United Virginia Chiropractic Association

Fall Convention
Reston, Virginia

Global Mechanical Assessment
Global Proprioceptive Deficits
Prevalence, Patterns, Clinical Implications and Effects on Performance

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Discovery

• “The process of seeing what others have seen before and thinking something new.”
  — Albert Einstein
It is what we think we know that keeps us from learning

Claude Bernard

Goals and Objectives
- Introduce the concept of global proprioceptive deficits
- Introduce a field test for discovery
- Introduce Reciprocal Limb Syndrome (RLS) patterns / layering / SAID
- Report pilot study prevalence findings
- Introduce clinical implications
- Propose effect on performance
- Future research
- Finish on time

Assessment Criteria
- History
- CC
- Orthopedic
- Technique
- Movement
  - Loaded / Unloaded
- Imaging
### Presumptions / Assumptions

**Medical Model**
- An intact nervous system free of frank injury or pathology performs as a neutral conduit of information for all systems.
- Performance via rehabilitation or task accomplishment in sport is a matter of skill, knowledge, training, and application.

**Chiropractic Model**
- Everyone is subluxated or has nerve interference and whatever we do via techniques removes said subluxation and nerve interference.
- Few models of assessment have a pre or post check for some level of objective outcome measures other than pain / symptom relief versus directly testing neurology.

### Neuromechanics

- **Performance Measures**
- **SPARQ Testing / FMS**

  - Feedforward: 100 ms + to 75 ms -
  - Feedback: 110+ ms –
  - Neural Plasticity
  - Cortex to MR
  - Task Specificity
  - Reach to Grip Task

### Global Proprioceptive Deficit Hypothesis

- Just as a single joint can display a non-pain driven neurological (proprioceptive) deficit the extrapolation to the kinetic chain and global movement is similar, but most research is performed with passive movement perception.
- The Global PDH engages active movement and integration principles of feedforward, feedback, and neural plasticity.
- Non-pain driven entity.
Single Joint Hypothesis – Cycle of Injuries

Lephart SM, Henry TJ 1992

- Ligamentum Injury
- Repetitive Injury
- Structural Instability
- Proprioceptive Deficit
- Functional Instability
- Decreased neuromuscular control

Panjabi’s article / implications

- Manohar M. Panjabi
- A hypothesis of chronic back pain: ligament subfailure injuries lead to muscle control dysfunction
- Eur Spine J (2006) 15: 668–676
  DOI 10.1007/s00586-005-0925-3

Efficient Performance

From Panjabi 2006

- Intact Mechanoreceptors
- Normal Transcranial Signals
- Feedback
- Neuromuscular Control Unit
- Normal Response
- Normal Muscle Response Pattern
- Coordination of individual motor activation
- No Adverse Consequences
Subfailure Injury of Ligaments in the Spine

- Injured Mechanoreceptors
  - Corrupted Transduced signal

- Nocicereptive Control Unit
  - Corrupted Responses

- Corrupted Muscle Response Pattern
  - Coordination of individual muscle activation

Chronic
- Back pain
- Tissue inflammation

Adverse
- Consequences
  - Higher muscle tone in Ligaments
  - Muscle, and Muscles
  - More fatigue
  - Higher footprints

Global Integration / Application

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Global Proprioceptive Deficit Model –

- Functional Instability
  - Adverse Consequences

- Feedback
  - Directed Muscle Response Pattern

- Distal Compensatory Effort
  - Altered Couple Patterns
  - Reciprocal Innervation Syndrome
  - Feedforward alterations
  - Functional Inefficiencies
  - Altered Movement Patterns

- Proprioceptive Deficit
  - Corrupted Signal
  - Feedback deficit
Reciprocal Inhibition Cycle  
- Subconscious  
- Preprogrammed  
- Spasm represents a short circuit  
- Critical for oscillations  
- Does not represent higher order integration – one joint model

Multiple joint system – global

Supraspinal – SSF- CPGs

Integrated movement system
Where is feedforward in this system?
How does this look in performance?
How does it look in dysfunction?
Integrated regulation

- Where is the common connection?
- How can we effect change?
- How can we test for symmetry?

RECIPROCAL LIMB RELATIONSHIP

Bates, et al. note that there is an intimate relationship of movement between the opposite lower and upper quadrants involving extremity movement as it relates to locomotion and task execution.

RECIPROCAL LIMB CONNECTIONS

- Bates, et al. neurological activation / inhibition relationship
- Myers, et al. myofascial patterns of connection from contralateral LE to UE
- Vleeming, et al. Back force transmission – facilitation of deep spinal stabilizers to superficial load transfer via thoracolumbar fascia
IMPLICATIONS

• There is a clear reciprocal relationship neurological, biomechanical, myofascial, and operational
• Any region that is symptomatic without a history of direct trauma should be evaluated for local, regional, and global performance efficiencies in all four categories

Testing for discovery - GMA

• Utilizes the relationship of the extremities to the spine
• The afferent / efferent relationship of the nervous system
• The extrapolation / integration of Panjabi with Lephart / Henry model
• Loading of CNS via long lever mechanics
• Use of FFA for muscle synergies / muscle coupling patterns
• Looking for the PD, RLS, or both

Starting Point
Reciprocal Limb Syndrome

- RLS is the manifestation of dysfunction in contralateral upper and lower extremities, which may involve neurological, biomechanical, and/or soft tissue components.

Neural, Tensegrity, Planes-Trains-Lines

Prevalence Studies - summary

- USA Rugby – assessments at Life University
- Chinese Olympic Gymnastic Team - 2002
- University of Costa Rica, School of Physical Education Symposium – 2000
- National Games Costa Rica – 2000
- LU Sport Science Institute – ACL prevalence study, Ghana – Prevalence study 2012 / 2013
- Tsinghua University, Beijing – 2013
- Range in studies 62.3 – 92 % prevalence
Clinical Implications

- Removes a component of presumptive clinical management — van Vliet PM, Heneghan NR - 2006
- Non-pain driven assessment process that engages the patient in the discovery
- Altered / corrupted feedforward mechanisms
- Delays / inhibits recovery / rehabilitation
- Susceptibility of kinetic chain — Hass CJ, et.al. 2010
- Susceptibility of ligaments — Koga H, et.al. 2010

Effect on Performance

- Over training syndrome – sudden drop in performance
- Aberrant awkwardness (dyskinesia) with cervical position Vucetic (2008)
- Chronic injury patterns that do not seem to resolve with cutting edge rehabilitation strategies
- Non-contact ligament failure

PFLM™ goal

- Optimum / Ideal
- Asymptomatic / accommodation
- Symptomatic
Future studies

- Intra-rater reliability
- Inter-rater reliability
- Specificity
- Reproducibility
- Impact on CAI studies
- Impact on injury susceptibility studies
- Impact on RPE = Borg Scale
- Impact on VO2 max

References

- Panjabi MM. A hypothesis of chronic back pain ligament instability injuries lead to muscle control dysfunction. *Eur Spine J* 15:668-676, 2006

Articles to Consider

- The Effect of Sacroiliac Joint Manipulation on Feed Forward Activation Times of the Deep Abdominal Musculature, Marshall, Murphy, *J Manipulative Physiol Ther* Vol 29, Number 3, 2006
- Deep and Superficial Fibers of the Lumbar Multifidus Muscles are Differentially Active During Voluntary Arm Movements, Moseley, et.al., *Spine* Vol 27 Number 2, 2002
Yup even More


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Keep climbing!

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Keep smiling!