Assessing Posture
Paul Taylor & Oliver Scott

What is Posture?
- Position of the body, or relative alignment of body parts; in particular the musculo-skeletal system; but has an effect on every system of the body
- COG over base of support
- Posture should fulfill 3 functions (Martin, 2002):
  - Maintain the alignment of body segments in all positions; standing, sitting, quadruped, prone & supine
  - Anticipate change to facilitate engagement in goal-directed movements such as reaching & stepping
  - React to unexpected disturbances in balance
- Not just a static state – it is important during movement and has an impact on balance
  - Sitting
  - Standing
  - Moving

What is Posture?
- Understanding the principles of posture → better exercise prescription
- Optimal posture → body requires minimal energy to maintain its position and movement is more efficient
- We use multiple sensing references
  - Visual
  - Somatosensory
  - Vestibular
- Neural component cannot be understated
  - Basis of motor control
- Connective tissue is active in posture
  - Fascia & Ligaments

Good And Poor Posture
- Good posture is the state of muscular and skeletal balance that protects the supporting structures of the body against injury or progressive deformity irrespective of the attitude (eg erect, lying, squatting, stooping) in which these structures are working
- Poor posture is a faulty relationship of the various parts of the body, which produces increased strain on the supporting structures and in which there is less efficient balance over its base of support
- Posture Committee of the American Academy of Orthopaedic Surgeons

Implications of Poor Posture
- Impaired movement
  - Body will compensate if one or more segment/s of the kinetic chain is not in proper alignment
  - Repeated movements and sustained postures associated with daily work and recreation activities are the main culprit (Sahrmann, 2002)
    - Computer analyst / office worker
    - Supermarket checkout assistant
    - Golfer / Soccer player
  - Inappropriate exercise prescription can exacerbate faulty movement patterns
  - Pattern overload – machine VS free weights
- Pain
  - In poor posture, the postural muscles are more active, with greater energy expended
  - Muscle ischaemia – the level of contraction of a muscle is inversely proportional to blood flow through it: at 50-60% peak contraction, blood flow is almost zero (Sjogaard, 1988)
  - Can lead to pain, dysfunction and breakdown in numerous systems of the body (compensatory effects)
Importance of Posture

- Forward head posture:
  - Average head weighs around 7% of BW
  - Activity of neck extensors increase dramatically
  - Leads to reflex muscle contraction & trigger points
  - For every inch the COG of the head moves forward, lower cervical spine is subjected to compressive forces equivalent to an additional single head weight (Zohn, 1988)
  - Chronic pain develops

Muscle imbalance

- Traditional viewpoint:
  - Occurs when a muscle shortens and its antagonist is stretched and lengthens
  - Both disadvantaged biomechanically
  - Length-tension relationship not optimal
  - Can displace the bones where they attach
  - Kinetic chain response

Muscle Fibre Types & Actions

- Fibre type
  - Fast-twitch: for powerful, gross movements
  - Slow-twitch: low-level endurance activities (posture)
- Tonic, phasic and mixed musculature
  - Tonic: resist gravity, so are strongly involved in posture. Slow-twitch dominant and react to faulty loading by shortening
  - Phasic: main function is movement. Predominantly fast-twitch and react to faulty loading by lengthening
  - Mixed: majority of muscles are mixed. React to faulty loading by either shortening or lengthening
- Muscle imbalance is identified where there is a lack of balance between tonic and phasic muscles (Spring et al, 1991)

Implications of Muscle Shortening

- Pseudoparesis (Janda, 1986):
  - Tight or overactive muscles may hinder or inhibit the opposing muscle (antagonist)
  - Reciprocal inhibition
  - The hypertonic muscles become active in movements they are not normally associated with
  - Tonic muscles are innervated by smaller type 2 motor neuron
  - Lower excitability threshold than phasic muscles
  - Can inhibit antagonist
  - Direct affect on movement patterns, range of motion and posture

Implications of Muscle Lengthening

- Stretch weakness (Kendall et al, 1993):
  - Result of altered length-tension relationship
  - Reduced contractile force as actin and myosin filaments are pulled apart
- Increase in Serial Sarcomere Number
  - Stretched muscle adds more sarcomeres in an attempt to move actin & myosin filaments closer together (Norris, 2000)

Muscle Classifications

<table>
<thead>
<tr>
<th>Shoulder Girdle</th>
<th>Predominantly Tonic (shortening)</th>
<th>Predominantly Phasic (lengthening)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pectoralis major</td>
<td>Rhomboids</td>
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<tr>
<td>Levator scapulae</td>
<td>Lower trapezius</td>
<td></td>
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<tr>
<td>Upper trapezius</td>
<td>Mid trapezius</td>
<td></td>
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<tr>
<td>Biceps brachii</td>
<td>Triceps brachii</td>
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<tr>
<td>Neck extensors</td>
<td>Neck flexors</td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th>Trunk</th>
<th>Thoracic extensors</th>
<th>Abdominals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar &amp; cervical erectors</td>
<td></td>
<td></td>
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<tr>
<td>Quadratus lumborum</td>
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</tr>
</tbody>
</table>

Adapted from Spring et al, 1991
Muscle Classifications

<table>
<thead>
<tr>
<th>Pelvic Girdle</th>
<th>Predominantly Tonic (shortening)</th>
<th>Predominantly Phasic (lengthening)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biceps femoris</td>
<td>Semitendinosus</td>
<td>Vastus medialis</td>
</tr>
<tr>
<td>Semimembranosus</td>
<td>Gluteus maximus</td>
<td>Vastus Lateralis</td>
</tr>
<tr>
<td>Sartorius</td>
<td>Gluteus minimus</td>
<td>Adductors</td>
</tr>
<tr>
<td>Rectus femoris</td>
<td>Gluteus medius</td>
<td>Periformis</td>
</tr>
<tr>
<td>Iliopsoas</td>
<td></td>
<td>TFL</td>
</tr>
<tr>
<td>Adductors</td>
<td></td>
<td></td>
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<tr>
<td>Piriformis</td>
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<tr>
<td>TFL</td>
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<td>Vastus medialis</td>
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<tr>
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</tr>
<tr>
<td>Gluteus minimus</td>
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<td></td>
</tr>
<tr>
<td>Gluteus medius</td>
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<td></td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>Tibialis anterior</td>
<td></td>
</tr>
<tr>
<td>Soleus</td>
<td>Peroneals</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Spring et al, 1991

Tensegrity

- Spine not stabilised by compression forces alone
- Vertebral bodies do not bear all forces transmitted to the spine
- Neural arch assists in transmitting force
- Spinal erectors form guide-wires for stabilising spine
- Help resists flexion & reduce forces on vertebral body & discs
- Spinous & transverse processes provide framework for guide-wires
- Pain & forces can refer throughout kinetic chain
- Beauty & complexity of Human design
- Need to view dysfunction globally

Development of the Muscle and Fascia

- Myofibril
  - Endomysium
- Fibre bundle
  - Perimysium
- Muscle
  - Epimysium

Correcting Faulty Posture

- Consider main myofascial line(s) involved
  - Tonic/phasic components within a line
- Other lines that assist/oppose to achieve balance
- Stimulate NS & blood flow – mobilisers
- Myofascial release – foam roller or therapist
- Facilitate - mobilisers
- Effective movement – exercises

Postural Assessments

- Static
  - Useful in identifying overt abnormalities
  - Critical for effective exercise prescription
- Dynamic
  - ‘3 big rocks’
  - Targeted movement screens
  - Intervention flow chart

Static Postural Assessment

- Assessment of posture in "relaxed" position
- Begin with a general observation to get an idea of global alignment
  - Head / Cervical Spine
  - Shoulder / thoracic spine / scapulae / arms
  - Lumbar spine / pelvis
  - Knees
  - Ankles & feet
- Observe client’s posture sequentially: inferior to superior or vice versa
- Observe from anterior, posterior & lateral viewpoints
- Move focus to specific screening points
Muscle Imbalances
- PT Academy view:
  - Take a global look
  - Tonic & phasic still has relevance
  - View as part of myofascial line disturbance
  - Prolonged sitting

Postural Screening – Back View
- Weight shift
- Ankle alignment
- Relative knee alignment
  - Varus/valgus
  - PSIS levels
  - Oblique folds
  - Gluteal folds
  - Spinal alignment
  - Scapulae
    - Flat against upper back
    - Shoulder height
    - Head carriage

Static Postural Assessment – Anterior View
- Feet & ankle
- Relative knee position
- Pelvis - Iliac crest height
- ASIS
- Shoulder height – level?
  - Hand position
- Head carriage
  - Laterally flexed / rotated?
  - Weight shift?
  - Nose & umbilicus

Scoliosis
- Structural & functional
- Compensatory lateral displacement of spinal column
- Often notice imbalances in tone/mass of spinal erectors
- Beyond scope of PT - Refer!

Lateral View
- Slightly anterior to ankle bone
- Leg vertical and at right angle to sole of foot
- Through or slightly anterior to centre of knee
  - Knees neither flexed or hyperextended
- Through or slightly posterior to hip bone
- Pelvis - neutral position, not tilted
  - Hips - neither flexed or extended
- Through the shoulder
  - Thoracic Spine - slightly convex posteriorly
  - Lumbar Spine - slightly convex anteriorly
- Through lobe of the ear
  - Head not tilted forward or back

Anterior Pelvic Tilt
- Short/tight erector spinae?
- Short/tight quadratus lumborum?
- Short/tight ilioopsoas?
- Short/tight rectus femoris?
- Long/weak hamstrings and gluteus maximus?
- The interactions are complicated
  - Kinetic chain!!
Posterior Pelvic Tilt
- Short/tight rectus abdominus?
- Short/tight external obliques?
- Short/tight gluteus maximus?
- Short/tight hamstrings?
- Long/weak hip flexors?

Upper & Lower Crossed Back Posture
- Head: Forward, cervical spine hyper-extended
- Short upper traps & SCM
- Long neck flexors
- Thoracic Spine: kyphosis
- Long mid traps & rhomboids
- Short pecs & lats
- Pelvis: Anterior tilt
- Short erector spinae
- Long abdominals
- Short hip flexors
- Long hamstrings & gluteus maximus
- Knee Joints: Hyperextended
- Ankle Joints: slightly plantar flexed
- Short plantar flexors

Lower Crossed (Lumbar Lordosis) – Pertinent Myofascial Lines
- DFL
- SBL
- SFL

Lordosis – Management Plan
- Foam Roller
  - ITB Adductors
  - Calves

- Mobilisers
  - Sag hip mobiliser
  - Tri-plane adductor
  - Anterior knee driver

- Basic Exercises
  - Cable rev woodchop
  - Squat w/ diagonal cable row
  - Alt arm bent knee shoulder press w/ hip driver

- Advanced Exercises
  - 2-arm DB uppercut
  - High cable sagittal jacks
  - Rev step DB scaption (extra load)

Upper Crossed (Thoracic Kyphosis) – Pertinent Myofascial Lines
- SFAL
- DFAL
- SFL
- DBAL

Kyphosis – Management Plan
- Foam Roller
  - Thoracic Lats

- Mobilisers
  - Incline crawl
  - Segmented gait with lateral reach
  - Tri-plane shoulder press w/ hip driver

- Basic Exercises
  - Reverse step scaption
  - TTWL
  - T-push-up

- Advanced Exercises
  - 1-arm hip extension swings
  - 1-leg backhander
  - Multi-directional punching
Flat Back Posture
- Head: Forward, cervical spine slightly extended
- Short upper traps & SCM
- Long neck flexors
- Thoracic Spine: Upper part increased flexion, lower part straight
- Long mid traps & rhomboids
- Short pecs & lats
- Straight (flexed) Lumbar Spine & Posterior tilt of pelvis, with hip extended
- Long erector spinae
- Short abdominals
- Long hip flexors (iliopsoas)
- Short hamstrings (& gluteus maximus)
- Knee Joints: Extended (or flexed)
- Ankle Joints: Slightly plantar flexed
- Short plantar flexors

Sway Back Posture
- Head: Forward, cervical spine slightly extended
- Short upper traps & SCM
- Long & weak neck flexors
- Thoracic Spine: Increased flexion (long kyphosis with posterior displacement of upper trunk)
- Long mid traps & rhomboids
- Short pecs, lats
- Short upper abdominals
- Lumbar Spine: Flattening of lower lumbar spine
- Strong (but not short) erector spinae
- Long lower abdominals & obliques
- Pelvis: Posterior tilt with hip extended & forward
- Long & weak ilioptsoas
- Short & tight hamstrings (& gluteus maximus)
- Knee Joints: Hyperextended
- Ankle Joints: Neutral Position (pelvis deviation) or plantar flexed
- Short plantar flexors??

Flat Back – Pertinent Myofascial Lines
- DFL
- SBL

Sway Back – Pertinent Myofascial Lines
- SBL
- SFAL
- DBAL
- DFL

Flat Back – Management Plan

<table>
<thead>
<tr>
<th>Foam Roller</th>
<th>Hamstrings Lower leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobilisers</td>
<td>Prone dynamic knee drive</td>
</tr>
<tr>
<td></td>
<td>Rev woodchop w/ forward/reverse step</td>
</tr>
<tr>
<td></td>
<td>Functional chest mobiliser</td>
</tr>
<tr>
<td>Basic Exercises</td>
<td>2-arm cable row with knee driver</td>
</tr>
<tr>
<td></td>
<td>Cable lawn mower</td>
</tr>
<tr>
<td></td>
<td>Reverse step dumbell scaption</td>
</tr>
<tr>
<td>Advanced Exercises</td>
<td>2-D uppercut</td>
</tr>
<tr>
<td></td>
<td>Cable trunk rotation w/ knee driver</td>
</tr>
<tr>
<td></td>
<td>Barbell kayak</td>
</tr>
</tbody>
</table>

Pronation
- SBL
- Spiral
- Lateral
- DFL
### Pronation Distortion – Management Plan

<table>
<thead>
<tr>
<th>Foam Roller</th>
<th>Medial calf / Glutes / Adductors / ITB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobilisers</td>
<td>Hip swings / Pigeon-toed walking / Forward/rev step w/foot adaptors</td>
</tr>
<tr>
<td>Basic Exercises</td>
<td>Dynamic squat w/ toe-in / Cable toe-in step / Alt arm bent-knee shoulder press w/ knee driver</td>
</tr>
<tr>
<td>Advanced Exercises</td>
<td>Bent-over leg swings / Cable x-over posterior toe-in step / 2-arm cable ward w/ frontal bound</td>
</tr>
</tbody>
</table>

### Winging Scapula – Management Plan

<table>
<thead>
<tr>
<th>Foam Roller</th>
<th>Thoracic serratus pulse / Thoracic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobilisers</td>
<td>Multi-planar wall scap mobiliser / Squat diagonal reach w/ foot adaptors / Wall fixed arm step around</td>
</tr>
<tr>
<td>Basic Exercises</td>
<td>Reverse step scaption / T-push up / YTWL</td>
</tr>
<tr>
<td>Advanced Exercises</td>
<td>Barbell kayak / Low cable pull w/ DB press / Multi-directional punching</td>
</tr>
</tbody>
</table>

### Summary
- Know your limits
- Refer where appropriate
- Do good, do no harm
- Remember the Kinetic Chain
- Compensations
- Augment with movement screen
- Observation, observation, observation

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### Dynamic Postural Assessments

**Michel Dalcourt**

- **THE ANKLE (TALOCRURAL) COMPLEX**
- **ILIO-FEMORAL (HIP) JOINT**
- **THORACIC SPINE**
**THE ANKLE (TALOCRURAL) JOINT**

- Made up of:
  - Tibiotalar Joint
  - Fibulotalar Joint
  - Tibiofibular Joint

**THE ANKLE (TALOCRURAL) JOINT**

- Normal Motions available:
  - 20° Inversion
  - 10° Eversion
  - 20° Dorsiflexion
  - 50° Plantarflexion
  - 19° Rotation

**THE Ilio-Femoral (Hip) JOINT**

- Normal Motions available:
  - 110 - 120° Flexion
  - 10 - 15° Extension
  - 30 - 50° Abduction
  - 30° Adduction
  - 30 - 40° Internal Rotation
  - 40 - 60° External Rotation

**THE Ilio-Femoral (Hip) JOINT**

- Normal Motions available:
  - 110 - 120° Flexion
  - 10 - 15° Extension
  - 30 - 50° Abduction
  - 30° Adduction
  - 30 - 40° Internal Rotation
  - 40 - 60° External Rotation

**THE THORACIC SPINE**

- Normal Motions available:
  - 30 - 40° Flexion
  - 20 - 30° Extension
  - 20 - 25° Lateral Flexion (from neutral)
  - 35° Rotation (from neutral)

**Movement Assessments – Video Links**

- **Assessment 1 – Ankle complex**
- **Assessment 2 – Hip complex**
- **Assessment 3 – Thoracic spine complex**
Movement Screen Examples

- Mobilisers linked to the previous Movement Screen
- Movement Screen Re-testing

More Movement Screen Examples

- Initial Movement Screen
- Latissimus Dorsi Foam Roller linked to Movement Screen
- Thorax Foam Roller linked to Movement Screen
- Mobilisers linked to Movement Screen and Re-test