Lab:

MOTOR PATTERN ASSESSMENT SCREENING & DIAGNOSIS

Albert J Kozar DO, FAOASM, RMSK

Board Certified in NMMOMM, FP, CAQSM, RMSK

Clinical Associate Professor, Univeristy of New England – Biddeford, ME

Clinical Associate Professor, Edward Via College of Osteopathic Medicine – Blacksburg, VA

Team Physician - University of Hartford

Valley Sports Physicians - Avon, CT

AAO Convocation

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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

Assessment of Muscle Function
Kendall & McCreary

Sahrmann
Global – whole body

Janda
Global – trunk & limbs

Lewit

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

Core Strength
Overload training of trunk & girdle

Alternative Therapies & approaches
Global – trunk & limbs

O'Sullivan
Integration of trunk stability into function

Core Strengthening
McGill

Integrative Assessment of Motor Patterns

Kolar
DNS

Leibenson
Magnificent 7
Evidenced based synthesis – whole body

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

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 sytem
- **delayed recruitment timing**
  - evidence in the local system
- **altered recruitment sequencing**
  - evidence in global system

Inhibition ≠ “off”
Inhibition ≠ “weak”

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

O’Sullivan 1998, Richardson et al 1998, Hides et al 2001, Cameron et al 2003, Alexander 2007, Keisal et al 2007

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 ??

NEURODEVELOPMENTAL PERSPECTIVE

- 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=eIkRyqLpcNk

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	FP	DP	DN
Functional	Functional	Dysfunctional	Dysfunctional
Non-painful	Painful	Painful	Non-painful
Normal			

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

Increasing Neurodevelopmental Order

1) **Active Cervical ROM**
   Active Cervical Flexion
   Active Cervical Extension
   Active Cervical Rotation

2) **Upper Extremity Patterns**
   Pattern 1: MRE -
   Pattern 2: LRF -

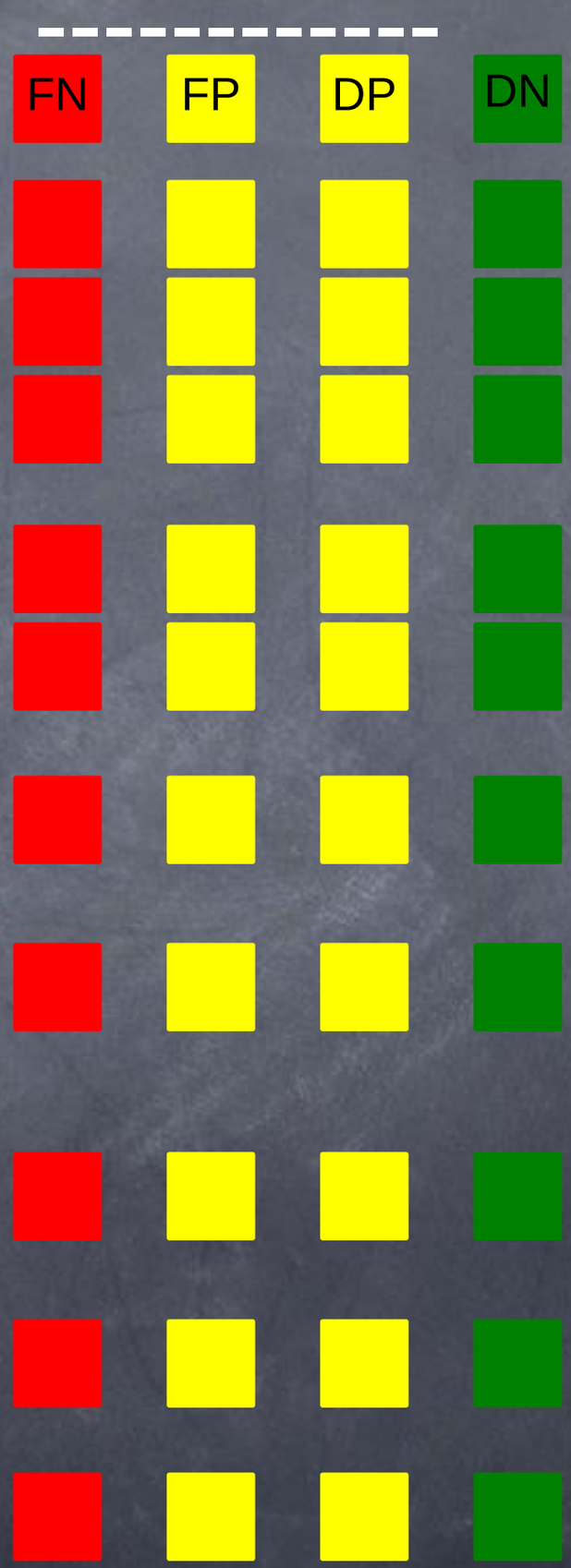
3) **Multi-Segmental Flexion**
   (Touch your Toes)

4) **Multi-Segmental Extension**
   (Hands overhead Backward Bend)

5) **Multi-Segmental Rotation**
   (Standing Rotation Test)

6) **Single Leg Stance**

7) **Overhead Deep Squat**



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

SELECTIVE FUNCTIONAL MOVEMENT SCREEN (SFMA) PRE / POST

	PRE		POST	
	Cerv Flex *FN FP DP DN*	*chin to chest*	**Cerv Flex** *FN FP DP DN*	*chin to chest*
	Cerv Ext *FN FP DP DN*	10^0 short horizontal	**Cerv Ext** *FN FP DP DN*	10^0 short horizontal
	Cerv Rot **R:** *FN FP DP DN* **L:** *FN FP DP DN*	*mid clavicle*	**Cerv Rot** **R:** *FN FP DP DN* **L:** *FN FP DP DN*	*mid clavicle*
	Upper Ext 1 **R:** *FN FP DP DN* **L:** *FN FP DP DN*	*inferior angle scapula ("back scratch")*	**Upper Ext 1** **R:** *FN FP DP DN* **L:** *FN FP DP DN*	*inferior angle scapula ("back scratch")*
	Upper Ext 2 **R:** *FN FP DP DN* **L:** *FN FP DP DN*	*behind head opposite spine of scapula*	**Upper Ext 2** **R:** *FN FP DP DN* **L:** *FN FP DP DN*	*behind head opposite spine of scapula*
✓	**MultSegFlex** *FN FP DP DN* *(Standing Toe Touch)*	*touch toes* *sacral angle* $< 70^0$ uniform spinal curve poster wt shift no effort / assym	**MultSegFlex** *FN FP DP DN* *(Standing Toe Touch)*	*touch toes* *sacral angle* $< 70^0$ uniform spinal curve poster wt shift no effort / assym
✓	**MultSegExt** *FN FP DP DN* *(Standing Backward Bend)*	*arms to ears* 170^0 flex *ASIS in front toes* spine scap behind heels uniform spinal curve no effort / assym	**MultSegExt** *FN FP DP DN* *(Standing Backward Bend)*	*arms to ears* 170^0 flex *ASIS in front toes* spine scap behind heels uniform spinal curve no effort / assym
✓	**MultiSegRot** **R:** *FN FP DP DN* **L:** *FN FP DP DN*	*pelvis rot* $> 50^0$ *shoulder rot* $> 50^0$ no spine/pelvic dev no excessive knee flex no effort / assym	**MultSegRot** **R:** *FN FP DP DN* **L:** *FN FP DP DN*	*pelvis rot* $> 50^0$ *shoulder rot* $> 50^0$ no spine/pelvic dev no excessive knee flex no effort / assym
	Single Leg Stance **R:** *FN FP DP DN* **L:** *FN FP DP DN*	*eyes open > 10s* *eyes closed > 10s* no loss of height no effort / assym	**Single Leg Stance** **R:** *FN FP DP DN* **L:** *FN FP DP DN*	*eyes open > 10s* *eyes closed > 10s* no loss of height no effort / assym
✓	**Overhead Deep Squat** *FN FP DP DN*	*no loss UE start position* *tibia - torso parallel* *sagittal plane symmetry* *thighs parallel* no effort / assym	**Overhead Deep Squat** *FN FP DP DN*	*no loss UE start position* *tibia - torso parallel* *sagittal plane symmetry* *thighs parallel* no effort / assym

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

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 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

Multi-Segmental Extension (Backward Bending) Breakdown

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

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:

Progressive Increasing Difficulty

Increasing Neurodevelopmental Order

POSITIONS

1. Non-Weightbearing
2. Quadriped
3. Kneeling
4. Standing

Types Resistance

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

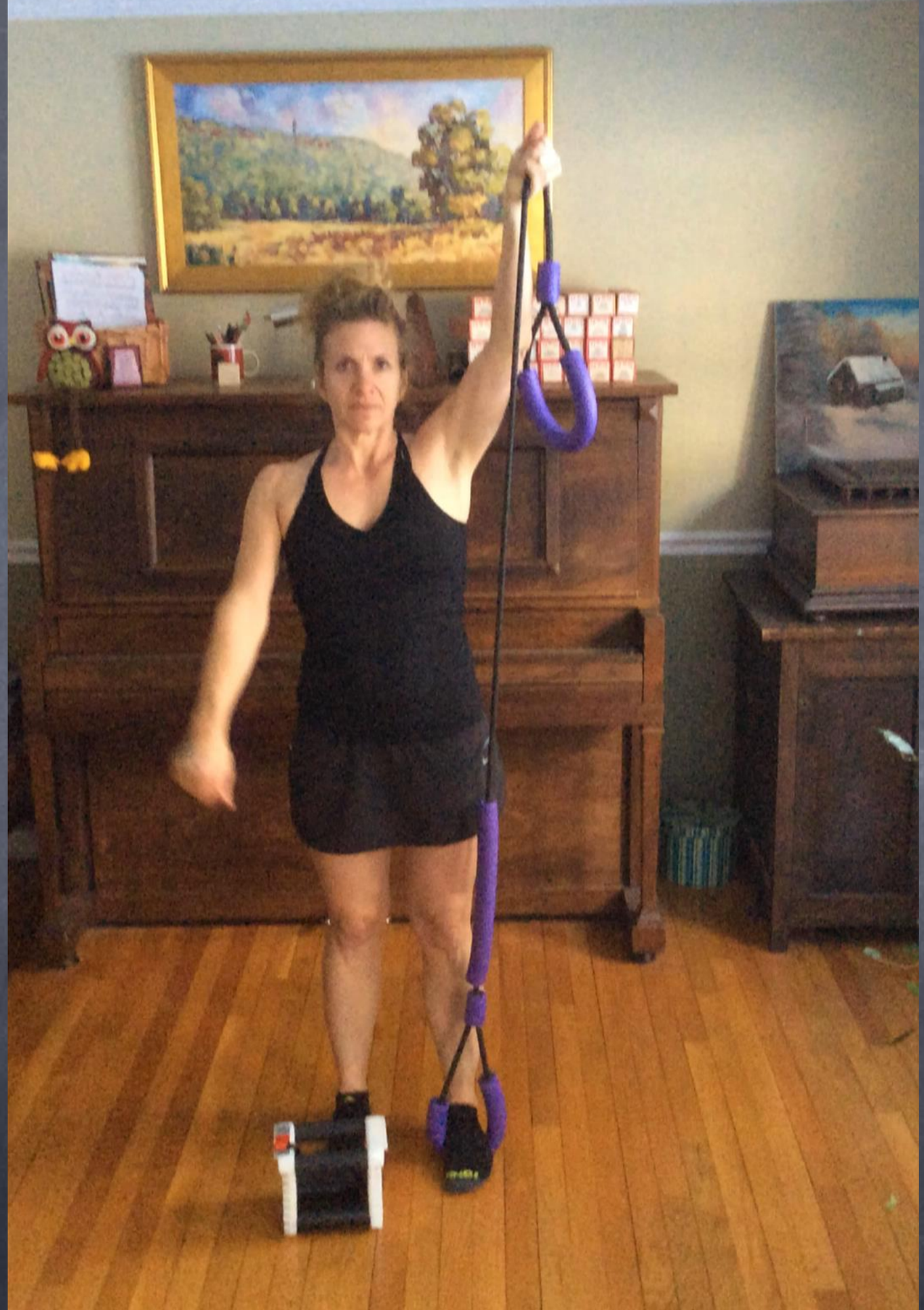
Most Common Progression: 1-1; 1-2; 2-1; 2-2; 3-1; 3-2; 4-1; 4-2; then 1-3; 1-4; 2-3; 2-4; 3-3; 3-4; 4-3; 4-4

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)

Basic Hip (Fle/Ext)

Squatting

Rotation (Rolling, Cross Crawl)

Basic Flexion / Extension

Flexion Pattern

- Curl Up & Oblique Curl Up
- Dead Bugs
- Dorsiflexion Ball Rolls
- ASLR
- Cats
- Reachunders
- Quadruped Posterior Rocking
- Quadruped Ball Press
- Kneeling Chops
- Tall Kneeling Sit Back
- Standing Chops & lifts
- Toe Touches

Extension Pattern

- T-Spine Press Up (Cobra)
- T-Spine to LumbarPress Up
- Arms Up Press Up
- Rolling
- Bridging
- Quadruped Reachbacks
- Reach Roll Lift
- Bird Dogs
- Hamstrings Stands
- Kneeling Lifts
- Standing Lifts
- Overhead Press & Lunging

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

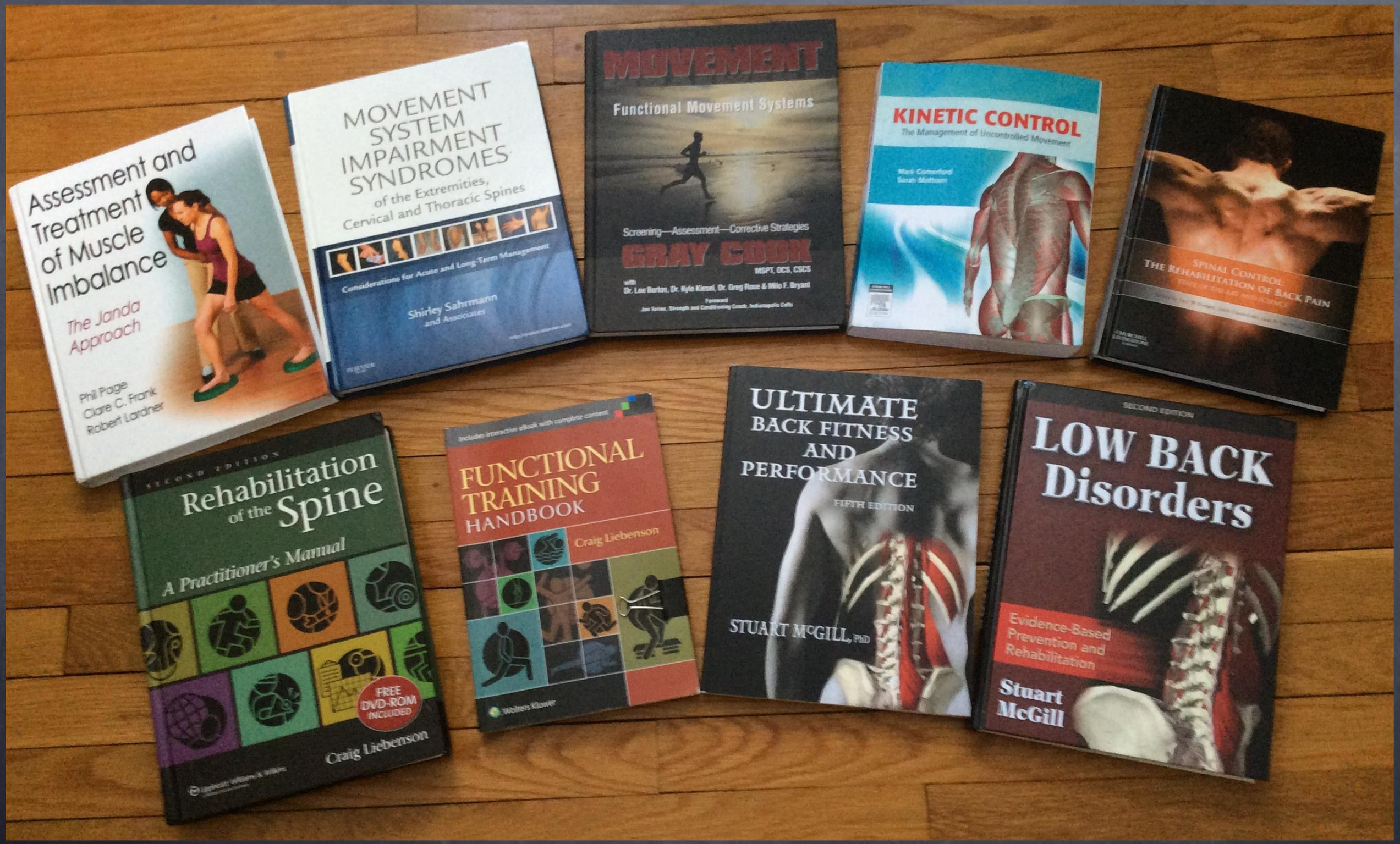
Moreside JM. McGiill SM. 2013 J Strength Cond Res. Oct;27(10):2635-43.
Improvements in hip flexibility do not transfer to mobility in functional movement patterns.
Grey Cook. Movement: Functional Movement Systems. 2010

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: Virgina 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

References


Assessment and Treatment of Muscle Imbalance
The Janda Approach
Phil Page
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Robert Lardner
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of the Extremities, Cervical and Thoracic Spines
Considerations for Acute and Long-Term Management
Shirley Sahrmann and Associates
MOVEMENT
Functional Movement Systems
Screening—Assessment—Corrective Strategies
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MSPT, OCS, CSCS
with
Dr. Lee Burton, Dr. Kyle Kiesel, Dr. Greg Rose & Milo F. Bryant
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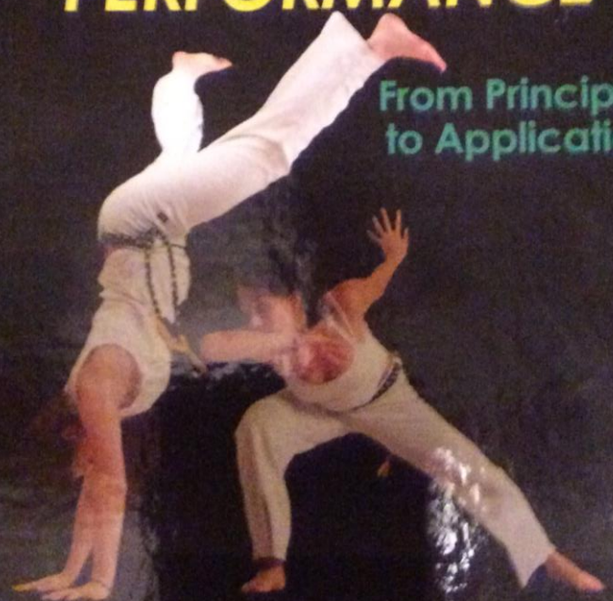

Richard A. Schmidt
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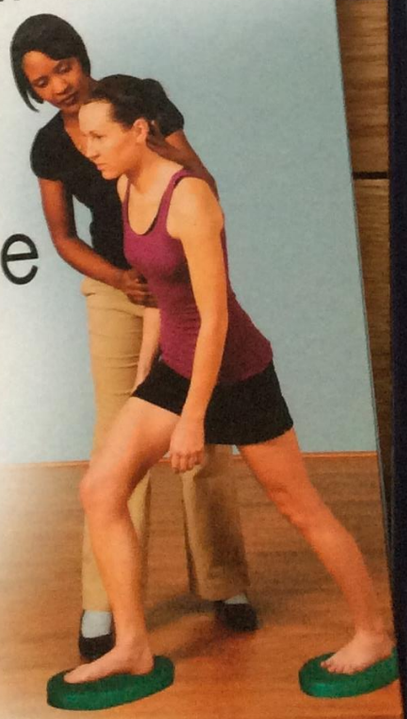
Assessment and Treatment of Muscle Imbalance

The Janda Approach



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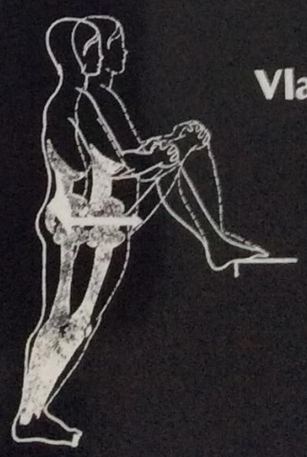
Muscle Function Testing



Vladimír Janda

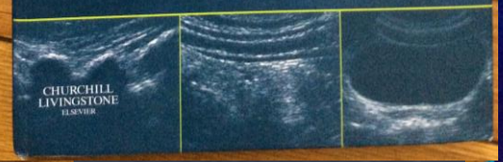
Butterworths

ULTRASOUND IMAGING FOR REHABILITATION OF THE LUMBOPELVIC REGION

A CLINICAL APPROACH

Jackie L. Whittaker

Foreword by Maria Stokes



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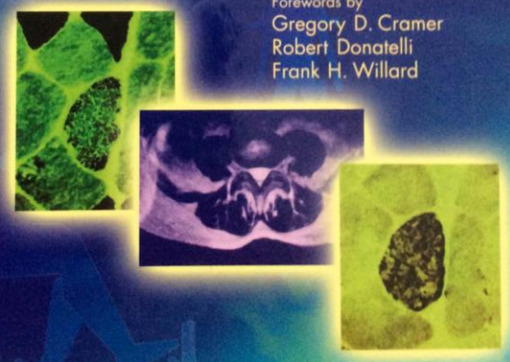


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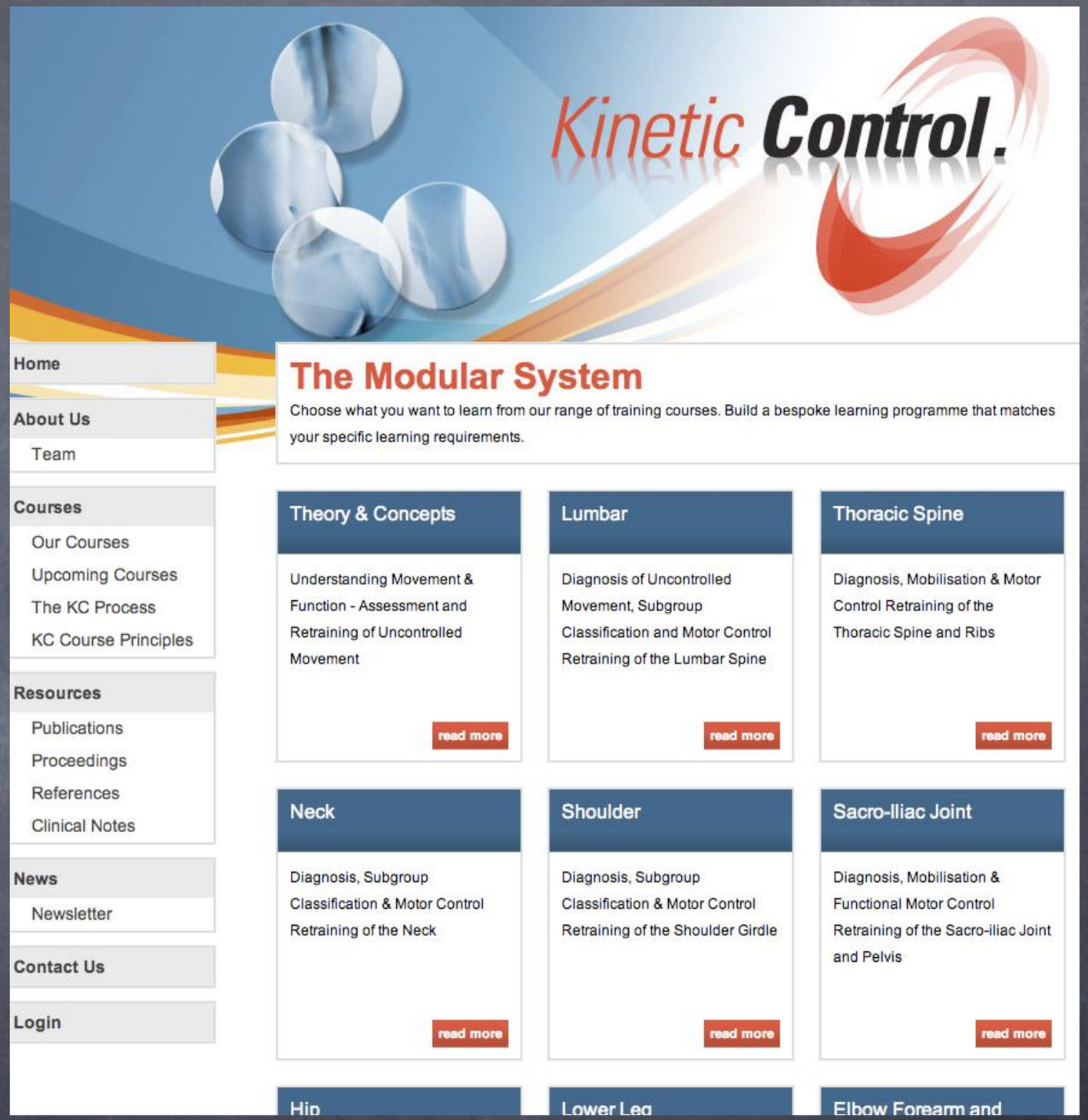
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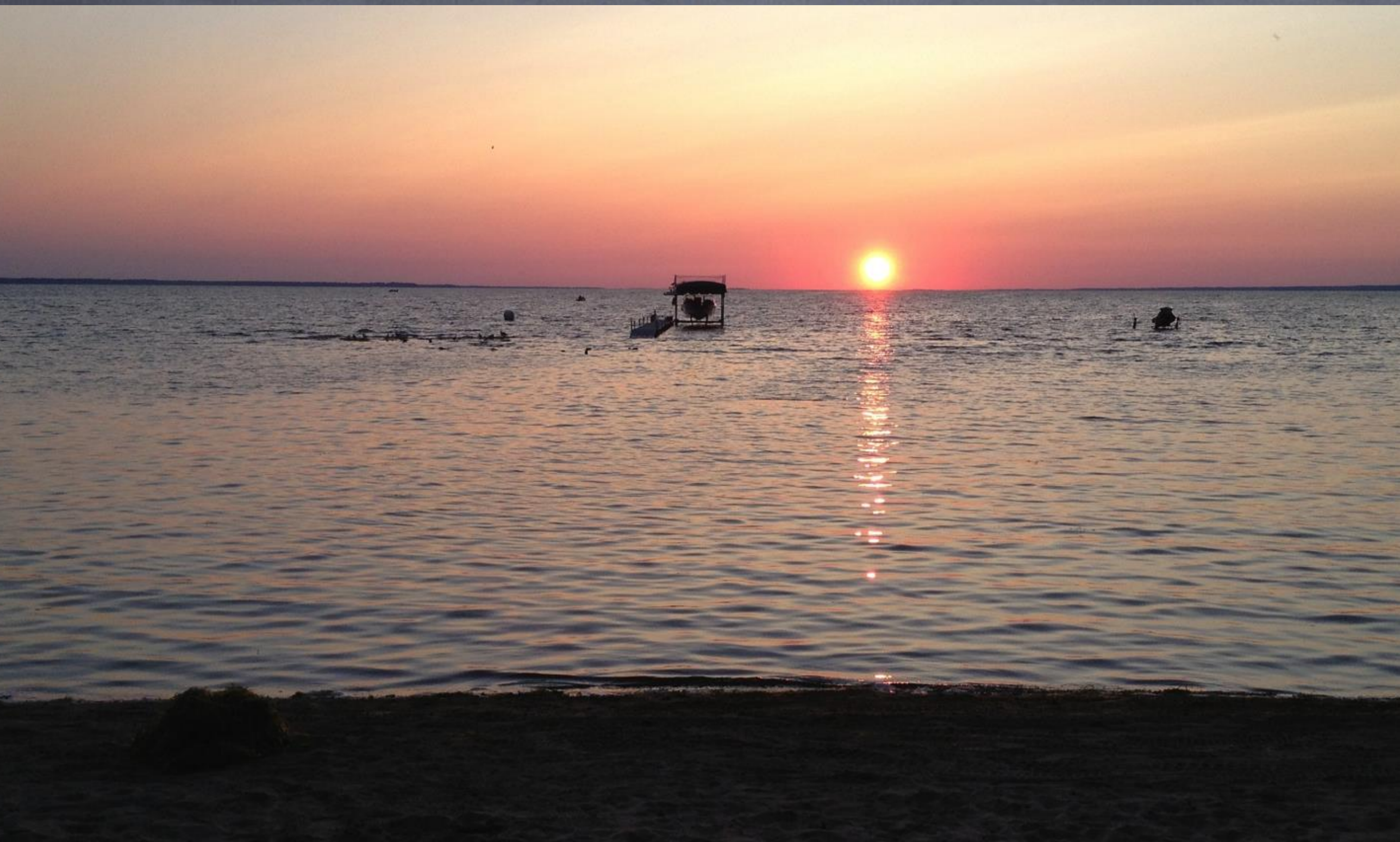
read more
Neck
Diagnosis, Subgroup Classification & Motor Control Retraining of the Neck
read more
Shoulder
Diagnosis, Subgroup Classification & Motor Control Retraining of the Shoulder Girdle
read more
Sacro-Iliac Joint
Diagnosis, Mobilisation & Functional Motor Control Retraining of the Sacro-iliac Joint and Pelvis
read more
Hip
Lower Leg
Elbow Forearm and

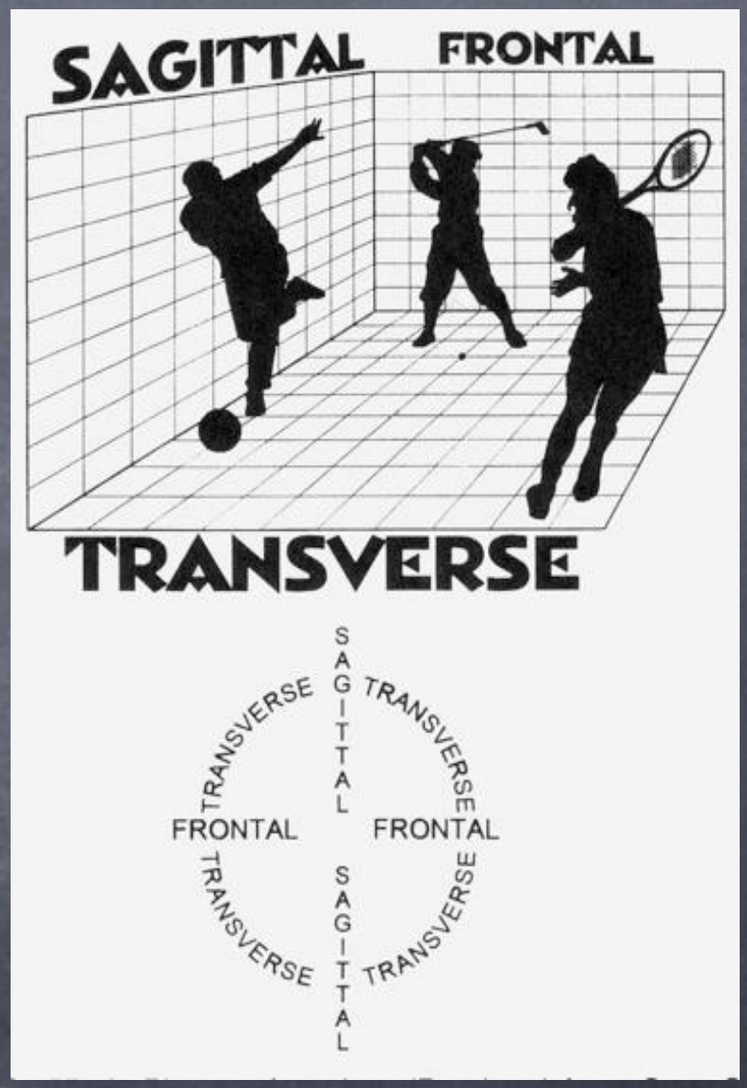
Thank You !!



“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.

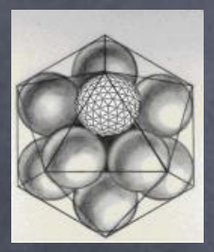


Brolinson PG, Gray G. Principle Centered Rehabilitation. Chapter 55 In: *Principles & Practice of Primary Care Sports Medicine*, edited Garrett WE, Lippincott 2001

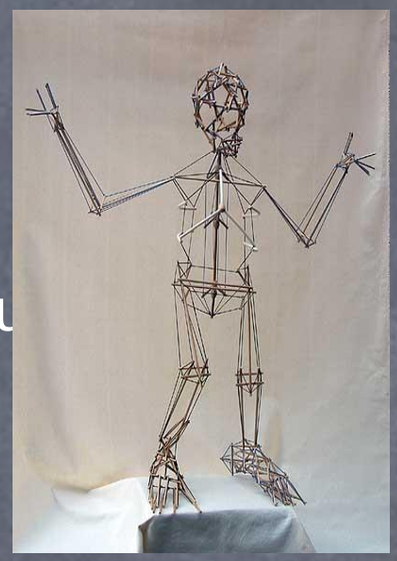
Structure / Function Reciprocity

- Has moved beyond ‘simple’ muscle and bone to:

– **BioTensegrity** (Levin)



- Macro - system integration
- Micro - Individual cellular stru
- Nuclear - Proteonomics



– **Neuromuscular Balance**

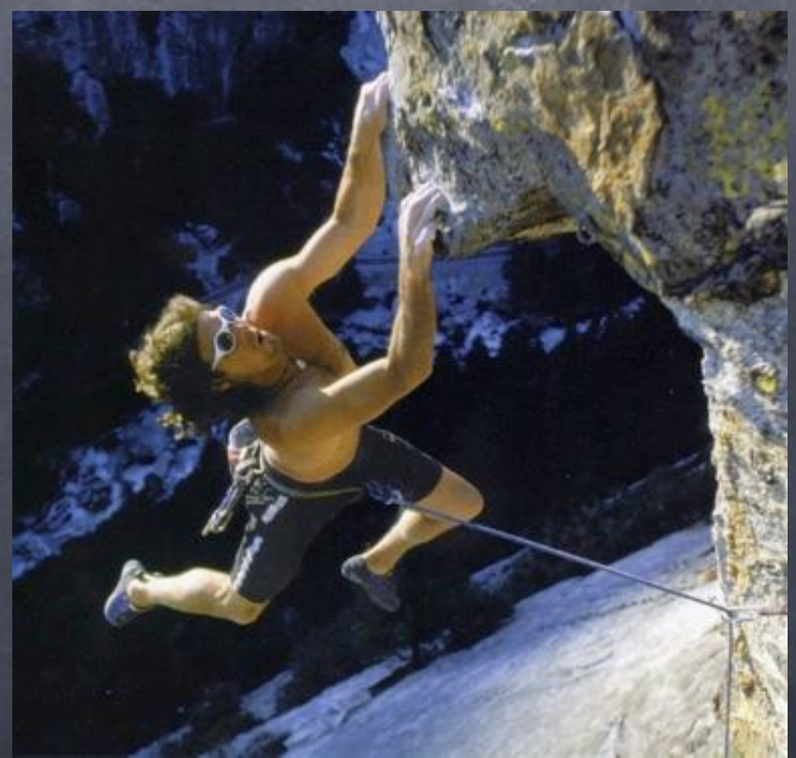
- Systemic neuromotor integration of stability
- Engrams or motor patterns

– **Real Word Muscle Function** (G Brolinson & G Gray)

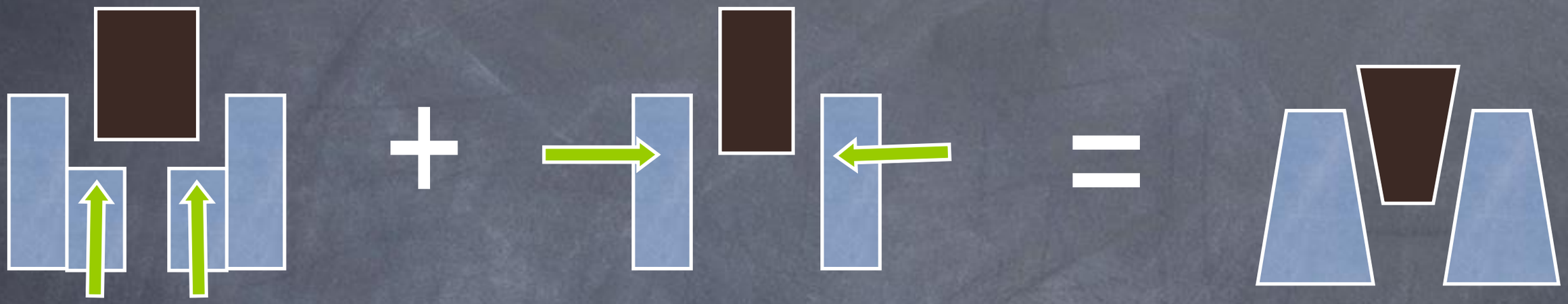
- Ecconcentric contraction
- Supination / Pronation Link (Spiral Power)

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

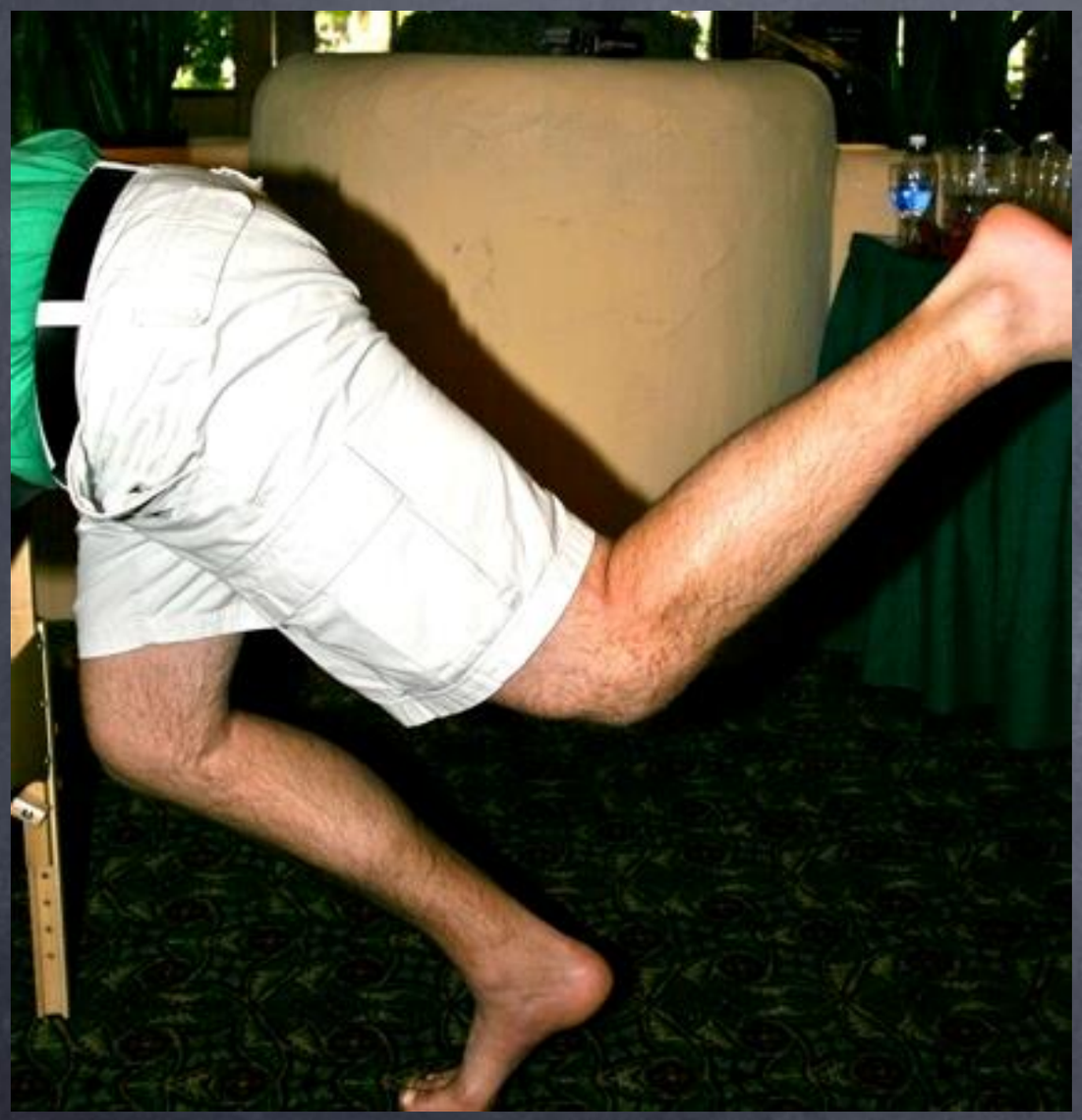
Neuromuscular Imbalance

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
  - Eccessive 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

Functional Classification LE Muscle Roles

Joint	Local Stabilizar	Global Stabilizer	Global Mobiliser
Knee	Popliteus VMO		Biceps Femoris ITB (TFL & SGM) Lateral Retinaculum Rectus Femoris Gastroc Soleus
Foot / Ankle	Intrinsics Tibialis Posterior	Tibialis Posterior (CKC) Tibialis Anterior Soleus	Peroneals Gastroc Toe flexors Toe Extensors

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

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

Symmetrical / Traditional Strength Training

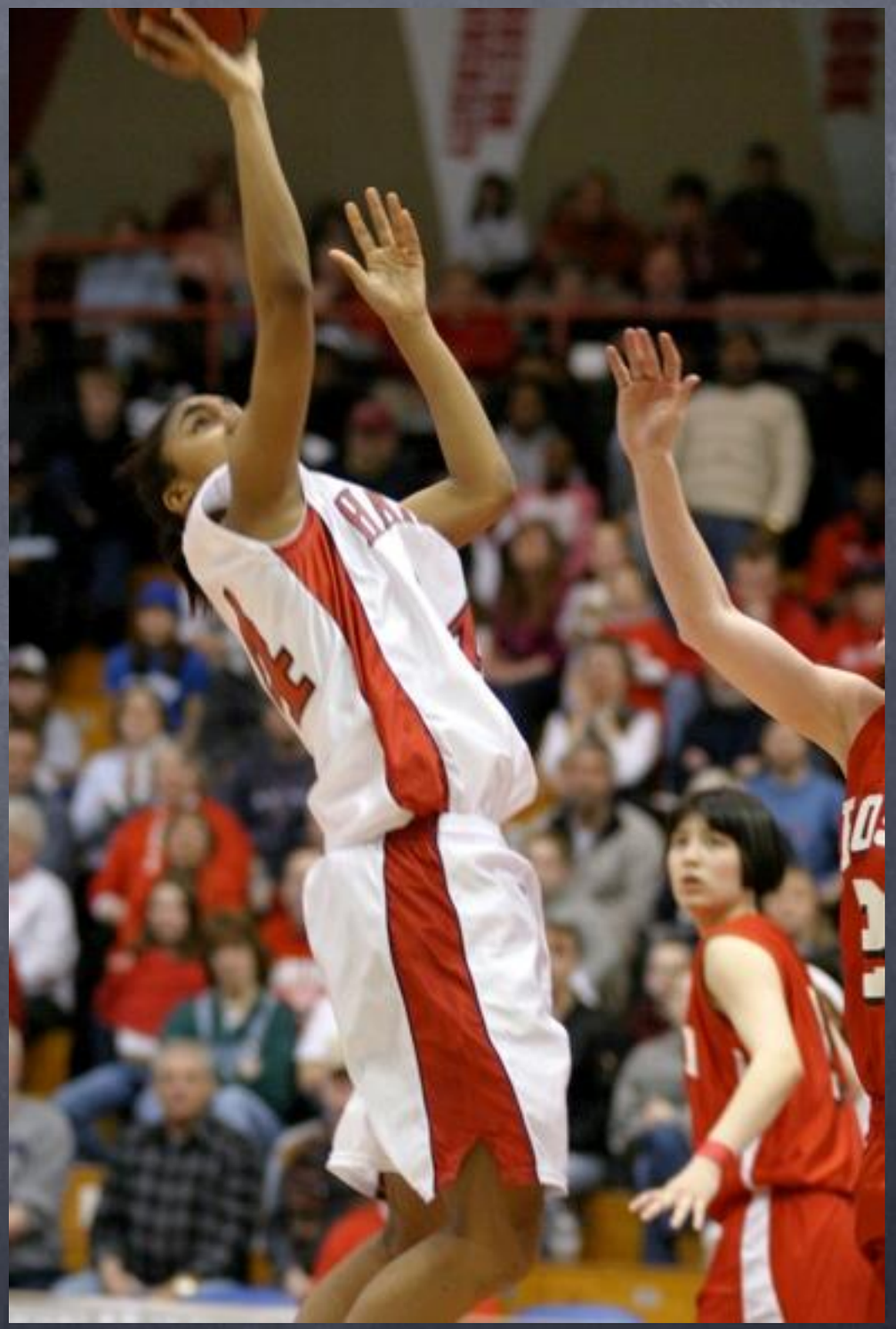
Muscle Specific: biased for global mobilisers

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

	Traditional Strengthening (Limbs)	Core Strengthening (Trunk)	Motor Control Stability (Global)	Motor Control Stability (Local)
Training Threshold	high	high	low	low
Muscle Bias	global mobilizers	global stabilizers	global stabilizers	local stabilizers
Position/Plane of Primary Loading	sagittal plane +/- coronal	neutral position +/- axial plane	neutral position +/- axial plane	neutral position
Type of Loading	isotonic (concentric) +/- isometric & isokinetic	isometric +/- isotonic (concentric)	isotonic (eccentric) & isometric	isometric

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

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: Virgina 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 Pathogensis of MSk Disorders. V Janda.
- Phil Greenman. Manual Medicine Text. Chp: Exercise Prescription.
- Richardson C, Jull G, Hides J, Hodges P (2004), Therapeutic Exercise for Spinal Stabilisation: Scientific basis and practical techniques, 2nd Edition Churchill Livingstone, London
- In Grieve's: Modern Manual Therapy: The Vertebral Column. Boling & Jull. 2004. Ch 22: Clinical Instabilty of the Lumbar Spine: Its pathology & conservative management. O'Sullivan.
- Preseedings 2nd & 3rd Internatinal 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 1997Andry 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

Brolinson PG, Gray G. Principle Centered Rehabilitation. Chapter 55 In: *Principles & Practice of Primary Care Sports Medicine*, edited Garrett WE, Lippincott 2001

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 ecconcentric 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*

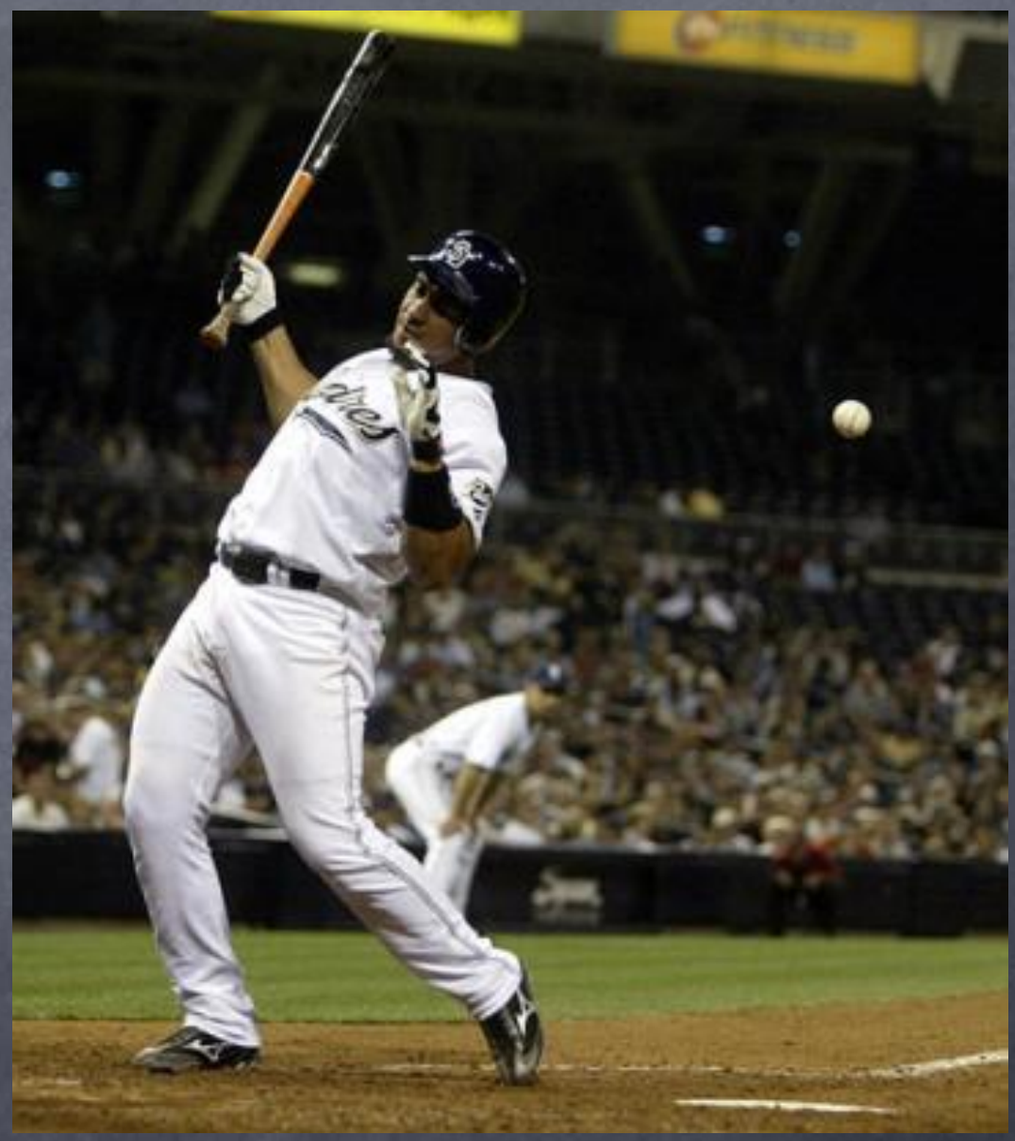
Principles of Stability Rehab

- 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*