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.
- Defined crossed syndromes in 1979.
- 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 muscle 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.

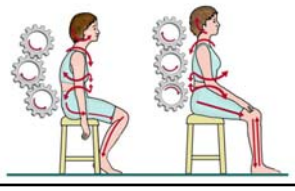
Chain Reactions

- 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.

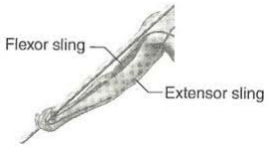
- Classifications:
  - Articular
  - Muscular
  - Neurological

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**:
    - **Global movement** across multiple joints. Produce functional movement.
    - **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
  - **Myofascial chains**: Fascia serves as **vital link** between multiple muscles acting together for movement. Connection between extremities and trunk.
    - **Abdominal Fascia**
    - **Thoracolumbar Fascia**

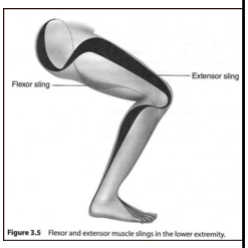


Figure 3.5 Flexor and extensor muscle slings in the lower extremity.

Chain Reactions

- **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)

Tonic system muscles *prone to tightness*	Phasic system muscles *prone to weakness*
UPPER QUARTER	
Suboccipitals Pectorals (major and minor) Upper trapezius Levator scaplua SCM Scalenes* Latissimus dorsi Upper-extremity flexors and pronators Masticators	Middle and lower trapezius Rhomboids Serratus anterior Deep cervical flexors (longus colli and capitis) Scalenes* Upper-extremity extensors and supinators Digastricus
LOWER QUARTER	
Quadratus lumborum Thoracolumbar paraspinals Piriformis Iliopsoas Rectus femoris TFL-IT band Hamstrings Short hip adductors Triceps surae (particularly soleus) Tibialis posterior	Rectus abdominis TrA Gluteus maximus Gluteus medius, minimus Vastus medialis, lateralis Tibialis anterior Peroneals

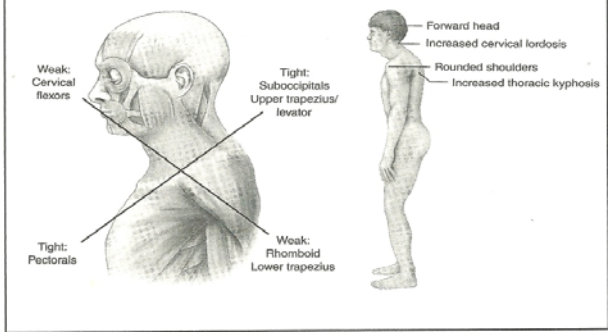
*The scalenes may be tight or weak.

Upper Crossed Syndrome

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

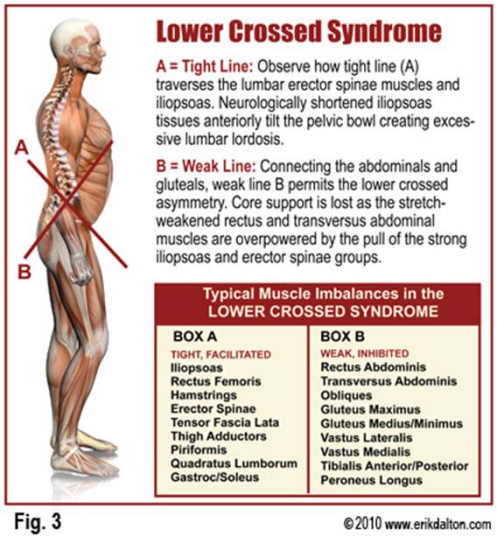
Upper Crossed Syndrome

Muscles Prone to Tightness	Muscles Prone to Weakness
Suboccipitals Upper Trapezius Levator Scapula Pectoralis Major Pectoralis Minor	Cervical Flexors Rhomboids Lower Trapezius



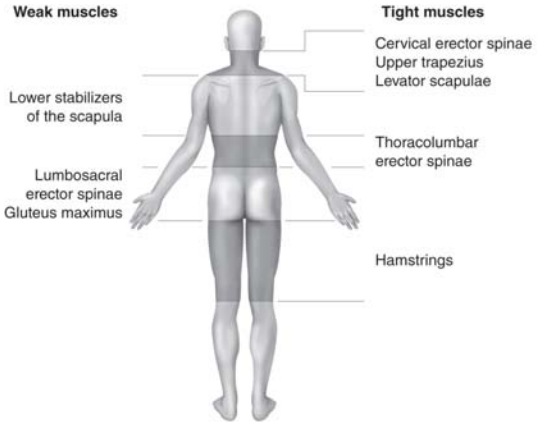
Lower Crossed Syndrome

- 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



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Musculoskeletal Pain

- **Centralization**:
  - Patients with chronic MSK pain in fibromyalgia and low back pain exhibit altered pain processing through out 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.

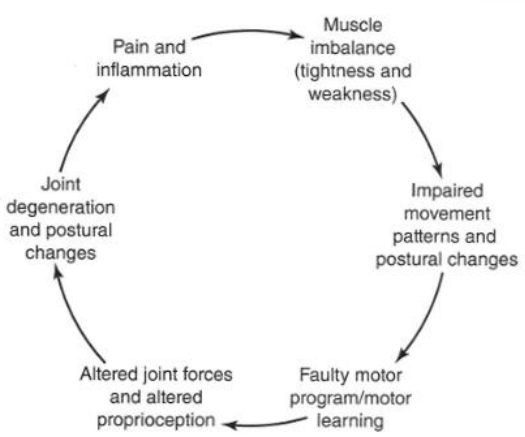


Figure 4.1 The chronic musculoskeletal pain cycle presented from a neurological perspective.

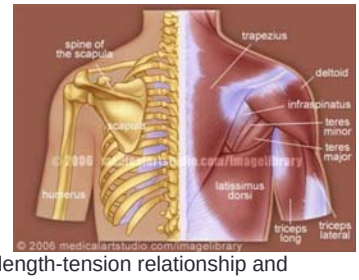
Why?

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

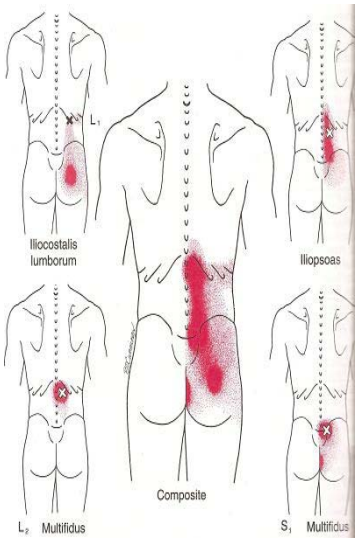
Shoulder

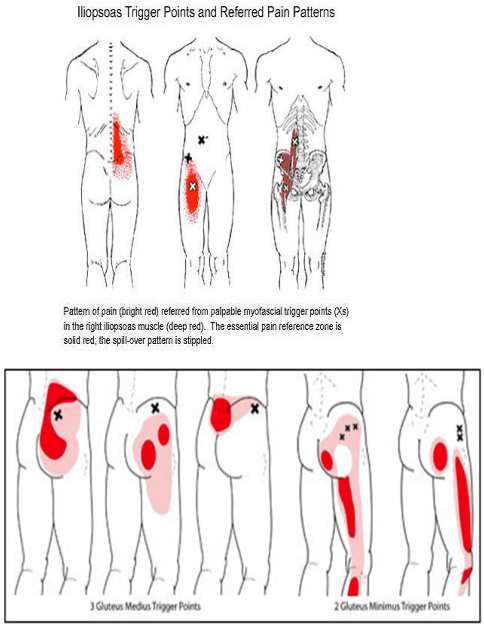


- Instability and Impingement:
  - Stability:
    - Rotator Cuff
    - Joint Capsule (proprioceptive fibers)
    - Trapezius:
      - Lower Trapezius Inhibited= loss of deltoid length-tension relationship and overuse of RTC muscles.
    - Scapula:
      - Scapular Rotator Force Coupling:
        - Upper 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.

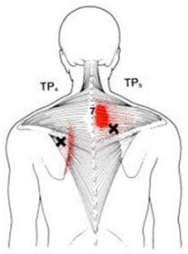
Pain Syndromes

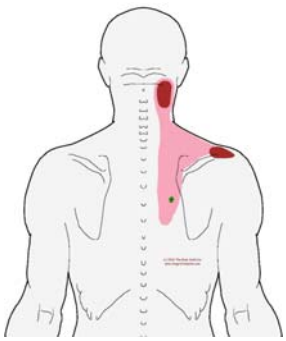
- Lumbar:
  - Low Back Pain
  - SI Joint Dysfunction
    - Gluteus maximus and contralateral erector spinae (stabilizers).
    - Gluteus muscles are inhibited with SI joint dysfunction with spasm of iliacus, piriformis, and QL (Pelvic shift).
- Lower Extremity:
  - Groin pain and injury (abdominal weakness)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

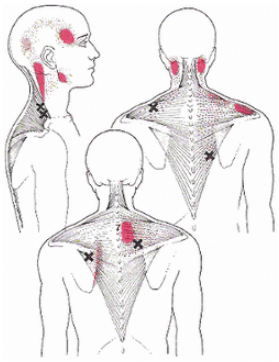


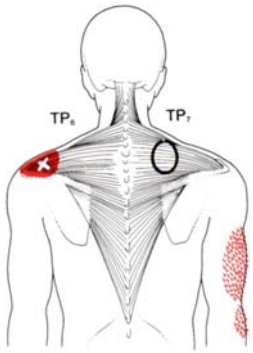


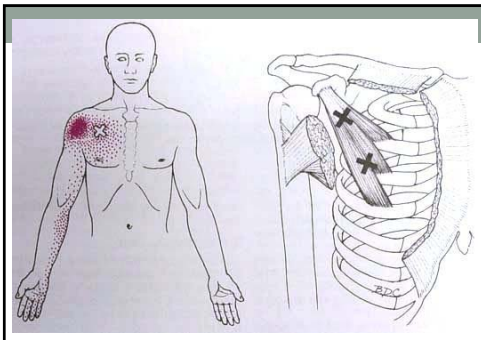
Trapezius Trigger Points

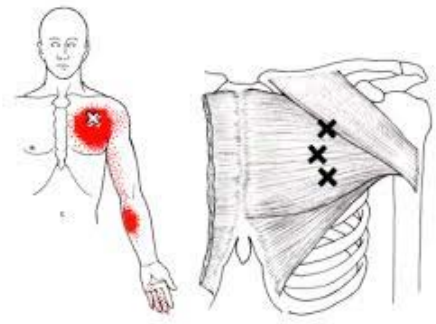


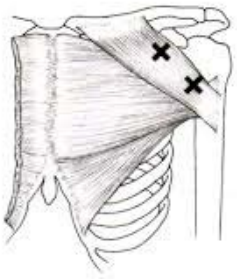






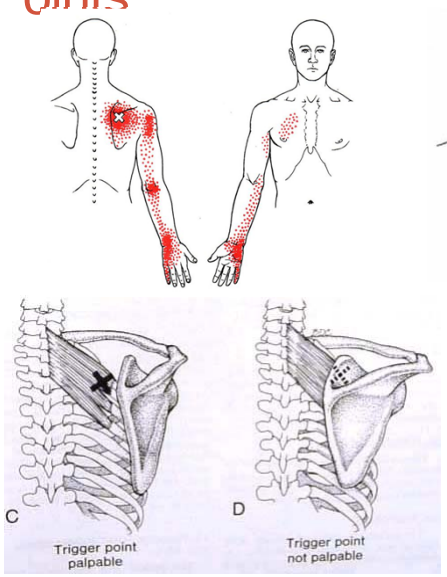


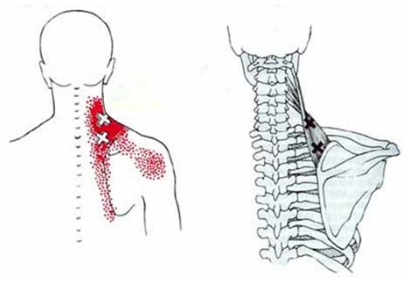


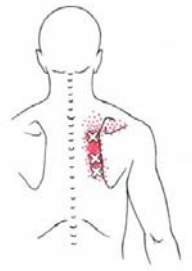


Pectoralis Trigger Points

Levator and Periscapular Trigger Points







Movement Patterns

- 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

Table 6.1 Key Indicators for Janda's Movement Tests

Movement test	Key indicators
Hip extension	Decreased gluteus maximus bulk Increased hamstring bulk Observation of spinal horizontal grooves or creases Anterior pelvic tilt Increased or asymmetrical paraspinal bulk Decreased trailing limb posture at terminal stance during gait
Hip abduction	Lateral shift or rotation of pelvis Asymmetrical height of iliac crest Observation of adductor notch Adducted hips or varus position Increased lateral IT groove Positive result on single-leg stance test Trendelenburg sign or increased lateral pelvic shift during loading response during gait
Trunk curl-up	Decreased abdominal tone Lateral grooves in abdominal wall Impaired respiration Pseudohernia
Cervical flexion	Prominence of sternocleidomastoid at mid- to distal insertion Forward head posture Increased angle (>90°) between chin and neck Impaired respiration
Push-up	Forward head with protracted shoulders Increased internal rotation of arms Nipples that face out superiorly and laterally (in males) Scapula winging, tipping
Shoulder abduction	Forward head with protracted shoulders Gothic shoulder Levator notch Scapular winging, tipping

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.

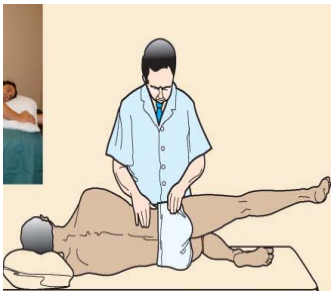
Figure 6.3 Curl-up test. (a) Start. (b) Finish.

Muscle Firing Patterns

Hip Extension	Monitoring
1. Hamstring	Caudal Middle Finger
2. Gluteus Maximus	Caudal Thumb
3. Contralateral QL	Cephalad Middle Finger
4. Ipsilateral QL	Cephalad Thumb
5. Contralateral E. Spinae	
6. Ipsilateral E. Spinae	


Muscle Firing Patterns

Hip Abduction	Monitoring
1. TFL	Caudal Thumb
2. Gluteus Medius	Caudal Middle Finger
3. QL	Cephalad Thumb
4. Erector Spinae	Cephalad Middle Finger
5. Contralateral E. Spinae	



Movement Patterns

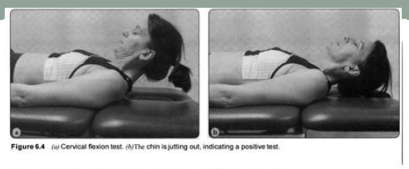


Figure 6.4 (a) Cervical flexion test. (b) The chin is jutting out, indicating a positive test.

Figure 6.4 (a) Cervical flexion test. (b) The chin is jutting out, indicating a positive test.

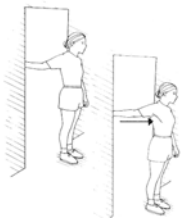
- Cervical Flexion:
  - Primary deep flexors are longus capitis, longus colli and rectus capitis anterior.
  - SCM and anterior scalene are superficial flexors.
  - Compensation by SCM and scalene will result in the chin or jaw jutting forward (OA extension) during cervical spine flexion.
- Push-up: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

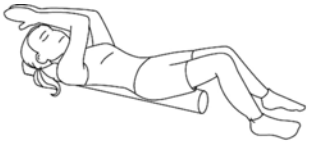
Treatment Approaches

- 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:





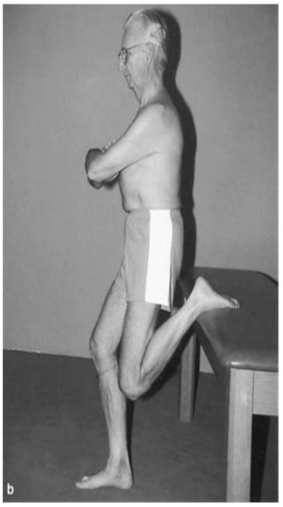
Stretching

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

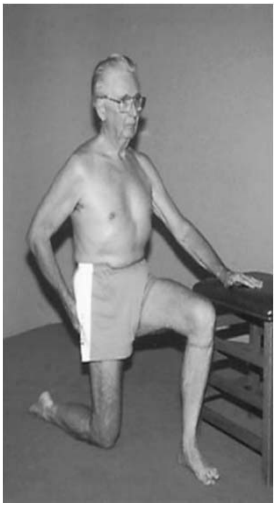
Strengthening

- Gluteus Medius, Minimus and Maximus
- Rectus Abdominis

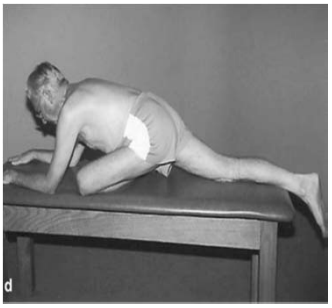
Rectus Femoris



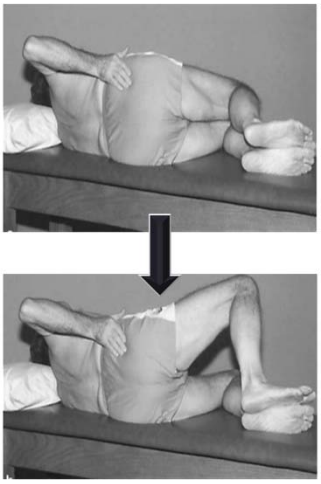
Psoas



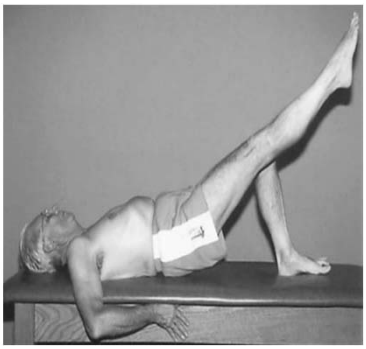
Piriformis



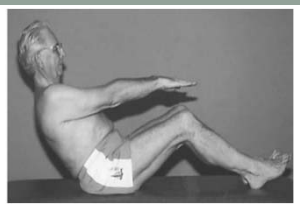
Gluteus Medius

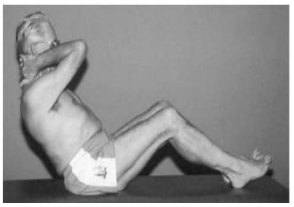


Gluteus Maximus



Abdominal Muscle
(Sit Backs)





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