
<th>PRE</th>
<th>POST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cerv Flex</strong></td>
<td>FN FP DP DN</td>
<td>chin to chest</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10° short horizontal</td>
</tr>
<tr>
<td><strong>Cerv Ext</strong></td>
<td>FN FP DP DN</td>
<td>10° short horizontal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cerv Rot</strong></td>
<td>R: FN FP DP DN</td>
<td>mid clavicle</td>
</tr>
<tr>
<td></td>
<td>L: FN FP DP DN</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Upper Ext 1</strong></td>
<td>R: FN FP DP DN</td>
<td>inferior angle scapula (&quot;back scratch&quot;)</td>
</tr>
<tr>
<td></td>
<td>L: FN FP DP DN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Upper Ext 2</strong></td>
<td>R: FN FP DP DN</td>
<td>behind head opposite spine of scapula</td>
</tr>
<tr>
<td></td>
<td>L: FN FP DP DN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MultSegFlex</strong></td>
<td>FN FP DP DN</td>
<td>touch toes</td>
</tr>
<tr>
<td>(Standing Toe Touch)</td>
<td></td>
<td>sacral angle &lt; 70°</td>
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<tr>
<td></td>
<td></td>
<td>uniform spinal curve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>poster wt shift</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no effort / assym</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MultSegExt</strong></td>
<td>FN FP DP DN</td>
<td>arms to ears 170° flex</td>
</tr>
<tr>
<td>(Standing Backward</td>
<td></td>
<td>ASIS in front toes</td>
</tr>
<tr>
<td>Bend)</td>
<td></td>
<td>spine scap behind heels</td>
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<tr>
<td></td>
<td></td>
<td>no effort / assym</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td><strong>MultiSegRot</strong></td>
<td>R: FN FP DP DN</td>
<td>pelvis rot &gt; 50°</td>
</tr>
<tr>
<td></td>
<td>L: FN FP DP DN</td>
<td>shoulder rot &gt; 50°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no spine/pelvic dev</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no excessive knee flex</td>
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<td></td>
<td></td>
<td>no effort / assym</td>
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<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Single Leg Stance</strong></td>
<td>R: FN FP DP DN</td>
<td>eyes open &gt; 10s</td>
</tr>
<tr>
<td></td>
<td>L: FN FP DP DN</td>
<td>eyes closed &gt; 10s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no loss of height</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no effort / assym</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Overhead Deep Squat</strong></td>
<td>FN FP DP DN</td>
<td>no loss UE start position</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tibia - torso parallel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sagittal plane symmetry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>thighs parallel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no effort / assym</td>
</tr>
</tbody>
</table>

Key: FN=Functional Nonpainful; FP=Functional Painful; DP=DysFunctional Painful; DN=DysFunctional Nonpainful
✔ for Failed Criteria
Multi-Segmental Flexion (Toe Touch)

Normal Criteria:
- Touches toes
- Posterior weight shift
- Uniform spinal curves
- Sacral Angle is LESS than 70°
- No excessive effort or asymmetry

Possible Causes Poor Movement:
- Limited spinal flexion – thor, lumb
- Limited hip flexion
- Poor Hamstring tone or guarding
- Lack Core Stability -
- Lack wt-bearing hip stability
- Lack wt-bearing spine stability
- Poor toe-touch coordination pattern
Multi-Segmental Extension (Backward Bend)

Normal Criteria:
- UE reaches & keeps 170°
- ASIS clears toes
- Spine & Scapula clear heels
- Uniform spinal curves
- No excessive effort or asymmetry

Possible Causes Poor Movement:
- Limited shoulder extension
- Limited hip extension
- Limited spine extension – thor, lumb
- Lack Core Stability
- Lack wt-bearing hip stability
- Lack wt-bearing spine stability
- Lack wt-bearing ankle stability
Multi-Segmental Rotation

Normal Criteria:
- Pelvis rotation >50°
- Shoulder rotation >50°
- No spine or pelvic deviation
- No excessive knee flexion
- No excessive effort or asymmetry

Possible Causes Poor Movement:
- Limited cervical rotation
- Limited spine rotation – thor, lumb
- Limited pelvic
- Limited hip rotation or extension
- Limited knee or feet mobility
- Lack Core Stability
- Lack wt-bearing hip stability
- Lack wt-bearing spine stability
Overhead Deep Squat

Normal Criteria:
• UE reaches & keeps 170°
• ASIS clears toes
• Spine & Scapula clear heels
• Uniform spinal curves
• No excessive effort or asymmetry

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• Limited hip extension
• Limited spine extension – thor, lumb
• Lack Core Stability
• Lack wt-bearing hip stability
• Lack wt-bearing spine stability
• Lack wt-bearing ankle stability
Multi-Segmental Flexion (Toe Touch) Breakdown

Possible Causes Poor Movement:
- Limited spinal flexion – thor, lumb
- Limited hip flexion
- Poor Hamstring tone or guarding
- Lack Core Stability -
- Lack wt-bearing hip stability
- Lack wt-bearing spine stability
- Poor toe-touch coordination pattern
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Overhead Deep Squat

Possible Causes Poor Movement:
- Limited shoulder extension
- Limited hip extension
- Limited spine extension – thor, lumb
- Lack Core Stability
- Lack wt-bearing hip stability
- Lack wt-bearing spine stability
- Lack wt-bearing ankle stability
SFMA Rehabilitative Approach

Subconscious Dysfunction

Conscious Dysfunction

Conscious Function

Subconscious Function

Phases of progressive improvement in motor programs
SFMA Rehabilitative Approach

Three Rs:

- **RESET** – manual procedure to correct mobility restriction
  - may also correct stability dysfunction
  - It should not be a guided exercise

- **RE-ENFORCE** – education on habit change or ergonomics
  - Stretching exercise, taping, orthotics, nutrition etc

- **RELOAD** – corrective exercise for motor patterns
  - Sequenced based on 4x4 Matrix
SFMA Rehabilitative Approach
Corrective Exercise is for Restoration of Motor Patterns Only

4x4 Matrix:

**POSITIONS**
1. Non-Weightbearing
2. Quadripped
3. Kneeling
4. Standing

**Types Resistance**
1. No-Resistance – PA (Pattern Assistance)
2. No-Resistance
3. Resistance – PA (Pattern Assistance)
4. Resistance

Progressive Increasing Difficulty
Increasing Neurodevelopmental Order

Most Common Progression: 1-1; 1-2; 2-1; 2-2; 3-1; 3-2; 4-1; 4-2; then 1-3; 1-4; 2-3; 2-4; 3-3; 3-4; 4-3; 4-4
SFMA Rehabilitative Approach
Corrective Exercise is for Restoration of Motor Patterns Only

Pattern Assistance

- Any technique during or before a task to:
  - inhibit or facilitate tone
  - assist a movement
  - Alter a motor firing sequence
How to Provide Feedback during motor control retraining

Types

- Fading Techniques
- Learner Requested Feedback
- Error-Detection Feedback
- Performance Bandwidth
- Summary Technique
- Playing Stats
How to Provide Feedback during motor control retraining

Possible Progression

• Start with Performance Based Feedback
• Ask for Patient Feedback with a successful pattern
  • Learn *THEIR* language and adapt your words
  • Ask them: “What did that one *FEEL* like to you”
• Move quickly to Error-Detection Feedback (Random)
  • Provide feedback based on their response
• Performance Bandwidth feedback next
• Learner Requested Feedback next
• Summary Technique after time
Important concepts for teaching movement patterns

- Avoid fatigue at all costs
- Minimize verbal instruction & visual feedback
- Encourage patients not to over-think or try too hard … Balance is automatic – balance is natural
- Avoid stress breathing – if noted, stop the drill and make patient laugh or perform breathing drills
- Progress patients only as they gain control – do not overload or turn motor control into a conventional exercise
- End each session with re-appraisal of dysfunctional pattern
SFMA Rehabilitative Approach
5 Basic Reloading Strategies

- Basic Spine (Fle/Ext)
- Single Leg Stance (Lunge)
- Squatting
- Basic Hip (Fle/Ext)
- Rotation (Rolling, Cross Crawl)
<table>
<thead>
<tr>
<th>Flexion Pattern</th>
<th>Extension Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curl Up &amp; Oblique Curl Up</td>
<td>T-Spine Press Up (Cobra)</td>
</tr>
<tr>
<td>Dead Bugs</td>
<td>T-Spine to Lumbar Press Up</td>
</tr>
<tr>
<td>Dorsiflexion Ball Rolls</td>
<td>Arms Up Press Up</td>
</tr>
<tr>
<td>ASLR</td>
<td>Rolling</td>
</tr>
<tr>
<td>Cats</td>
<td>Bridging</td>
</tr>
<tr>
<td>Reachunders</td>
<td>Quadruped Reachbacks</td>
</tr>
<tr>
<td>Quadruped Posterior Rocking</td>
<td>Reach Roll Lift</td>
</tr>
<tr>
<td>Quadruped Ball Press</td>
<td>Bird Dogs</td>
</tr>
<tr>
<td>Kneeling Chops</td>
<td>Hamstrings Stands</td>
</tr>
<tr>
<td>Tall Kneeling Sit Back</td>
<td>Kneeling Lifts</td>
</tr>
<tr>
<td>Standing Chops &amp; lifts</td>
<td>Standing Lifts</td>
</tr>
<tr>
<td>Toe Touches</td>
<td>Overhead Press &amp; Lunging</td>
</tr>
</tbody>
</table>
Basic Hip & Rotation

**Hip**
- Rolling

**Rotation: Spine & Hip**
- Rolling & Starfish
- Supine Chopping & Lifting
- Reachbacks/unders
- Rotary Bird Dogs
- Kneeling Chopping & Lifting (with rotation)
Squatting / Single Leg Stance

**Squatting**
- Triple Flexion
- Dorsiflexion Ball Slides
- Active Supine Knees to Chest
- Posterior Rocking (w Shoulder Flexion)
- Quadruped Triple Flexion
- Kneeling Chopping & Lifting
- Squatting w/ Pattern Assist

**Single Leg Stance**
- Rolling & Bridging
- Ankle Dorsiflexion & Inv/Ever
- Bird Dogs
- Quad to Kneeling
- Kneeling Chopping & Lifting
- LSL & Swinging
- Wallslides
- Deadlifts & Lunges

**Shoulder Int/Ext Rotation**
- Pillow Presses
- Rolling
- Chops & Lifts (PNFs)
- Quadruped PNFs & Reach, Roll & Lift
Final Thoughts

Movement patterns come from the brain …

These patterns MUST be retrained after mobilization procedures to ensure

… a change in the engram within the brain

… a change with how one will use their newfound ROM – it is often not automatic

Think gross motion in assessing these patterns


Understanding Movement & Function

This lecture/workshop is based on the clinical approach to the assessment and correction of movement dysfunction, with concepts integrated and developed from the following sources:

- Clinical development & collaborative research: KineticControl.com - Mark Comerford, Sarah Mottram, Sean Gibbons, Clark, Silvester, Bunce, Enoch, Andreotti, & Strassel
- late Vladimir Janda, MD Check Republic
- Phillip Greenman, DO: Michigan State University, USA
- P Gunner Brolinson, DO, FAOASM, FAAFP: Virginia Polytechnic Insti & State Univ, Blacksburg, VA, USA
- S Sahrmann: Washington University, St Louis USA
- Perform Better: Gary Gray & Grey Cook
- Richardson, Jull, Hodges, & Hides: Physiotherapy Depart, Univ Queensland, Australia
- D Lee: Ocean Pointe Physiotherapy Consultants, White Rock, BC, Canada
- Vleeming & Snijders (Research Group Musculoskeletal System), Erasmus University, Rotterdam, Netherlands
- Physiotools, Finland
- Ben Kibler, MD; USA
References
PERFORM BETTER!

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- Diagnosis, Subgroup Classification & Motor Control Retraining of the Shoulder Girdle

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- Diagnosis, Mobilisation & Functional Motor Control Retraining of the Sacro-Iliac Joint and Pelvis

Kinetic Control

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Thank You !!
"Real World” Muscle Function

Motor pattern of Ecconcentric Contraction

def: During functional activity, different portions of the same muscle may undergo concentric, eccentric, isometric, or even no activity, simultaneously.

Human function is three dimensional - All of our core functional activities require an integrated NMS system that reacts and moves in all three planes simultaneously.

Walking forward obviously includes sagittal plane motion, but actually is dominated by transverse plane motion with significant frontal plane motion occurring concurrently.

Successful standing and balancing requires three dimensional capabilities of the NMS system throughout the chain reaction.

Structure / Function Reciprocity

- Has moved beyond ‘simple’ muscle and bone to:
  - **BioTensegrity** (Levin)
    - Macro - system integration
    - Micro - Individual cellular structure
    - Nuclear - Proteonomics
  - **Neuromuscular Balance**
    - Systemic neuromotor integration of stability
    - Engrams or motor patterns
  - **Real Word Muscle Function** (G Brolinson & G Gray)
    - Eccentric contraction
    - Supination / Pronation Link (Spiral Power)
Basis of Functional Approach

Interdependence of all structures from both the CNS & MSK system in production and control of motion

- Osteopathic Principles
- Tensegrity / Biotensegrity
- Fascial Continuity

The muscle system lies at a functional crossroad because it is influenced by stimuli from both CNS & PNS system

Dysfunction any component of either of these systems is reflected in the MSK SYSTEM as:

- altered muscle tone
- muscle contraction
- muscle balance
- Dis-coordination
- altered motor patterns
- altered performance
Joint Stability

**Form Closure** + **Force Closure** = **Clinical Stability**

**Stability Dysfunction**

- **Bony Problem** (Surgical)
- Enthesopathy: Ligament Laxity, Tendinosis
- Neuromuscular Imbalance

**Clinical Instability**
Hip Extension Test (w/ Knee Flexed)

- Gluteus Max, Medius, Minimus
- Hip extensor stabilizers
- Lumbar extension & rotation stability

Ideal Pattern:
- Neutral lumbo-pelvic region during active hip extension (0° ext) to lift thigh horizontal

Assess ability:
- Active glut to shorten w/out subst
- Hold position
- Control eccentric return

Substitutions to avoid:
- *Any* Lumbo-pelvic ext
- Hamstring activity > glut max
- Excessive back extensor activity
- Lumbar rotation
Hip Extension Test (w/ Knee Flexed)

- Gluteus Max Retraining
  - Co-activate abdominal & glut muscles to control neutral spine
  - Initial goal to 0 hip extension

Progress - full supine with pillow under pelvis
Ideal Scapular Positioning

- Place thenar eminences on the CORACOID & INFERIOR MEDIAL BORDER of scapula.
- Push your hands together creating:
  - decreased anterior tilt
  - de-rotation
  - mild retraction & elevation
- Passive show patient position 5-10 times. Then they actively try to find it.
Tibial Rotational Control

Knee Flexion Test (prone)
- Active flexion & observation of medial or lateral tibial rotation
- Ideal: none; Common: lateral
- Txm: knee flex w/ neutral tibia
- Eliminate dominance of biceps femoris, toe flexors, excessive plantar-flexion at talo-crural joint

Modified Thomas Test (w/ adduction)
- Ideal: hip passively extended with thigh resting on table with flat-back lumbo-pelvic position, femur in midline of body, & knee 90° flexed; Common: hip rotation & abduction, lumbar movt, lateral tibial rotation
- Txm: slow active lowering
- Eliminate dominance of ITB, biceps femoris
Tibial Rotational Control

- Small Knee Bend (SKB)
  - Standing, active SKB -
  - Ideal: ; Common: heel pulls in or foot turns out -> lateral tibial rotation, loss tibial rotational control
  - Eliminate dominance of TFL, BF
  - Remove inhibition popliteus
  - Txm: ideal SKB

- Single Legged Turn Out (standing)
  - Ideal: ; Common: lacks ability laterally hip rotate - substitutes rotation femur on the tibia (lateral tibial rotation)
  - Eliminate dominance of TFL, BF
  - Remove inhibition popliteus
  - Txm: ideal turn out
<table>
<thead>
<tr>
<th>Joint</th>
<th>Local Stabilizer</th>
<th>Global Stabilizer</th>
<th>Global Mobiliser</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee</td>
<td></td>
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<tr>
<td></td>
<td>Popliteus VMO</td>
<td></td>
<td>Biceps Femoris</td>
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<td>ITB (TFL &amp; SGM)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lateral Retinaculum</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Rectus Femoris</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Gastroc</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Soleus</td>
</tr>
<tr>
<td>Foot / Ankle</td>
<td>Intrinsics</td>
<td>Tibialis Posterior (CKC)</td>
<td>Peroneals</td>
</tr>
<tr>
<td></td>
<td>Tibialis Posterior</td>
<td>Tibialis Anterior</td>
<td>Gastroc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soleus</td>
<td>Toe flexors</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Toe Extensors</td>
</tr>
</tbody>
</table>
Redefining Core Stability Rehabilitation

“core stability” has achieved generic status in exercise & fitness industry

- representing large range exercises from
  - almost imperceptible activation of deep abdominals … to …
  - lifting weights while balancing on a physioball
Redefining Core Stability
Rehabilitation

**Motor Control Stability**: central nervous system modulation of efficient integration and low threshold recruitment of local & global muscle systems - - new label for low threshold stability

**Core Strength Training**: high threshold or overload strengthening of the global stabilizer muscle system

**Symmetrical Strength Training**: traditional high threshold or overload strength training of the global mobiliser muscle system
# Redefining Core Stability Rehabilitation

## DIFFERENCES BETWEEN

<table>
<thead>
<tr>
<th>Motor Control Stability</th>
<th>Core Strength</th>
<th>Symmetrical / Traditional Strength Training</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Muscle Specific:</strong> training can be biased for either local or global stabiliser muscle</td>
<td><strong>Muscle Non-specific:</strong> Co-contraction of local stabilisers, global stabilisers, and global mobiliser muscles (all relevant synergists significantly activated)</td>
<td><strong>Muscle Specific:</strong> biased for global mobilisers</td>
</tr>
<tr>
<td><strong>Recruitment Specific:</strong> slow motor units predominately recruited (since under low load or normal functional loads)</td>
<td><strong>Recruitment Non-specific:</strong> both slow &amp; fast motor units are strongly recruited</td>
<td><strong>High Threshold Training</strong></td>
</tr>
<tr>
<td><strong>CNS Modulated:</strong> afferent spindle input influences tonic motor output (“software upgrade”)</td>
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</tr>
</tbody>
</table>
Symmetrical / Traditional Strength Training

**Muscle Specific**: biased for global mobilisers

**High Threshold Training**: muscle adapting to overload demand

**Sagital plane prevailing**: +/- coronal plane

The need to control a rotational challenge or load is eliminated

**Predominately isotonic with emphasis on concentric**: also isometric & isokinetic
### Similarities & Differences between Core Rehabilitation Processes

<table>
<thead>
<tr>
<th></th>
<th>Traditional Strengthening (Limbs)</th>
<th>Core Strengthening (Trunk)</th>
<th>Motor Control Stability (Global)</th>
<th>Motor Control Stability (Local)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Training Threshold</strong></td>
<td>high</td>
<td>high</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td><strong>Muscle Bias</strong></td>
<td>global mobilizers</td>
<td>global stabilizers</td>
<td>global stabilizers</td>
<td>local stabilizers</td>
</tr>
<tr>
<td><strong>Position/Plane of Primary Loading</strong></td>
<td>sagittal plane +/- coronal</td>
<td>neutral position +/- axial plane</td>
<td>neutral position +/- axial plane</td>
<td>neutral position</td>
</tr>
<tr>
<td><strong>Type of Loading</strong></td>
<td>isotonic (concentric) +/- isometric &amp; isokinetic</td>
<td>isometric +/- isotonic (concentric)</td>
<td>isotonic (eccentric) &amp; isometric</td>
<td>isometric</td>
</tr>
</tbody>
</table>
Indications for LOW LOAD TRAINING of the LOCAL SYSTEM as a clinical priority

1. Relevant symptom presentation:
   a. assoc low load normal daily function
   b. non-direction specific pain
   c. assoc static position & all postures

2. Uncontrolled compensatory articular translation

3. History of insidious recurrence (prevention)

4. Poor voluntary low threshold recruitment efficiency
Indications for LOW LOAD TRAINING of the GLOBAL SYSTEM as a clinical priority

1. Relevant symptom presentation:
   a. assoc low load normal daily function
   b. direction specific pain - assoc specific direction movement provocation

2. Direction related mechanical pain

3. Low threshold recruitment imbalance between stabilizers & mobilizers

4. History recurrence - usu related precipitating event where specific direction of stress or strain is implicated in mechanism injury

5. Asymptomatic uncontrolled (direction specific) segmental movement
Indications for HIGH LOAD TRAINING of the LOCAL SYSTEM as a clinical priority

1. Relevant symptom presentation:
   a. unilateral pain
   b. Only assoc high load activity
   c. Direction specific pain - assoc specific direction movement provocation
   d. provoked with asymmetrical activity

2. Atrophy (disuse) or load related weakness

3. Rotation “give” under high load testing
   a. with unilateral or asymmetrical (rotational) load
   b. with bilateral or symmetrical (sagittal) load
Indications for HIGH LOAD TRAINING of the GLOBAL SYSTEM as a clinical priority

1. Relevant symptom presentation:
   a. midline pain
   b. only assoc high load activity
   c. Direction specific pain - assoc specific direction movement provocation
   d. symptoms provoked with symmetrical or sagittal (flexion/extension) activity

2. Atrophy (disuse) or load related weakness

3. Sagittal (flexion/extension) “give” under high load testing:
   a. with bilateral or symmetrical (sagittal) load
   b. with unilateral or asymmetrical (rotational) load
This lecture/workshop is based on the clinical approach to the assessment and correction of movement dysfunction, with concepts integrated and developed from the following sources:

- Clinical development & collaborative research: KineticControl.com - Mark Comerford, Sarah Mottram, Sean Gibbons, Clark, Silvester, Bunce, Enoch, Andreotti, & Strassel
- late Vladimir Janda, MD Check Republic
- Phillip Greenman, DO: Michigan State University, USA
- P Gunner Brolinson, DO, FAOASM, FAAFP: Virginia Polytechnic Insti & State Univ, Blacksburg, VA, USA
- S Sahrmann: Washington University, St Louis USA
- Perform Better: Gary Gray & Grey Cook
- Richardson, Jull, Hodges, & Hides: Physiotherapy Depart, Univ Queensland, Australia
- D Lee: Ocean Pointe Physiotherapy Consultants, White Rock, BC, Canada
- Vleeming & Snijders (Research Group Musculoskeletal System), Erasmus University, Rotterdam, Netherland
- Physiotools, Finland
- Ben Kibler, MD; USA
Additional References

- kineticcontrol.com -- Mark Comerford et al - including various course handouts
- Textbook of Musculoskeletal Medicine, Michael Hutson & Richard Ellis 2006
  - Chp 4.3.12 Exercise Therapy: The Spine. Mark Comerford.
  - Chp 2.2.2 Muscles in Pathogenesis of MSk Disorders. V Janda.
- Preseedings 2nd & 3rd International Conferences on Motor Control
- Movement, Stability & Lumbopelvic Pain: Integration of research and therapy (Hardcover) 2nd ed 2008 Andry Vleeming PhD,PT (Author), Vert Mooney MD (Author), Rob Stoeckart PhD (Author)
- Movement, Stability and Low Back Pain: The Essential Role of the Pelvis (Hardcover) 1st ed 1997 Andry Vleeming PhD (Author), Vert Mooney MD (Author), Chris J. Snijders PhD (Author), Thomas A. Dorman MD (Author), Rob Stoeckart PhD (Author)
- My Website: www.jockdoctors.com
Principle Centered Rehabilitation

Treatment Thinking vs Preventive Thinking

Functional Analysis Rehabilitative Method:

- Goal: find root cause
- Functional evaluation / testing
- “Causative Cure” and “Integrated Isolation”

Real World muscle function

Consideration of Compensations

Success Imperative

# Principle Centered Rehabilitation

**Pronation:**
- Chain collapse
- Shock absorption
- Reaction to gravity & ground reactive forces
- Succumbs to gravity
- Eccentric (deceleration) muscle function

**Supination:**
- Chain elongation
- Propulsion
- Overcomes gravity
- Concentric (acceleration) muscle function

---

“The transformation of pronation into supination is the KEY to the process of the locomotor system in sport movement”

Brolinson & Gray

This transformation is dominated by Isometric (stabilizing) and eccentric muscle function: a deceleration of motion at one joint and acceleration of motion at another joint or in another plane, all at the same time.
Principles of the Exercise Prescription

- **Spectrum** of Rehabilitation
  - *NOT* stages

  - **Acute - Inflammation**
    - Tools – rest/modalities/sensory balance/early mobilization
  - **Recovery - Fibrosis**
    - Tools – directional movements (unloaded), mobilization, specific progression, flexibility, proprioception
  - **Retraining - Sclerosis**
    - Tools – directional movements (loaded), functional program, power, endurance, skills

Comprehensive functional spectrum therapy **begins with** function and **ends with** function

Motion, stability, flexibility, and strength are facilitated concurrently and not independently
Principles of Stability Rehab

- **Local/Global Stability System** – **Control of Direction**
  1. Retrain **Dynamic Control** of the Direction of Stability Dysfunction
     - **Motor Control & Co-ordination of direction specific stress & strain**

- **Local Stability System** – **Control of Translation**
  1. **Control** of Translation in the Neutral Joint Position
     - **Low Threshold Recruitment of the local stability system to control articular translation**

- **Global Stability System** – **Control Of Imbalance**
  1. Rehabilitate Global Stabiliser **Control** through Range
  2. Rehabilitate Global Stabiliser **Extensibility** through Range
     - **Balancing functional length and recruitment dominance between global synergists**
Principles of Stability Rehab

Local/Global Stability System – Control of Direction

- Retrain Dynamic Control of the Direction of Stability Dysfunction
  - Control the ‘give’ & Move the restriction
  - Retrain control in the direction of symptom producing movements
  - Use *low load integration* of local and global stabiliser muscle recruitment to control and limit motion at the segment or region of ‘give’
  - Then actively move the adjacent restriction
  - Only move through as much range as the restriction allows or as far as the ‘give’ is dynamically controlled

- Control of direction directly unloads mechanical provocation of pathology and therefore is the key strategy to symptom management

- Motor Control & Co-ordination of direction specific stress & strain
Principles of Stability Rehab

Local Stability System – Control of Translation

Control in the Neutral Joint Position

Retrain tonic, low threshold activation of the local stability muscle system to increase muscle stiffness and train functional low load integration of the local and global stabiliser muscles to control abnormal translation in the neutral joint position

– Low Threshold Recruitment of the local stability system to control articular translation
Principles of Stability Rehab

Global Stability System – Control Of Imbalance

Rehabilitate Global Stabiliser Control through Range

- Rehab to control the full available range of joint motion
- These muscles are required to actively shorten and control limb load through to the full passive inner joint ROM
- They must also control any hypermobile outer range
- Control of rotational forces is critical
- Eccentric control of range is more important than concentric
  - **Optimised by low effort, sustained holds in the muscles shortened position with controlled eccentric lowering**

Rehabilitate Global Stabiliser Extensibility through Range

- When the 2-joint global mobility muscles demonstrate a lack of extensibility due to overuse or adaptive shortening, *compensatory overstrain or ‘give’ occurs elsewhere in the kinetic chain in an attempt to maintain function*
- Need to lengthen or inhibit dominance or over-activity in the global mobilisers to eliminate the need for compensation to keep function
  - **Balancing functional length and recruitment dominance between global synergists**