UPPER AND LOWER CROSSED SYNDROME: FIXING THE SLOUCH FOR BETTER HEALTH

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Objectives

- By the end of this lecture, attendees will be able to:
  - Understand the mechanism by which the development of muscle imbalance occurs and the consequences of it.
  - Describe the patterns of muscle imbalance present in both upper and lower crossed syndrome.
  - Describe the associated joint dysfunctions and pain syndromes that develop as a result of the muscle imbalances present in upper and lower crossed syndrome.
  - Identify abnormal muscle firing patterns present in upper and lower crossed syndrome.
  - Identify a treatment plan for patients with upper and lower crossed syndrome.
Vladimir Janda M.D.

- Combined therapy and medicine in a hands on approach; one of the earliest to practice physical medicine and rehabilitation.
- Published more than 16 books and 200 papers.
- Emphasized that the sensorimotor system, composed of sensory system and motor system, could not be functionally divided. He emphasized the importance of proper proprioception.

Paradigm Shift in Musculoskeletal Medicine

- Structural

- Functional
Muscle Function

- **Intrinsic:**
  - Physiological
  - Biomechanical
  - Neuromuscular
- **Extrinsic:**
  - Made up of specific, purposeful and synergistic movements that integrate the three intrinsic systems.
- **Interdependent:**
  - Three views of intrinsic function are not dependent of one another but interdependent upon one another.

Muscle Balance

- Relative equality of muscle length or strength between an agonist and an antagonist; **this balance is necessary for normal movement and function.**
- Necessary because of reciprocal nature of human movement (opposing muscle groups must coordinate).
- **Muscle Imbalance:**
  - **Functional**
  - **Pathologic:**
    - When muscle imbalance **impairs function.**
    - Joint dysfunction and altered movement which results in pain.
    - Joint injury may either lead to muscle imbalance or be the result of muscle imbalance.
Muscle Imbalance Paradigms

- Biomechanical:
  - Repetitive movement and posture.
  - Joint motion is altered when a particular synergist becomes dominant at the expense of the other synergist.
  - Abnormal stresses on joints.
  - Treatment: Shortening the longer muscles and strengthening the weaker muscles.

- Neurological:
  - Muscles are predisposed to become imbalanced because of their role in motor function.
  - Certain muscles are prone towards tightness or shortness and others prone towards inhibition.
  - Natural reflexes present for balance and function.
  - Tonic vs. Phasic Muscles.

Muscle Imbalance

- Muscle Tightness:
  - Key factor in muscle imbalance.
  - Three important factors:
    - Muscle Length
    - Irritability Threshold
    - Altered Recruitment

- Muscle Weakness:
  - Neuroflexive factors for increased tension:
    - Reciprocal Inhibition: Inhibited by tight antagonist.
    - Arthrogenic Weakness: inhibited by painful joint (swollen/dysfunctional).
    - Deafferentation: Decrease in afferent input from damaged receptors (joint mechanoreceptors).
    - Pseudoparesis: Clinical presentation from a neuroreflexive origin.
    - Fatigue: neurologic or metabolic.
Sensorimotor System

- Sensory Receptors (mechanoreceptors, muscular receptors and exteroceptors):
  - Integrate feedback and feed-forward mechanisms (balance and walking)
  - Muscle tone (muscle spindle and golgi tendon organ).
- Proprioception:
  - Sole of the feet
  - Sacroiliac joint
  - Cervical spine
- Central Processing:
  - Spinal Level: Fast, involuntary and unconscious.
  - Subcortical Level: Intermediate, automatic and subconscious.
  - Cortical Level: Slowest, greatest control and conscious
- Motor:
  - Alpha: Voluntary motor commands.
  - Gamma: Unconscious muscle length.
  - Facilitation vs. Inhibition.

Proprioception

- Sensory system is **KEY** to proper motor function.
- Leads to recurrent/chronic sprain, microinstability or chronic subluxation (chronic pain ankle, shoulder, knee, back and neck)
- Reduced proprioceptive input from atrophied muscles results in chronic pain and poor postural stability.
- **Compensatory movements for pain or dysfunction eventually become ingrained in the motor cortex, essentially reprogramming normal movement patterns.**
- Global vs. Local:
  - Global compensatory changes muscle firing patterns and local compensatory changes the biomechanics around a specific joint.
Chain Reactions

- Interactions between the skeletal system, muscular system and CNS.
- Dysfunction of any joint or muscle in the body is reflected in the quality and function of the others, not just locally but globally.

- Classifications:
  - Articular
  - Muscular
  - Neurological

Chain Reactions

- Articular:
  - Postural Chains: The position of one joint in relation to another when the body is in an upright position.
    - **Structural**: Positioning of skeletal structures directly influences adjacent structures (cogwheel chain mechanism). Pelvis, vertebral column and rib cage.
    - **Functional**: Postural position of **keystone structures** contribute to pathology. Keystone structures include skeletal structures that serve as attachment points for groups of postural muscles (pelvis, ribs and scapula). 17 muscles originate or insert on the scapula- influencing shoulder girdle and spine.
Chain Reactions

Muscular:
- Synergistic:
  - Works with another muscle (agonist/antagonist) to produce movement and stabilize a joint (ex. Shoulder RTC and scapula stabilizers).
- Slings:
- Extremity:
  - Flexors and Extensors.
  - Gait Cycle.
  - Reciprocal Gait.
- Trunk: Facilitated reciprocal gait patterns between upper and lower extremity and rotation trunk stabilization.
  - Anterior
  - Spiral
  - Posterior

Synergistic:
Myofascial chains: Fascia serves as vital link between multiple muscles acting together for movement. Connection between extremities and trunk.
- Abdominal Fascia
- Thoracolumbar Fascia

Neurological:
- Protective Reflexes (basis for all human movement patterns):
  - Cross extensor and withdrawal reflexes.
  - Locomotion, prehension, mastication and breathing.
- Sensorimotor Chains:
  - Reflexive Stabilization:
    - Functional neurological chain reaction.
    - Muscle contract to provide stability both locally and globally (i.e. anterior weight shift activates posterior dorsal muscles and vice versa).
  - Pelvic Chain: Transverse abdominus, multifidus, diaphragm and pelvic floor.
- Sensorimotor Adaptation Chains:
  - Horizontal (anatomic) Adaptation: Impaired function in one joint or muscle creates a reaction and adaptation in other joint segments (i.e. low back pain resulting in neck pain).
  - Vertical (neurological) Adaptation: Occurs between CNS and PNS. Seen as a change in motor programming that is then reflected in abnormal movement patterns (i.e. ankle instability and altered gait).
- Neurodevelopmental Locomotor Patterns:
  - Tonic Muscle System: prone towards tightness.
  - Phasic Muscle System: prone towards weakness.
  - Work together synchronously through coactivation for posture, gait and coordinated movement
Muscle Imbalance (UCS and LCS)

<table>
<thead>
<tr>
<th>Tonic system muscles prone to tightness</th>
<th>Phasic system muscles prone to weakness</th>
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</thead>
<tbody>
<tr>
<td><strong>UPPER QUARTER</strong></td>
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<tr>
<td>Suboccipitals</td>
<td>Middle and lower trapezius</td>
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<tr>
<td>Pectoralis (major and minor)</td>
<td>Rhomboids</td>
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<tr>
<td>Upper trapezius</td>
<td>Serratus anterior</td>
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<tr>
<td>Levator scapula</td>
<td>Deep cervical flexors (longus capitis)</td>
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<tr>
<td>SCM</td>
<td>Scalenus*</td>
</tr>
<tr>
<td>Scalenus*</td>
<td>Upper-extremity extensors and respirators</td>
</tr>
<tr>
<td>Latissimus dorsi</td>
<td>Dysgynes</td>
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<tr>
<td>Upper-extremity flexors and pronators</td>
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<tr>
<td>Musculi</td>
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<tr>
<td><strong>LOWER QUARTER</strong></td>
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<tr>
<td>Quadratus lumborum</td>
<td>Rectus abdominis</td>
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<tr>
<td>Thoracolumbar paraspinales</td>
<td>TrA</td>
</tr>
<tr>
<td>Piriormis</td>
<td>Gluteus maximus</td>
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<tr>
<td>Illipsoas</td>
<td>Gluteus medius, minimus</td>
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<tr>
<td>Rectus femoris</td>
<td>Vastus medialis, lateralis</td>
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<tr>
<td>TFL/T-band</td>
<td>Tibialis anterior</td>
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<tr>
<td>Hamstrings</td>
<td>Peroneus</td>
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<tr>
<td>Short hip adductors</td>
<td></td>
</tr>
<tr>
<td>Triceps surae (particularly soleus)</td>
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<tr>
<td>Tibialis posterior</td>
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</tbody>
</table>

*The scalenes may be tight or weak.

Upper Crossed Syndrome

- Proximal or Shoulder Girdle Crossed Syndrome.
- Somatic Dysfunctions:
  - OA
  - C4-C5
  - C7-T1
  - Glenohumeral joint
  - T4-T5

Upper Crossed Syndrome

<table>
<thead>
<tr>
<th>Muscles Prone to Tightness</th>
<th>Muscles Prone to Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suboccipitals</td>
<td>Cervical flexors</td>
</tr>
<tr>
<td>Upper Trapezius</td>
<td>Rhomboids</td>
</tr>
<tr>
<td>Levator Scapula</td>
<td>Lower Trapezius</td>
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<tr>
<td>Pectoralis Major</td>
<td></td>
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<tr>
<td>Pectoralis Minor</td>
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</table>
Lower Crossed Syndrome

- Distal or Pelvic Crossed Syndrome.
- Somatic Dysfunctions:
  - L4-L5
  - L5-S1
  - SI joint
  - Hip joint

Layer Syndrome

- Combination of UCS and LCS.
- Older Adults.
- Unsuccessful Spinal Surgery.
- Poor Prognosis
Musculoskeletal Pain

- **Centralization:**
  - Patients with chronic MSK pain in fibromyalgia and low back pain exhibit altered pain processing throughout the body.

- **Painful Stimuli:**
  - Inhibitory effect on muscle activation.

- **Pain adaptation Model:**
  - Decrease in EMG activity of the agonist and increase in EMG activity of the antagonist muscle. In addition, there is decreased in strength, range, and velocity of movement.

**Figure 4.1** The chronic musculoskeletal pain cycle presented from a neurological perspective.

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**Why?**

Americans sit 8-10 hours a day.
Pain Syndromes

- Cranium:
  - Temporomandibular Disorders (SCM/Masseter; increased forward head posture).
  - Tension headaches.
- Cervical:
  - C5-C6 (Osteophytes on x-ray).
  - Neck pain from trapezius and levator scapula hypertonicity.
- Upper Extremity:
  - Shoulder Instability (elevated and protracted).
  - Impingement/RTC tendinosis
  - Thoracic Outlet Syndrome
  - Dorsal Scapular Nerve Impingement

Shoulder

- Instability and Impingement:
  - Stability:
    - Rotator Cuff
    - Joint Capsule (proprioceptive fibers)
  - Trapezius:
    - Lower Trapezius Inhibited= loss of deltoid length-tension relationship and overuse of RTC muscles.
  - Scapula:
    - Scapular Rotator Force Coupling:
      - Upper Trapezius, Lower Trapezius, Rhomboids and Serratus.
      - Pseudoparesis of Lower Trapezius and Rhomboid= scapular elevation and downward tilt=increased impingement.
  - Chain Reaction:
    - 50% of total force in overhead throwing comes from the legs and trunk.
    - Elevation of right shoulder→ contralateral erector spinae and lower extremity.
Pain Syndromes

- Lumbar:
  - Low Back Pain
  - SI Joint Dysfunction
    - Gluteus maximus and contralateral erector spinae (stabilizers).
    - Gluteus muscles are inhibited with SI joint dysfunction with spasm of iliacus, piriformis, and QL (Pelvic shift).

- Lower Extremity:
  - Groin pain and injury (abdominal weakness)
  - Hamstring Strain
  - ITB Syndrome (increase in demand to stabilize/hip abductor weakness).
  - Patellofemoral Pains Syndrome (AKP)- vasti and hip weakness.
  - Knee OA.
  - Ankle Sprains and Plantar Fasciitis.
  - Fibromyalgia/Myofascial Pain Syndromes
Trapezius Trigger Points

Pectoralis Trigger Points
Levator and Periscapular Trigger Points

- Functional movement is never isolated; requires several muscles acting as prime movers, synergists or stabilizers.

6 Basic Movement Patterns:
- Hip Extension
- Hip Abduction
- Curl-up
- Cervical Flexion
- Push-up
- Shoulder Abduction
Movement Patterns

- **Hip Extension:**
  - Hamstring, gluteus maximus, contralateral erector spinae and ipsilateral erector spinae.
  - Delayed/absent gluteus maximus or anterior pelvic tilt with hyperlordosis are a positive test.

- **Hip Abduction (20 degrees):**
  - Pelvis stabilizers during gait.
  - Gluteus medius, gluteus minimus and TFL are prime movers; QL and abdominal muscles are stabilizers.
  - Hip flexion (not pure abduction) indicates TFL tightness.
  - QL initiates hip abduction with gluteus weakness.

- **Trunk Curl-up:**
  - During trunk curl up the upper trunk should round, lower back flattens and the pelvis tilts posteriorly.
  - Hip flexor motion will be associated with little to no curling of upper trunk and anterior pelvic tilt.
  - Early loss of pressure under heels is another sign.

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**Table 6.1 Key Indicators for Janda’s Movement Tests**

<table>
<thead>
<tr>
<th>Movement Test</th>
<th>Key Indicators</th>
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<tbody>
<tr>
<td>Hip extension</td>
<td>Decreased gluteus maximus bulk&lt;br&gt;Increased hamstring bulk&lt;br&gt;Obstruction of spinal horizontal grooves or creases&lt;br&gt;Anterior pelvic tilt&lt;br&gt;Increased or asymmetrical paraspinal bulk&lt;br&gt;Decreased trailing limb posture at terminal stance during gait</td>
</tr>
<tr>
<td>Hip abduction</td>
<td>Lateral shift or rotation of pelvis&lt;br&gt;Asymmetrical height of iliac crest&lt;br&gt;Observation of adductor notch&lt;br&gt;Adducted hip or varus position&lt;br&gt;Increased lateral IT groove&lt;br&gt;Positive result on single-leg stance test&lt;br&gt;Trunk flexion sign or increased lateral pelvic shift during loading response during gait</td>
</tr>
<tr>
<td>Trunk curl-up</td>
<td>Decreased abdominal tone&lt;br&gt;Lateral grooves in abdominal wall&lt;br&gt;Impaired respiration&lt;br&gt;Pneumothorax</td>
</tr>
<tr>
<td>Cervical flexion</td>
<td>Prominence of sternocleidomastoid at mid-to-distal insertion&lt;br&gt;Forward head posture&lt;br&gt;Increased angle (&gt;90°) between chin and neck&lt;br&gt;Impaired respiration</td>
</tr>
<tr>
<td>Push-up</td>
<td>Forward head with protracted shoulders&lt;br&gt;Increased internal rotation of arms&lt;br&gt;Neck that faces out superiorly and laterally (in males)&lt;br&gt;Scapula winging, tipping</td>
</tr>
<tr>
<td>Shoulder abduction</td>
<td>Forward head with protracted shoulders&lt;br&gt;Glochic shoulder&lt;br&gt;Levator notch&lt;br&gt;Scapula winging, tipping</td>
</tr>
</tbody>
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## Muscle Firing Patterns

### Hip Extension Monitoring

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hamstring</td>
<td>Caudal Middle Finger</td>
</tr>
<tr>
<td>2. Gluteus Maximus</td>
<td>Caudal Thumb</td>
</tr>
<tr>
<td>3. Contralateral QL</td>
<td>Cephalad Middle Finger</td>
</tr>
<tr>
<td>4. Ipsilateral QL</td>
<td>Cephalad Thumb</td>
</tr>
<tr>
<td>5. Contralateral E. Spinae</td>
<td></td>
</tr>
<tr>
<td>6. Ipsilateral E. Spinae</td>
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### Muscle Firing Patterns

### Hip Abduction Monitoring

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. TFL</td>
<td>Caudal Thumb</td>
</tr>
<tr>
<td>2. Gluteus Medius</td>
<td>Caudal Middle Finger</td>
</tr>
<tr>
<td>3. QL</td>
<td>Cephalad Thumb</td>
</tr>
<tr>
<td>4. Erector Spinae</td>
<td>Cephalad Middle Finger</td>
</tr>
<tr>
<td>5. Contralateral E. Spinae</td>
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</tr>
</tbody>
</table>
Movement Patterns

- **Cervical Flexion:**
  - Primary deep flexors are longus capitis, longus colli, and rectus capitis anterior.
  - SCM and anterior scalene are superficial flexors.
  - Compensation by SCM and scalene will result in the chin or jaw jutting forward (OA extension) during cervical spine flexion.

- **Push-up:**
  - Force coupling between trapezius and serratus anterior necessary for scapula stabilization.
  - Excessive scapular elevation, tipping, winging, adduction or abduction.

- **Shoulder Abduction:**
  - Deltoid, rotator cuff, upper trapezius and levator scapula.
  - Elevation of shoulder girdle before 60 degrees of abduction is a positive test.
  - Contralateral side-bending of trunk to initiate abduction.

Treatment Approaches

- **Ergonomics**
  - Change habit that is causing or facilitating dysfunction.

- **Somatic Dysfunction/OSE:**
  - OA
  - C4-C5
  - C7-T1
  - Glenohumeral joint
  - T4-T5
  - L4-L5
  - L5-S1
  - SI joint
  - Hip joint

- **Strengthening and stretching:**
  - Joint Mobilization (ROM exercises vs. Soft Collar)
  - Stretch and lengthen tight muscles while simultaneously strengthening weak muscles.

- **Proprioception/Sensorimotor system:**
  - CNS involved in muscle imbalance.
  - Proprioceptive changes further facilitate dysfunction.
Upper Crossed Syndrome

- Balance lower trapezius/rhomboids and pectoralis minor:

Stretching

- Iliopsoas
- Rectus Femoris
- Hamstrings
- Piriformis
- Adductors
- Gastroc-soleus complex

Strengthening

- Gluteus Medius, Minimus and Maximus
- Rectus Abdominis
Gluteus Medius

Gluteus Maximus
Abdominal Muscle
(Sit Backs)
### References

- Hoppenfeld, S. *Physical Examination Spine and Extremities*. Prentice Hall.
- [http://www.physio-pedia.com/Lower_crossed_syndrome](http://www.physio-pedia.com/Lower_crossed_syndrome)