Hands-on Mechanical Assessment Tool (MAT) Introduction

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Objectives:

- Identify the systematic approach to MAT evaluations
- Increase confidence to complete hands-on assessments of clients by identifying:
  - Common postural abnormalities
  - Boney landmarks and their positions of symmetry
  - Joint range of motion and corresponding wheelchair seat system angles
- Explore interventions to support a variety of muscle tone presentations in wheelchair seating.
- Discuss simple wheelchair and seating adjustments to improve functional outcomes.
- Learn about complimentary assessment tools available to enhance your understanding of the wheelchair users' postural changes throughout the day.

Evidence Based Practice

Why do MAT evaluations?

- To gain a deeper understanding of why the wheelchair user sits the way they do, to understand their full potential to participate in physical tasks, and to complete the client profile of biomechanical assessment and physical examination.
- Only then can we truly develop client-centered goals with meaningful pathways of interventions. It can't be all about the equipment!
- It leads us on a journey of history about current and previous equipment, postural changes, skin integrity, and pressure care management. It is the catalyst that helps us to dig deeper into sitting balance, functioning from the wheelchair, and 24-hour postural management.

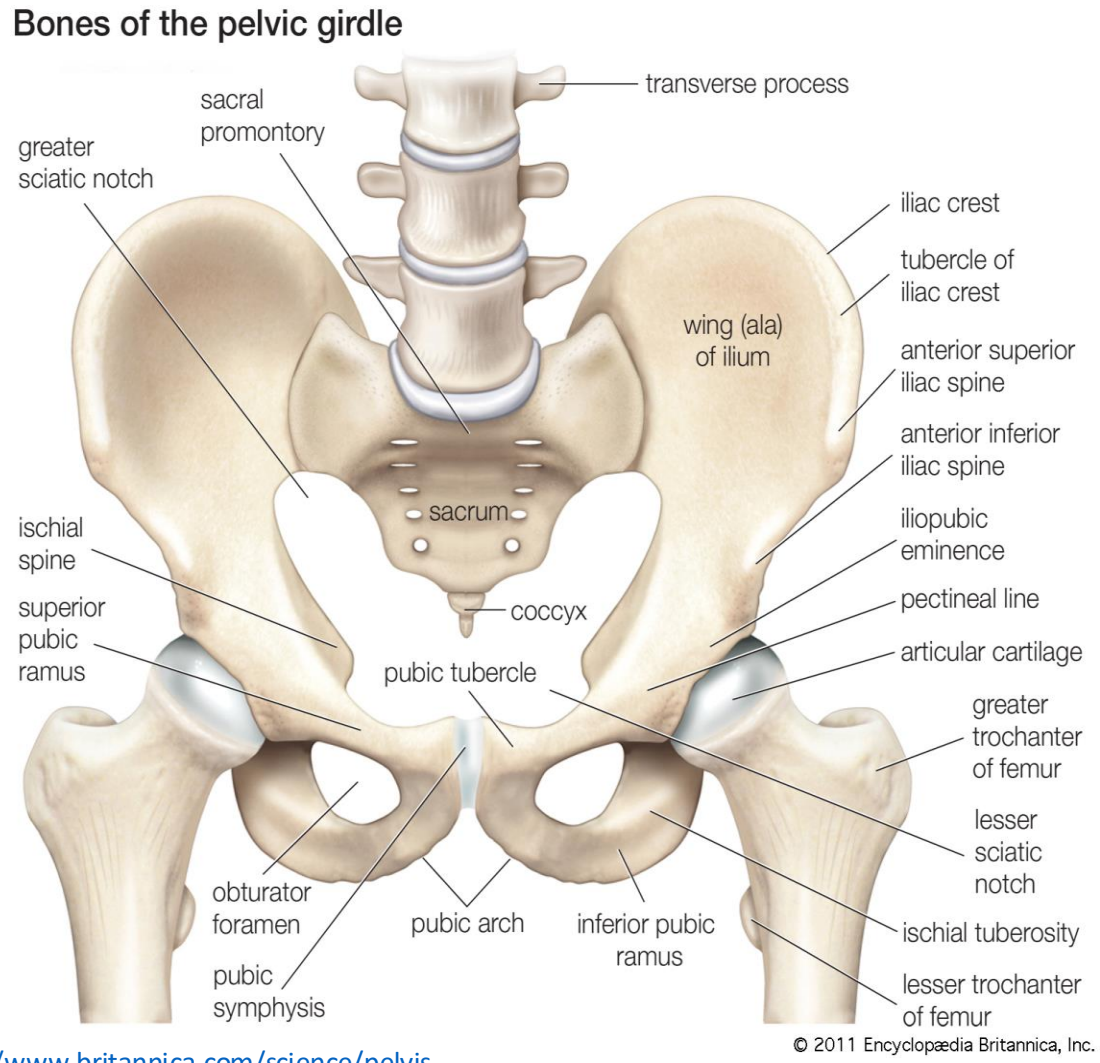
When to do MAT evaluations?

- As therapists, we should be asking “Why am I not doing a full MAT assessment on this client?”
- It may be because your client is:
  - Currently ambulating
  - Able to sit on the side of a plinth or bench with no balance problems
  - Reporting and demonstrating full sensation and the ability to move if uncomfortable and report pain
  - Able to actively complete a set of hip and spine ROM activities
  - Physical assessment can occur through observation and analysis of activities of daily living

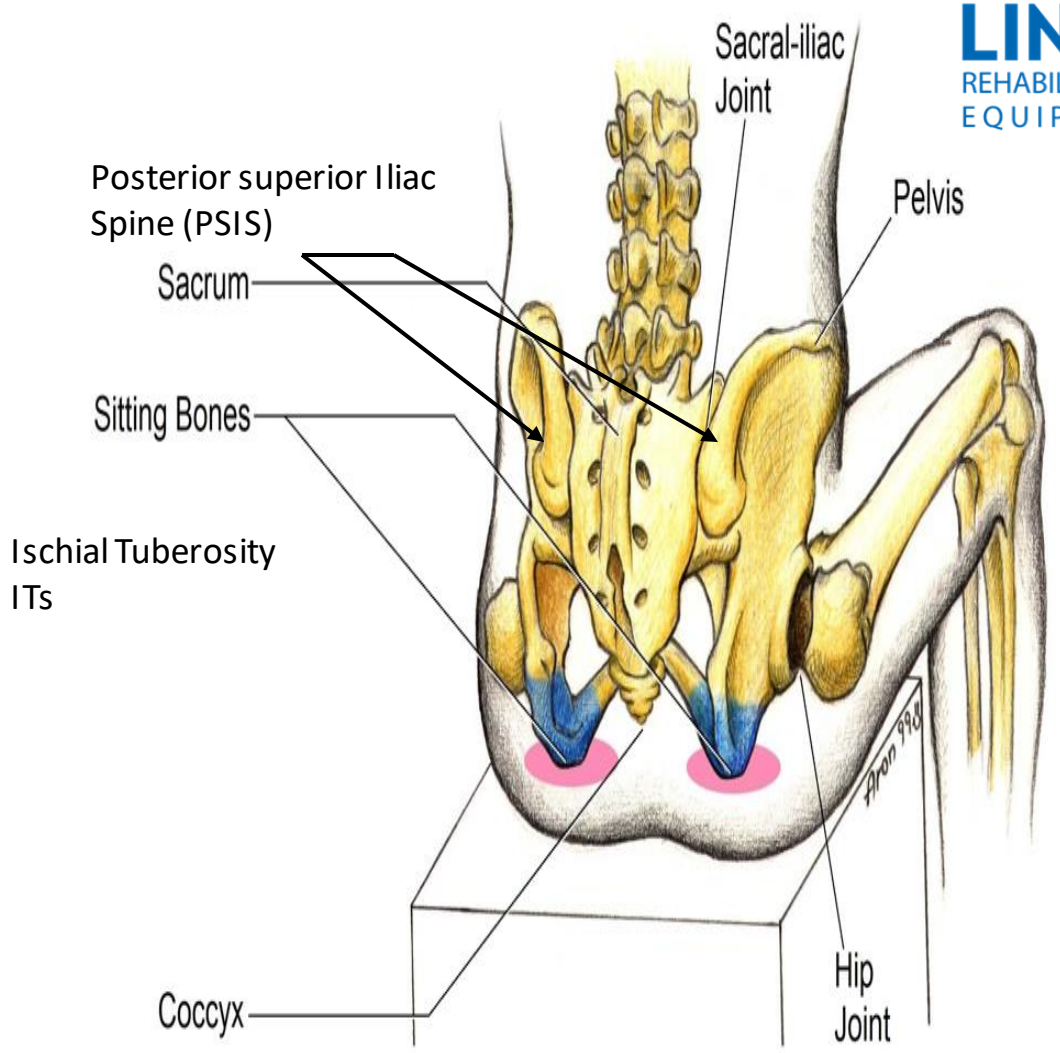
- As a “rule of thumb” map everyone's pelvis

Get to know the base of support

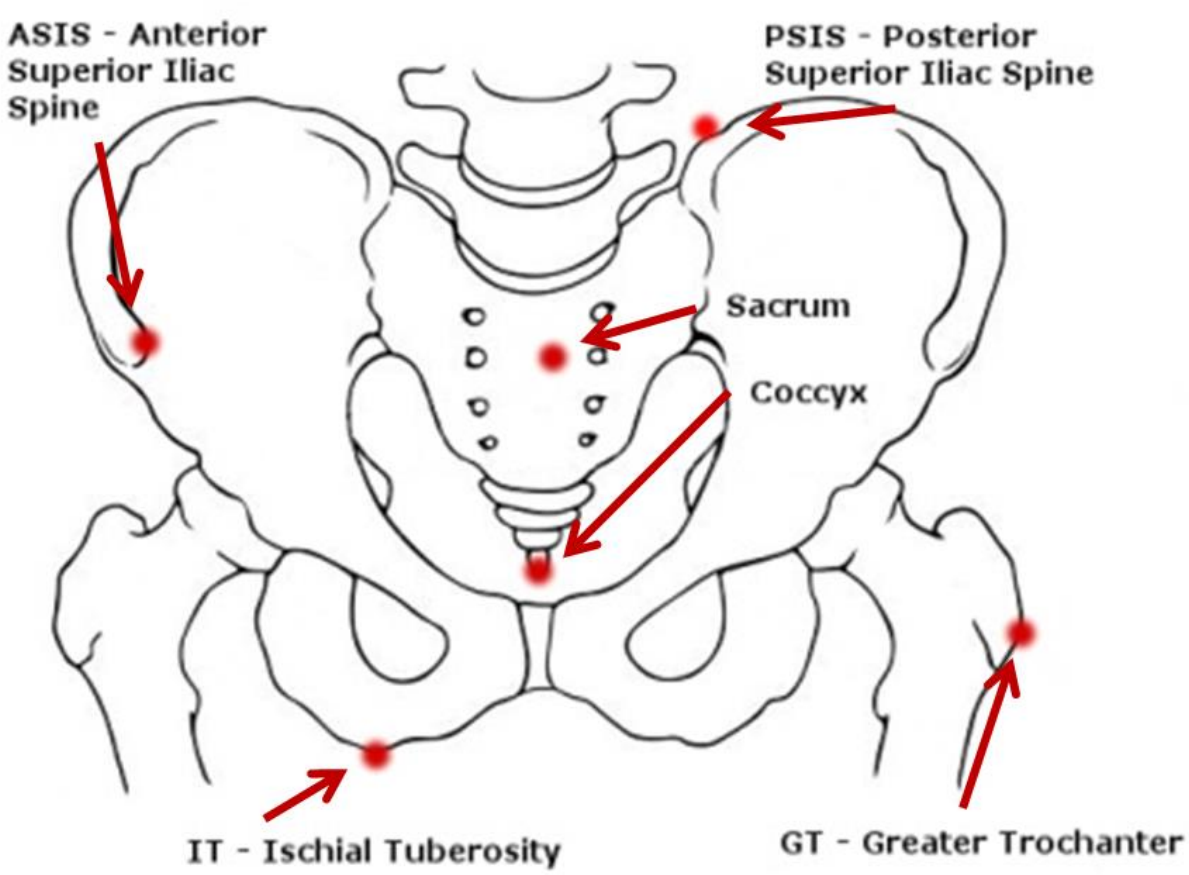
- Pelvis and hips

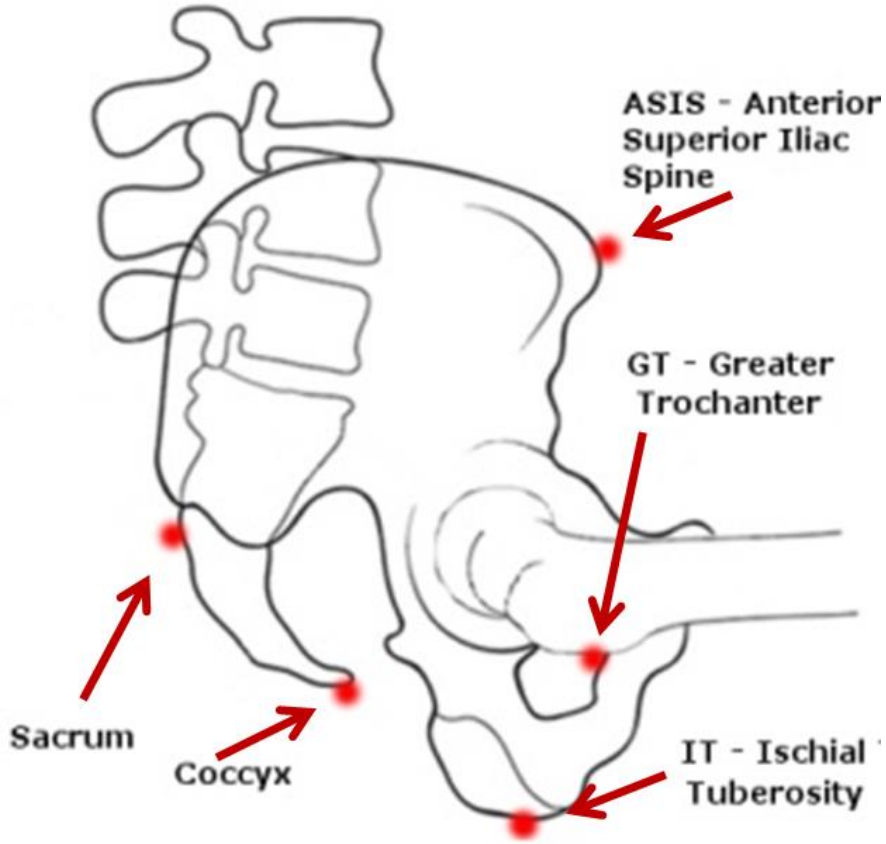


https://www.britannica.com/science/pelvis



https://alexanderteachingstudio.com/your-bottom-belongs-behind-you/



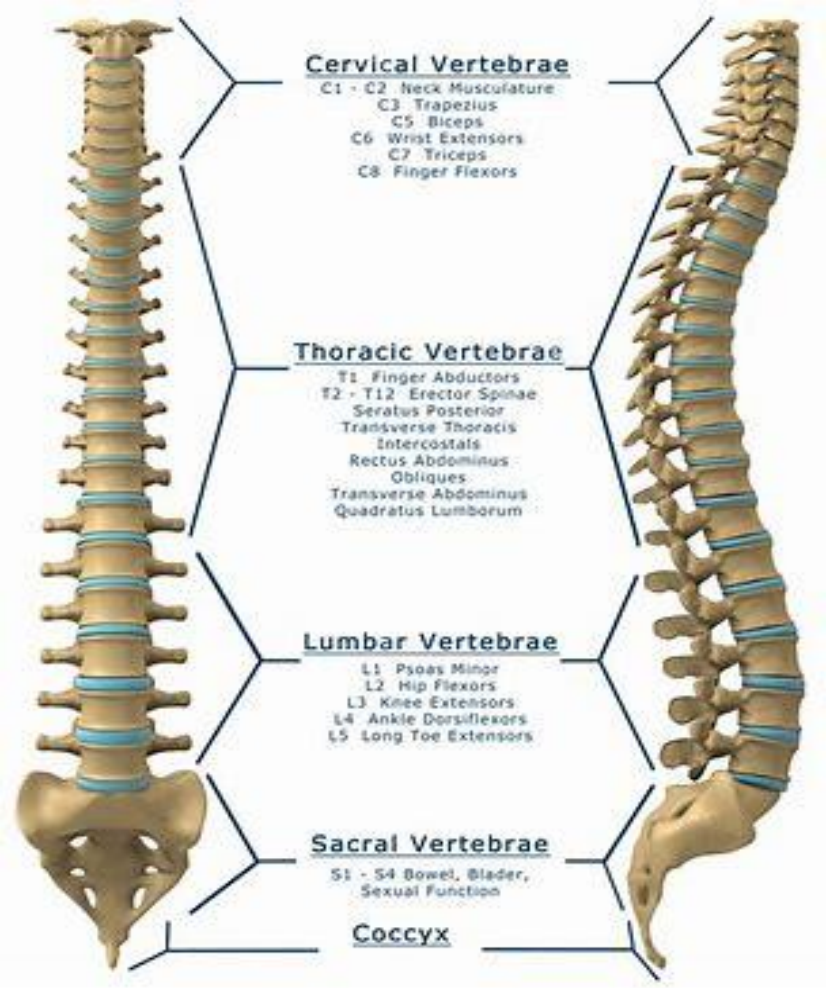


https://aci.health.nsw.gov.au/networks/spinal-cord-injury/spinal-seating/module-3/the-mechanical-assessment-tool-mat#:~:text=The%20MAT%20is%20a%20musculoskeletal%20examination%20of%20the,noted%20as%20they%20affect%20posture%20and%20muscle%20length

BASE OF SUPPORT

- Feel/map the following:
  - ASIS
  - Posterior Aspect of the GT
  - ITs
  - Distal aspect of the femur
  - PSIS
  - Sacrum and Coccyx if indicated
- What areas are taking the load?
- Can you improve the distribution of load with the current seat surface? Reduce peak mechanical tissue loading and improve area of distribution.
- Do you need to complete a full MAT Ax to understand the asymmetrical postures?

- Spine

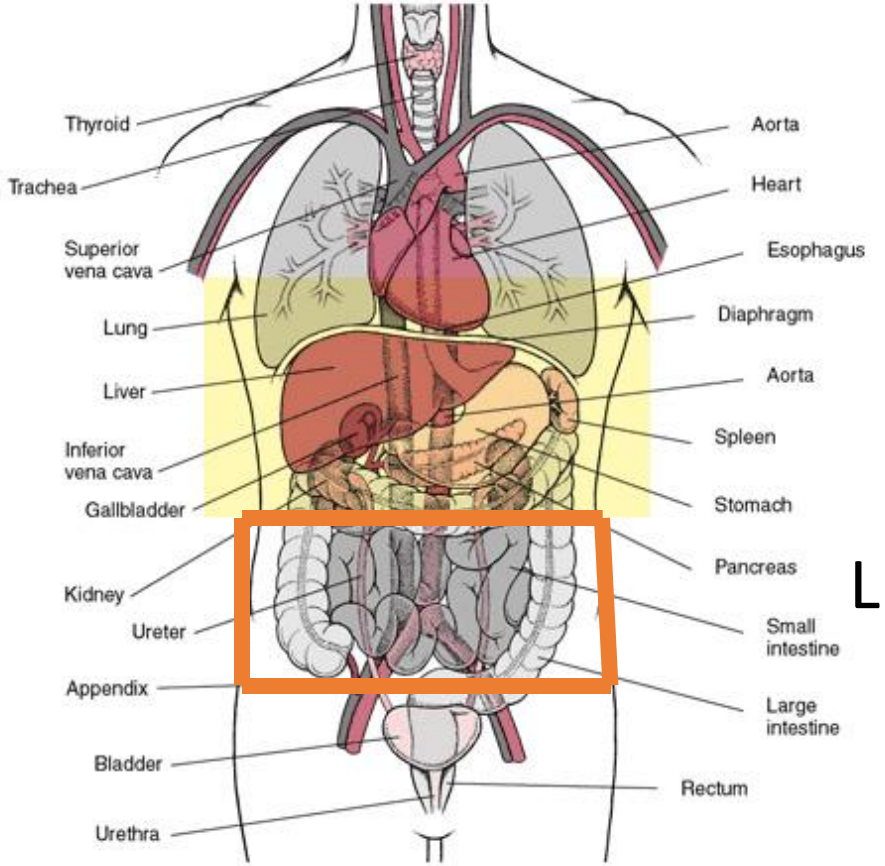


https://anatomy-medicine.com/nervous-system/116-the-spinal-cord.html

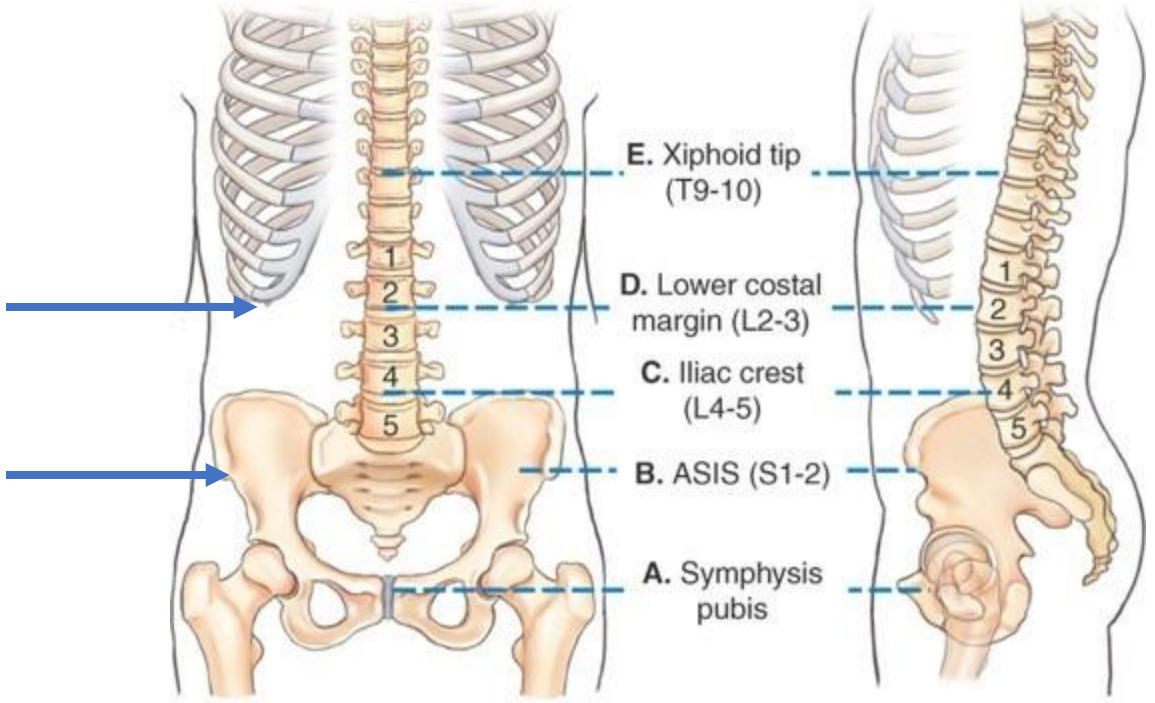
http://www.seat-specialists.com/products/knoedler-air-chief-seat-choose-your-options.html

https://karo.co.za/knowledge-center/what-happens-when-you-sit-and-how-it-affects-your-body/

- Life Box



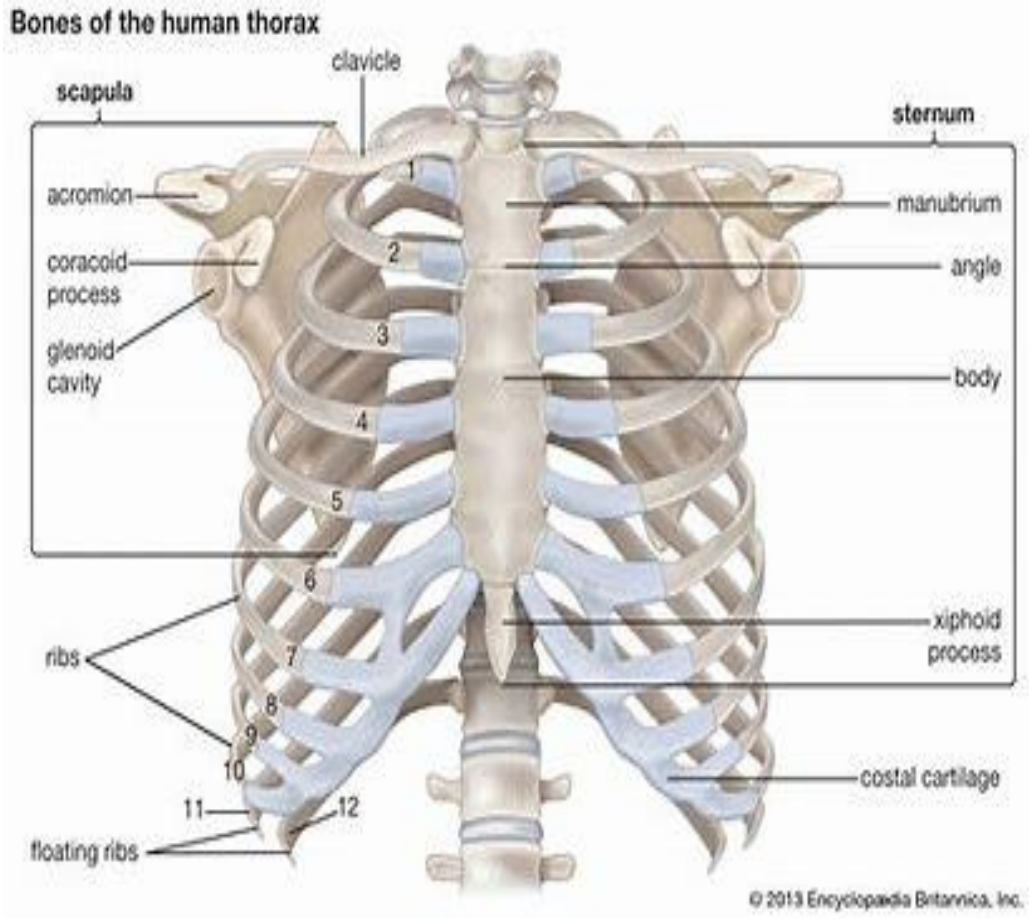
LIFE BOX



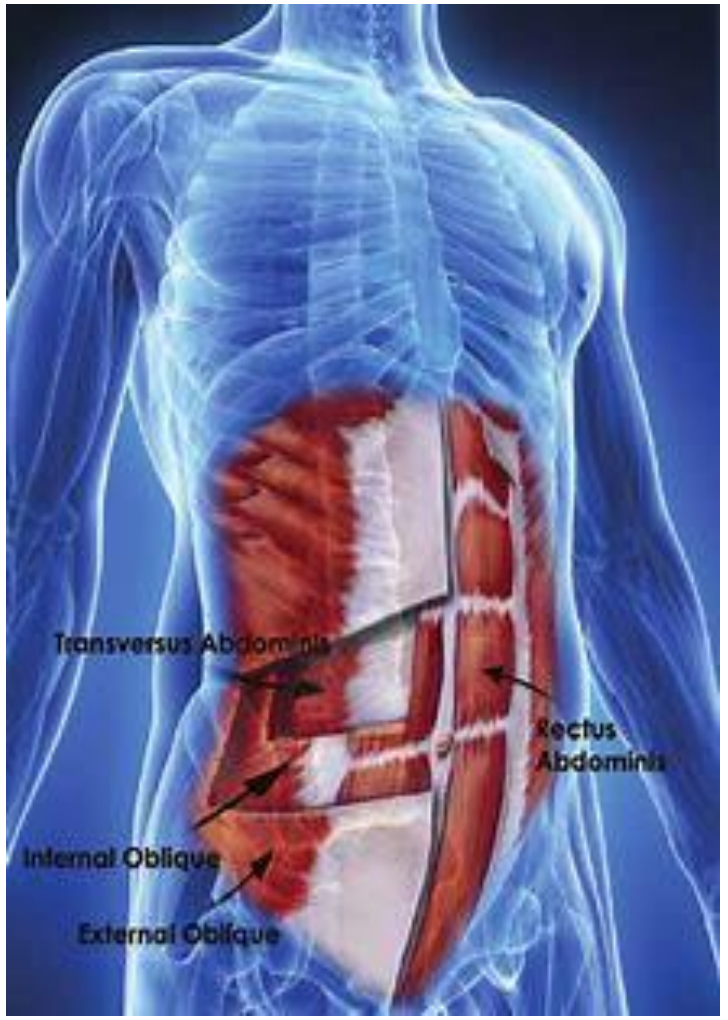
https://889community.com/the-breath-part-one-basic-breath-anatomy/

https://quizlet.com/345418418/chapter-9-lumbar-spine-sacrum-coccyx-radiographic-positioning-pathology-flash-cards/

- Thoracic – Apexes
  Abdominal Wall

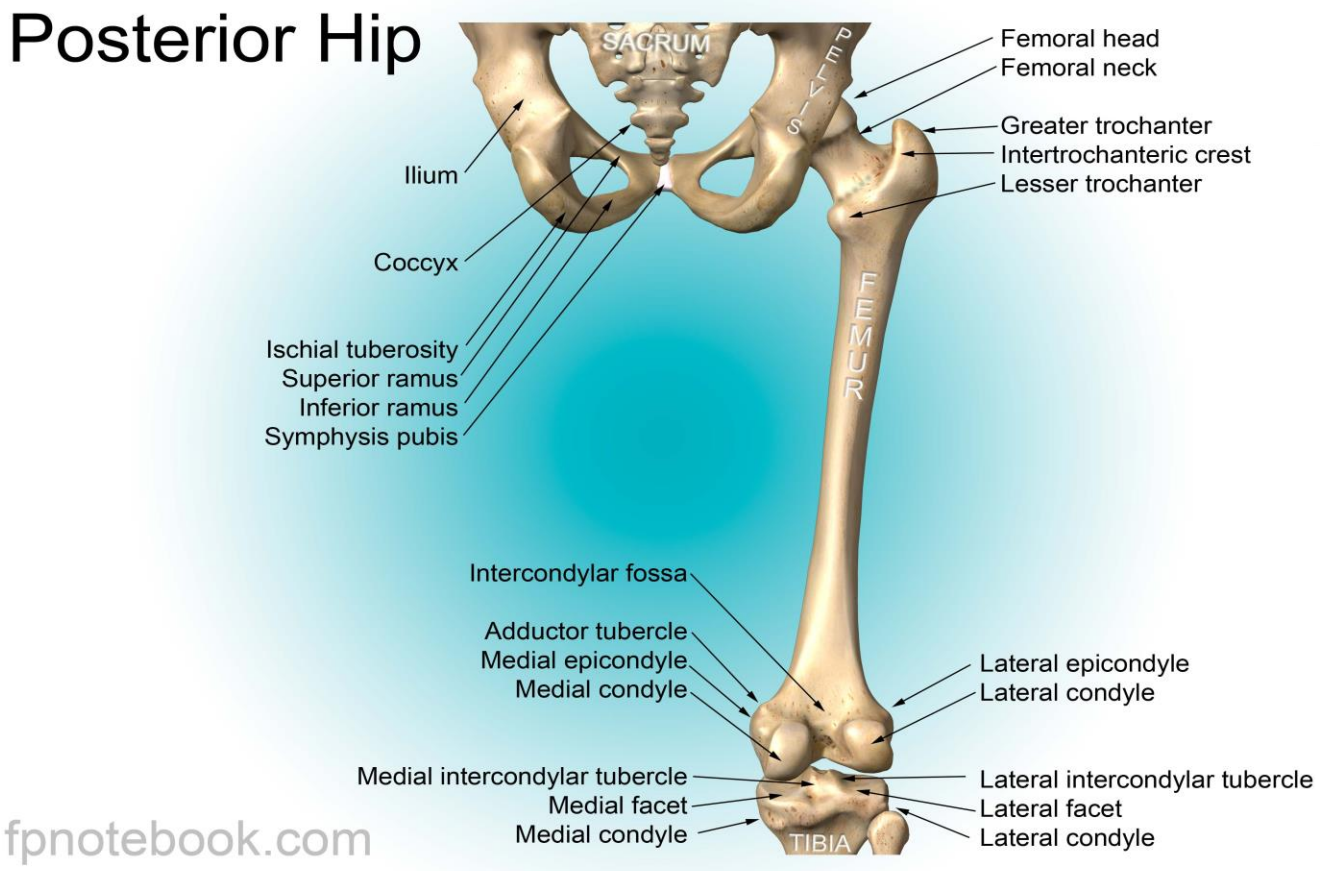


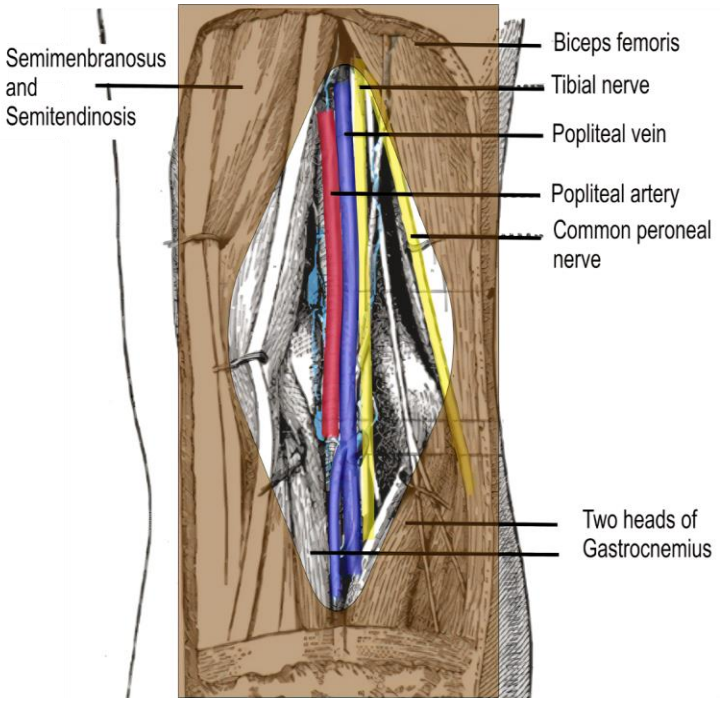
https://www.britannica.com/science/thoracic-cavity



https://www.researchgate.net/figure/The-anatomy-of-the-abdominal-wall_fig1_283209177

- Femur and Popliteal Fossa

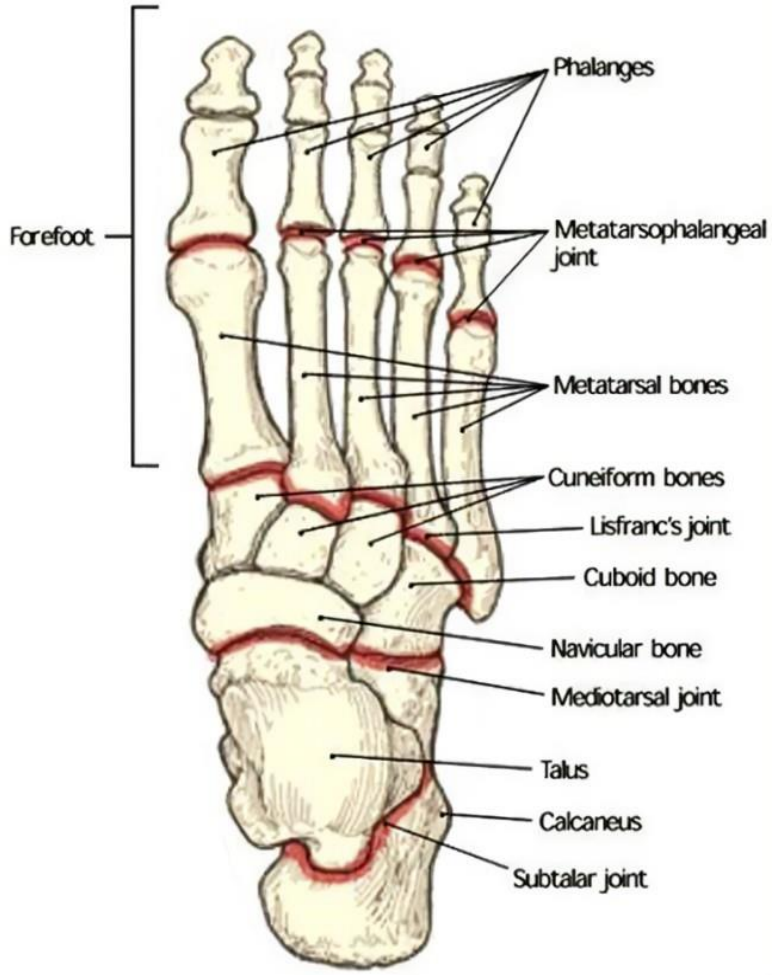




http://www.fpnotebook.com/Ortho/Anatomy/FmrBn.htm

http://www.cambridgeorthopaedics.com/cambridgeanaesthetics/advancednerveblocks/popliteal%20block.htm

- Forefoot and ankle (the lower is controlled by the hip and knee)



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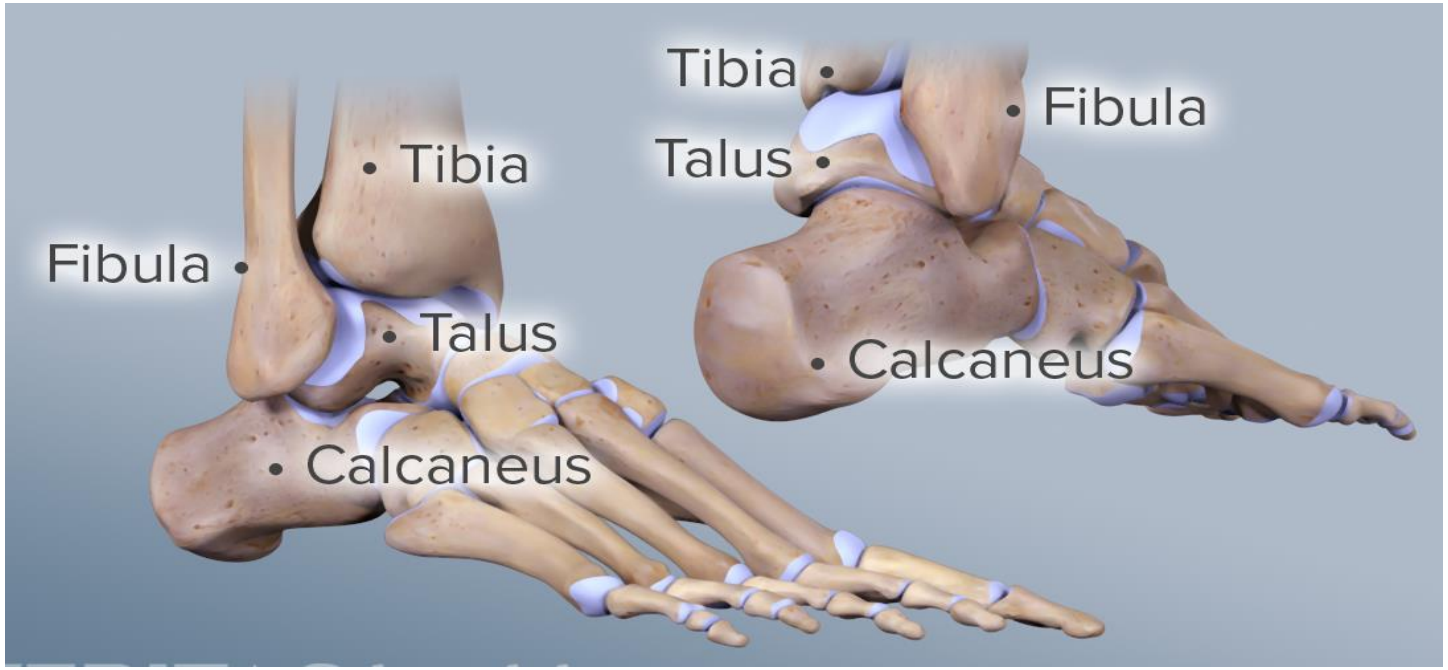
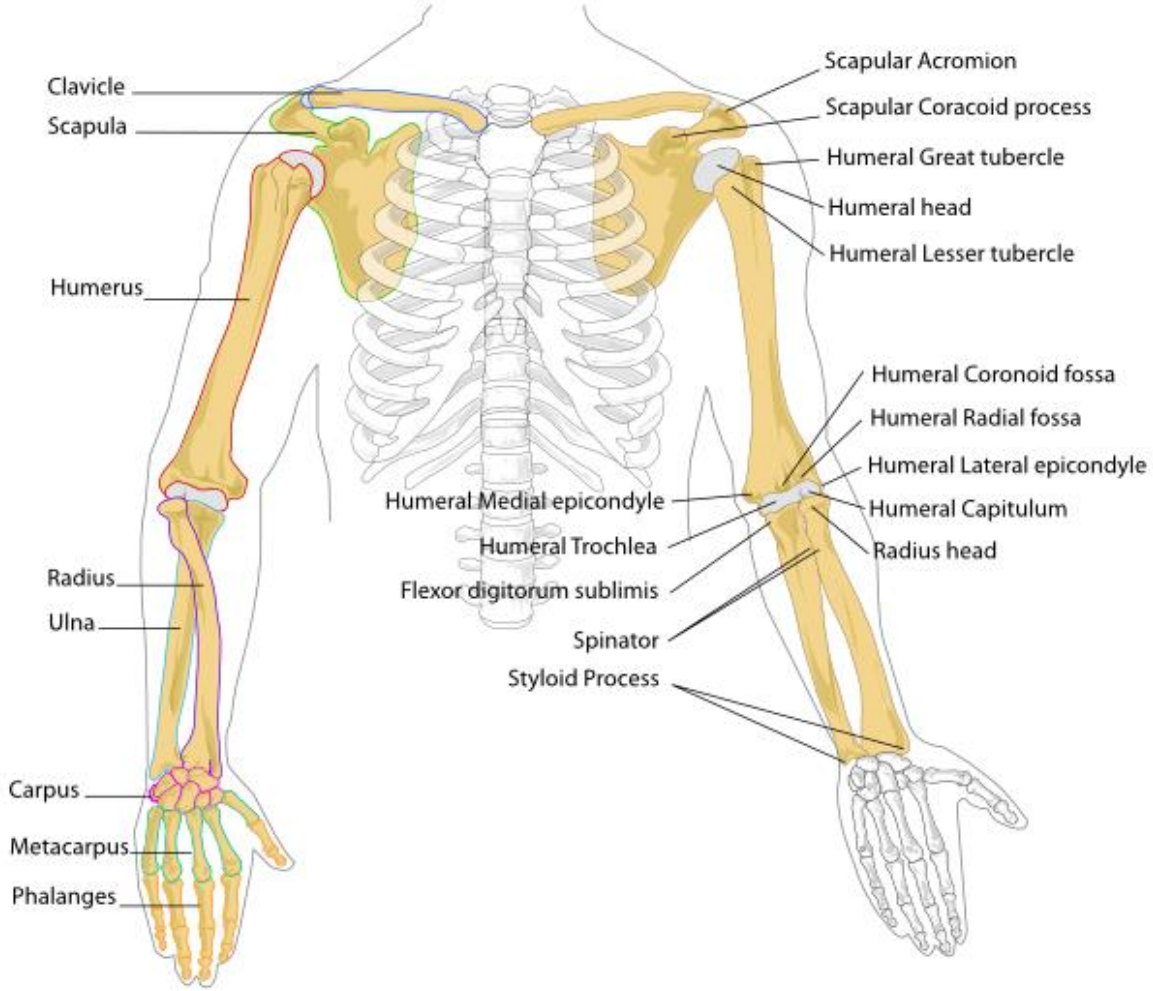


https://www.arthritis-health.com/types/osteoarthritis/ankle-joint-anatomy-and-osteoarthritis

- Upper extremities



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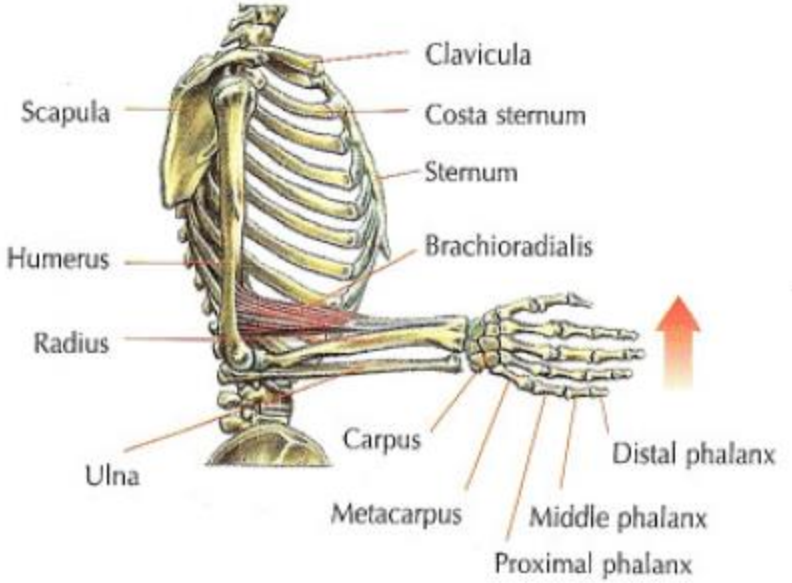
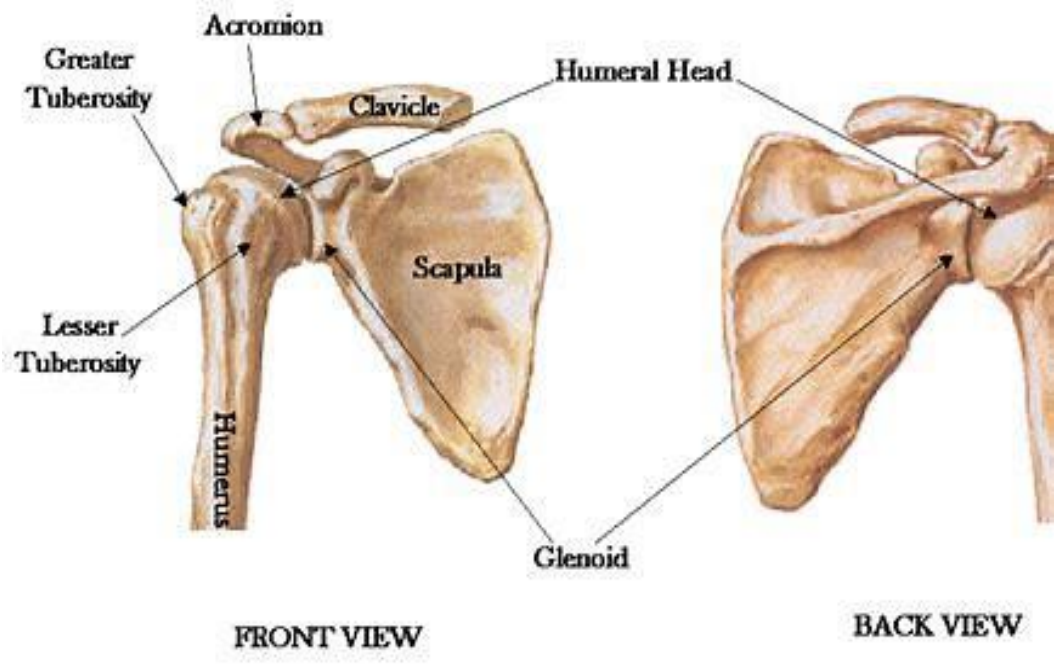


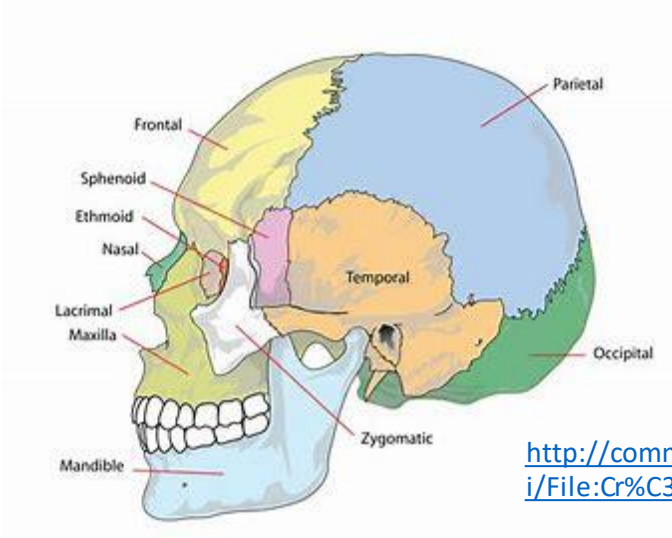
https://www.thestephaneandre.com/hammer-curls/

- Shoulder Girdle

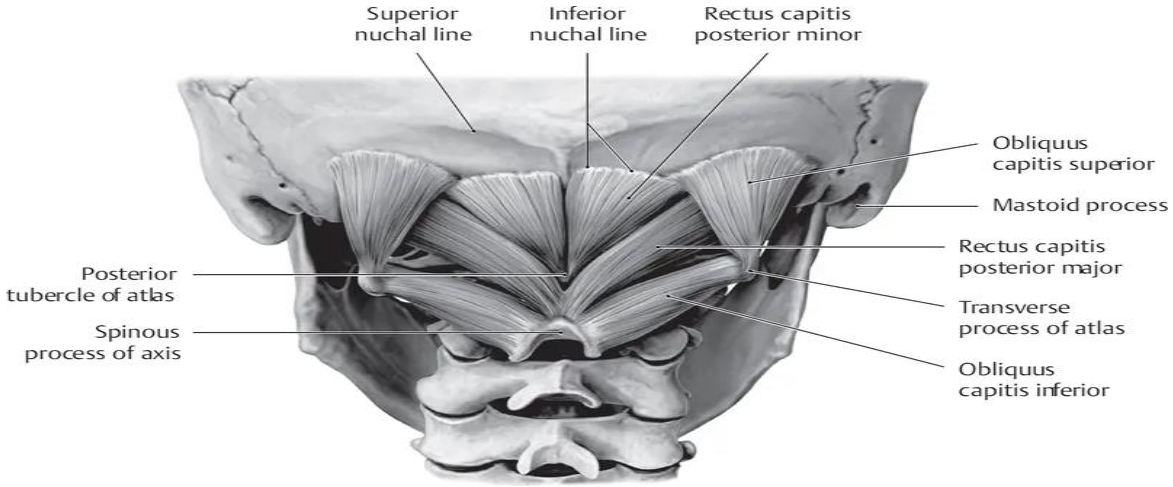


http://rrcmrt.wordpress.com/2012/07/16/shoulder-girdle-anatomy-tutorial/

- Skull – Sub Occipital



http://commons.wikimedia.org/wiki/File:Cr%C3%A2ne_2.svg



http://neupsykey.com/craniovertebral-junction-2/

Review all body planes of symmetry

- Consider what it means to be "Symmetrical"?
- What is a "neutral" sitting posture?
- What is a "position of comfort"?
- How do we use this information to increase our understanding and make sound clinical judgments about our client's seated postures?

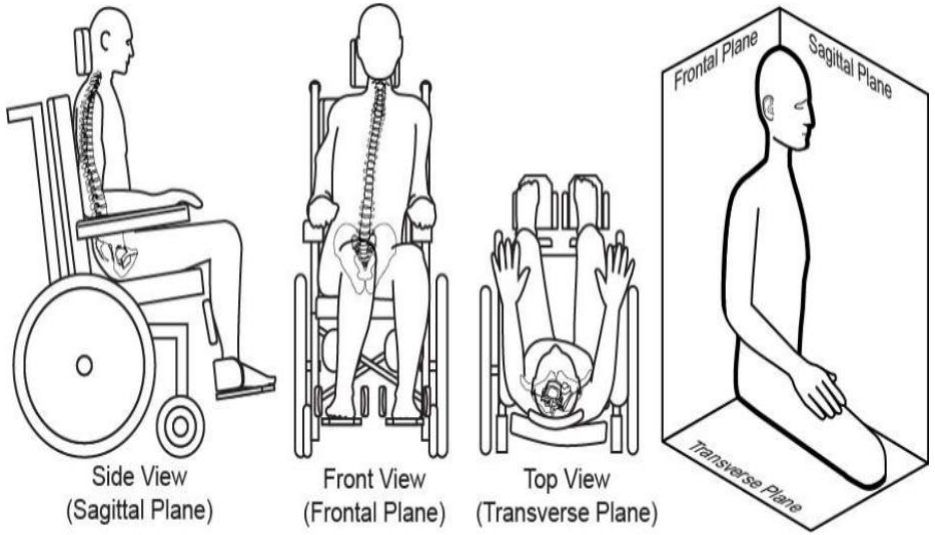


Fig. 1.5: Describing postural deviations in three planes

Waugh, et al., 2013 pg. 10

Talk the Talk before you Walk the Walk

- **Fixed**-fastened securely in position
- **Flexible**- able to be easily modified to respond to altered circumstances
- **Accommodating**- to fit in with someone's needs
- **Correctable**- put right back into neutral
- **Reducible**- capable of being simplified towards neutral
- **Neutral**- belonging to an impartial state or balance
- **Anterior**- nearer the front, especially in the front of the body
- **Posterior**- further back in position; of or nearer the rear or hind end
- **Obliquity**- neither parallel nor at right angles to a specified or implied line; slanting. Description of the lower side.
- **Rotation**- the action of rotating about an axis or from center (neutral) – call the direction of rotation
- **Thoracic Kyphosis**- An abnormality of the spine causing excessive curvature of the upper back
- **Lumbar/Cervical Lordosis**- The excessive inward curvature of the spine. It can affect either at the neck or lower back causing pain and discomfort

- **Scoliosis**- a condition characterised by sideways curvature of the spine
- **C-Curve Scoliosis**- single curvature scoliosis, occurs when the spine bends once off its center axis, before bending back around towards the midline of the vertebral column to form a shape roughly similar to the letter C. Defined by the side of the apex
- **S-Curve Scoliosis**- S-shaped curves present with two scoliotic curves, each bending to the opposite side. The two curves of the S-shaped scoliosis are best classified as minor curves and major curves. Define by apex side and locations
- **Convex**- having an outline or surface curved like the exterior of a circle or sphere
- **Concave**- having an outline or surface that curves inwards like the interior of a circle or sphere
- **Apex**-the tip of a pyramidal or rounded structure
- **Thigh-to-trunk angle**- goniometer measurement of the thighs relative to the trunk. Report on redundant tissue impact.
- **ABduct**- Abduction: the movement of a limb or other part away from the midline of the body, or from another part
- **ADduct**- Adduction: the movement of a limb or other part towards the midline of the body or towards another part
- **External Rotation**- rotation away from the center of the body
- **Internal Rotation**- Also known in anatomy as medial rotation, the rotation of a limb in a joint about a vertical axis toward the anterior or front of the body

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- **Windswept-** the abduction and external rotation of one hip with the adduction and internal rotation of the other. Defined by the direction the lower limbs face
- **Thigh- lower leg angle-** goniometer measurement of the thighs to the femur. Report on reductant tissue impact
- **Flexion**- the action of bending or the condition of being bent
- **Extension**- the action of moving a limb from a bent to a straight position
- **Hyperflexion**- flexion of a limb or part beyond the normal limit
- **Hyperextension**- the forceful extension of a limb or joint beyond its normal limits
- **Plantarflex**- positioning the foot with the toes furthest down
- **Dorsiflex**- backward bending and contracting of your hand or foot
- **Inversion**- movement of the sole towards the median plane
- **Eversion**- movement of the sole away from the median plane
- **Lateral Flexion**- active or passive bending movement of a body part in the lateral direction

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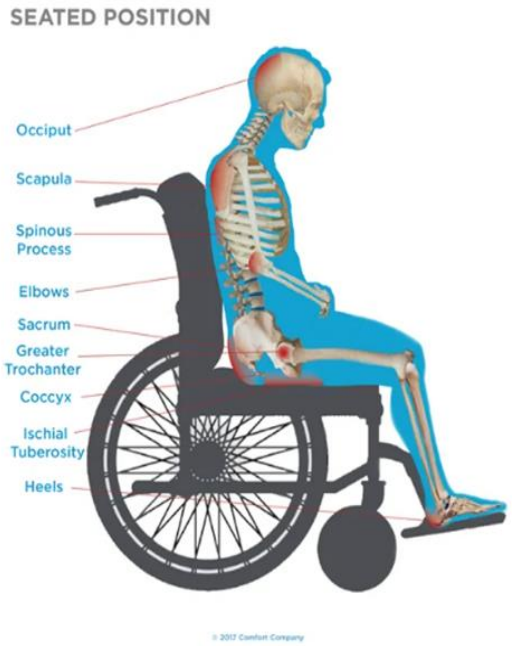
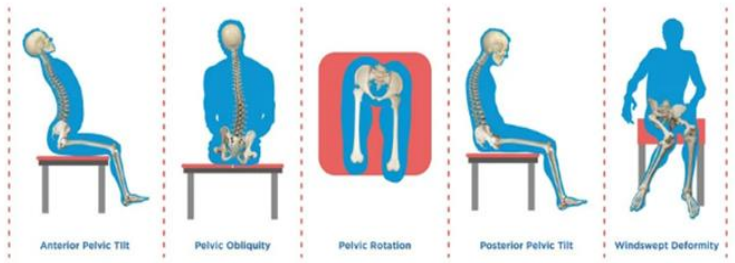
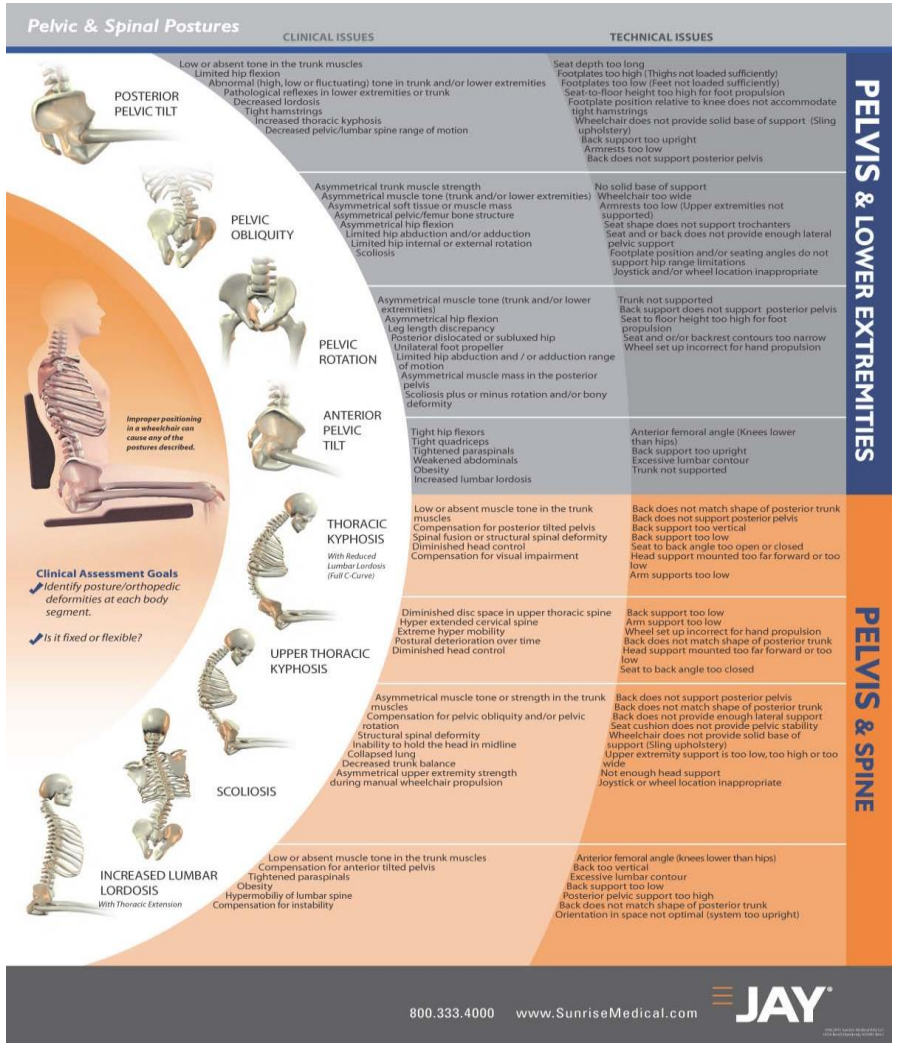
EQUIPMENT

Commonly Occurring Postures







https://hub.permobil.com/blog/postural-evaluation-sitting-let-hands-mimic-possibilities

https://hub.permobil.com/wheelchair-seating-and-positioning-guide

https://www.sunrisemedical.com.au/education-in-motion

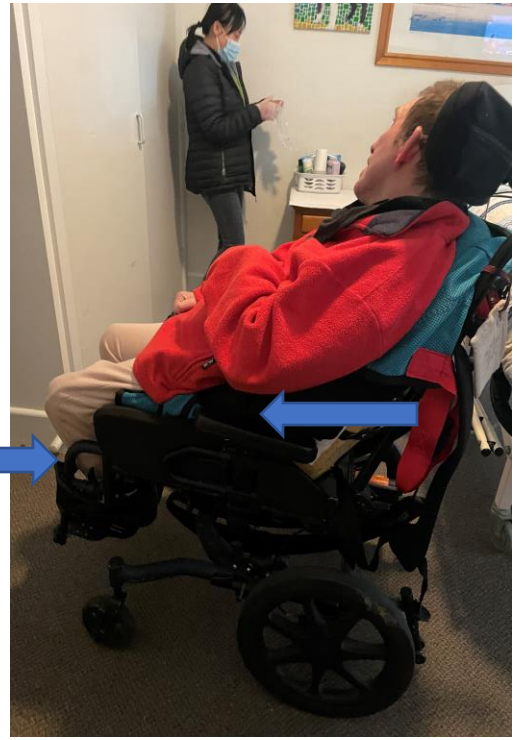
What are we looking to capture?

Positioning from transfer

Position before transferring out of the wheelchair

Before photos

Frontal



LHS Sagittal

RHS Sagittal

Traverse

Phase One: Review of Existing Seated Posture

Visual

Phase One: Review of Existing Seated Posture

Hands-on, feel and record. Consent for photos. Highlight Landmarks.

Take the opportunity to dig deeper:

- How long have they had this wheelchair?
- What do they like about it? What don't they like about it?
- Does the person look like this when first transferred into the wheelchair?
- How long is the person sitting in the wheelchair for?
- How long have they been in the wheelchair for at the time of assessment?
- What ADL task do they complete from this wheelchair?
- Are they comfortable?
- Map out existing seating support surfaces.

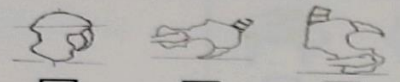
Phase One: Review of Existing Seated Posture

POSTURE IN CURRENT SEATING SYSTEM

ASSESSMENT FOR: | **DATE:** | **Problems /Comments**

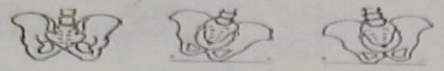
Pelvis

Tilt (Side View)



☐ Neutral ☐ Posterior ☐ Anterior

Obliquity (Frontal View)



☐ Neutral ☐ Left Lower ☐ Right Lower

Lowered by:

Rotation (Top View)

☐ Neutral ☐ Left Forward ☐ Right Forward

Trunk

Anterior / Posterior

☐ Neutral ☐ Thoracic Kyphosis ☐ Lumbar Lordosis

☐ Lumbar C-Curve Flattening

Scoliosis (Frontal View)

☐ Neutral ☐ Convex Left ☐ Convex Right

Apex at:

Rotation (Top View)

☐ Neutral ☐ Left Forward ☐ Right Forward

Hips

Thigh to Trunk Angle

Left: _____ ° Degrees

Right: _____ ° Degrees

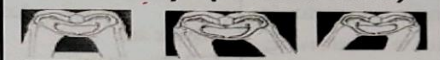
Position (Frontal View)

☐ Neutral ☐ ABduct^{n} L / R ☐ ADduct^{n} L / R

☐ External Rotation: L / R

☐ Internal Rotation: L / R

Windswept (Frontal View)

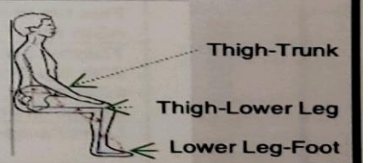


☐ Neutral ☐ Left ☐ Right

Angles

Left:

Right:



Knees and Feet

Thigh-Lower Leg Angle

Left: _____ ° Degrees

Right: _____ ° Degrees

Lower Leg- Foot Angle

Left: _____ ° Degrees ☐ Plantar-flex ☐ Dorsi-flex

Right: _____ ° Degrees ☐ Plantar-flex ☐ Dorsi-flex

Foot Position

Left: ☐ Neutral ☐ Inversion ☐ Eversion

Right: ☐ Neutral ☐ Inversion ☐ Eversion

Head and Neck

Cervical Curve (Side View)

☐ Neutral
☐ Flexion
☐ Extension
☐ Cervical Hyperextension (Chin poke)

Neck Position (Frontal View)

☐ Midline
☐ Lateral Flexion: L / R
☐ Rotation: L / R

Control

☐ Independent Head Control and Full ROM
☐ Restricted Head Control
☐ Restricted ROM
☐ Absent Head Control

Upper Limbs

Shoulder positioning

☐ Level ☐ Asymmetry

Elbow and Forearm Position

☐ Arm Support ☐ No Support

Wrist and Handgrip

Phase Two: Supine MAT Assessment

https://www.physicaltherapy.com/articles/wheelchair-seating-considerations-for-prop-4785#:~:text=Prop%20sitter%20One%20way%20of%20looking%20at%20wheelchair,sitter%2C%20the%20hands-dependent%20sitter%2C%20and%20the%20prop%20sitter

Visual

Phase Two: Supine MAT Assessment

Hands-on, feel and record direction of force and counteracting force. Consent for photos. Highlight Landmarks.

Take the opportunity to dig deeper:

- How did they/or were they transferred out of the wheelchair?
- Were there any tone responses during this process?
- If transferred using a sling, how was the sling fit? What did their posture look like?
- Are they comfortable? Any indications of pain?
- Do you need to review sleep positioning?
- Do you have consent to look at the skin?
- Review the seating system they came from.
- CONTRIDICTIONS: Aspiration risks; behaviors of concern; medically indicated risks; sensory processing disorders (hypersensitive)

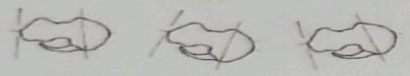
Phase Two: Supine MAT Assessment

SUPINE MAT ASSESSMENT

ASSESSMENT FOR: | **DATE:** | **Problems /Comments**

Pelvis

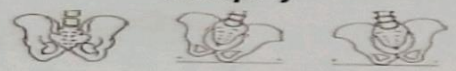
Tilt



☐ Neutral ☐ Posterior ☐ Anterior

☐ Fixed
☐ Flexible
☐ Corrects with Effort
(to neutral / partial correction)

Obliquity



☐ Neutral ☐ Left Lower ☐ Right Lower

Lowered by:
☐ Fixed
☐ Flexible
☐ Corrects with Effort
(to neutral / partial correction)

Rotation

☐ Neutral ☐ Left Forward ☐ Right Forward

☐ Fixed
☐ Flexible
☐ Corrects with Effort
(to neutral / partial correction)

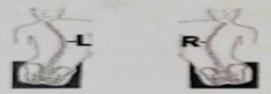
Trunk

Anterior / Posterior

☐ Neutral ☐ Thoracic Kyphosis ☐ Lumbar Lordosis

☐ Lumbar C-Curve Flattening
☐ Fixed
☐ Flexible
☐ Corrects with Effort
(to neutral / partial correction)

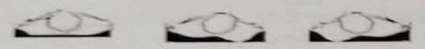
Scoliosis



☐ Neutral ☐ Convex Left ☐ Convex Right

Apex at:
☐ Fixed
☐ Flexible
☐ Corrects with Effort
(to neutral / partial correction)

Rotation



☐ Neutral ☐ Left Forward ☐ Right Forward

Forwarded by :
☐ Fixed
☐ Flexible
☐ Corrects with Effort
(to neutral / partial correction)

Lower Extremities

Angles	Range of Motion Left	Range of Motion Right	Normal ROM	OR Reported Observations
Trunk-Thigh Angle: Flex hip to 90° or a lesser angle till ASIS rolls / pelvic tilts			Simulate 0° - 90°	
Thigh-Low Leg Angle: With hip flexⁿ at 90° or the trunk to thigh angle, extend knee from flexion till pelvis tilt / ASIS rolls.			30° - 180°	
Lower Leg-Foot Angle:			30° - 135°	

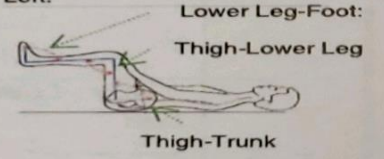
Fixed / Flexible / Corrects with Effort, Tone /Spasm that may impact on seating posture:

Hip Abduction / Adduction:

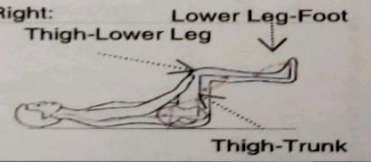
Hip External / Internal Rotation:

Foot Inversion / Eversion:

Left:



Right:



Head and Neck

Cervical Curve
Resting Posture
☐ Neutral
☐ Cervical Flexion
☐ Cervical Hyperextension

Lateral Flexion
Resting posture:
☐ Neutral ☐ Left ☐ Right
☐ Fixed ☐ Flexible
☐ Corrects with Effort

Rotation
Resting posture:
☐ Neutral ☐ Left ☐ Right
☐ Fixed ☐ Flexible
☐ Corrects with Effort

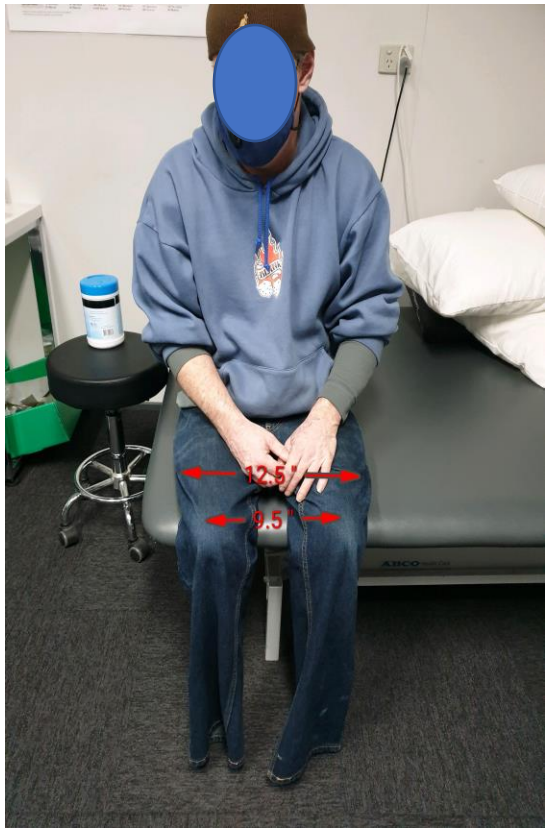
Upper Limbs

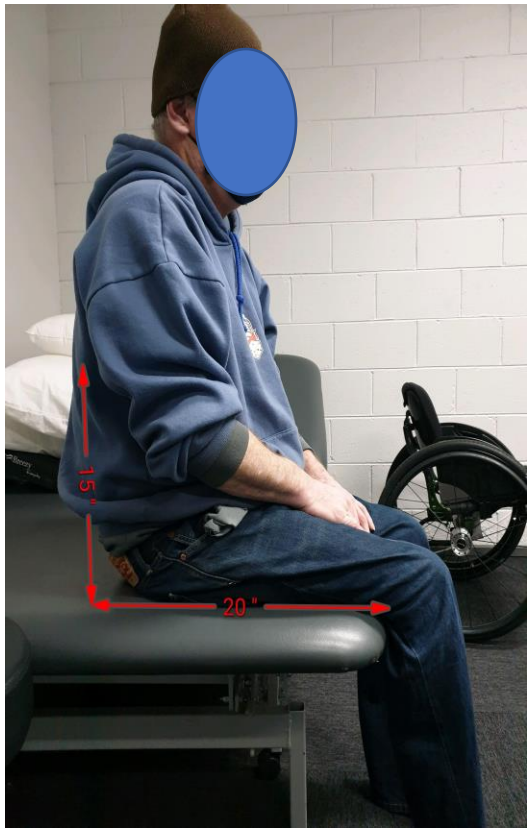
Shoulder PROM
☐ Level ☐ Asymmetry

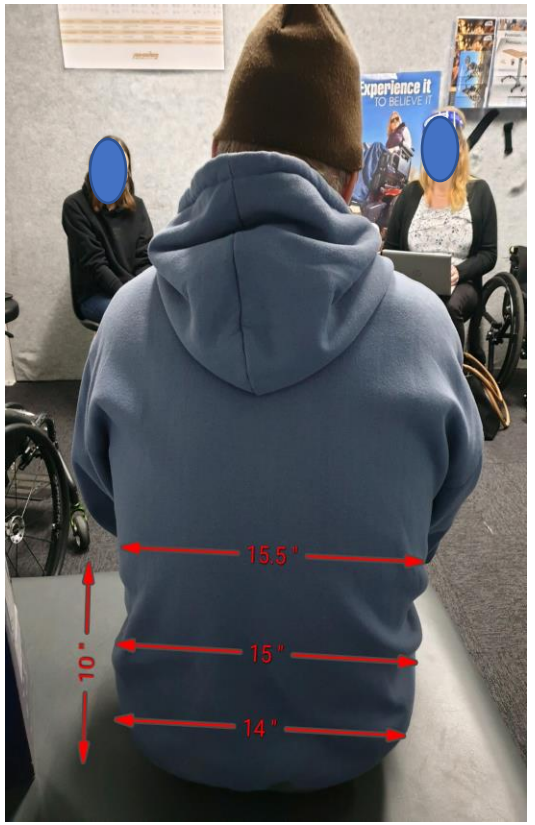
Elbow and Forearm PROM

Wrist and Hand
Description:

Phase Three: Sitting MAT Assessment







Visual

Phase Three: Sitting MAT Assessment

https://www.occupationaltherapy.com/articles/wheelchair-seating-assessment-2845

https://www.physicaltherapy.com/articles/wheelchair-seating-considerations-for-prop-4785#:~:text=Prop%20sitter%20One%20way%20of%20looking%20at%20wheelchair,sitter%2C%20the%20hands-dependent%20sitter%2C%20and%20the%20prop%20sitter

Phase Three: Sitting MAT Assessment

Hands-on, support, and record. Consent for photos. Highlight Landmarks and where postural support is required. Take anthropometric measurements.

Take the opportunity to dig deeper:

- Determine if your client is a “hands-free”, “hands-dependent” or “dependent” sitter
- Do they use functional reach? What happens to posture when functional?
- Are tone responses triggered when gravity is back in play?
- How much do you need to “back off” the posture to ensure comfort?
- Review head and neck control, and assess visual field.

Phase Three: Sitting MAT Assessment

SITTING MAT ASSESSMENT

ASSESSMENT FOR:

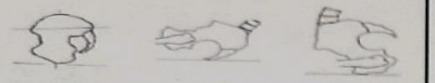
Balance: ☐ *Hands- free sitter* ☐ *Hands dependant sitter* ☐ **Dependant sitter** (* for advance clinician /specialist only)

DATE:

SIMULATION & OUTCOME: (Describe direction and location of forces applied)

Pelvis

Tilt (Side View)



☐ Neutral ☐ Posterior ☐ Anterior

Obliquity (Frontal View)

☐ Neutral ☐ Left Lower ☐ Right Lower

Lower by:

Rotation (Top view)

☐ Neutral ☐ Left Forward ☐ Right Forward

Accommodations / Corrections:

Outcomes:

Trunk

Anterior / Posterior

☐ Neutral ☐ Thoracic Kyphosis ☐ Lumbar Lordosis

☐ Lumbar C-curve Flattening

☐ Fixed ☐ Flexible

☐ Corrects with Effort (to neutral / partial correction)

Scoliosis (Frontal View)

☐ Neutral ☐ Convex Left ☐ Convex Right

Apex at:

☐ Fixed ☐ Flexible

☐ Corrects with Effort (to neutral / partial correction)

Rotation (Top view)

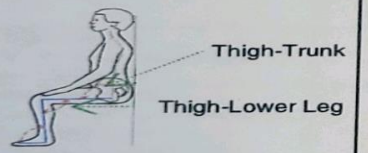
☐ Neutral ☐ Left Forward ☐ Right Forward

Accommodations / Corrections:

Outcomes:

Lower Extremities

Initial Sitting Angles



Position (Frontal View)

☐ Neutral ☐ ABduct^{n} L / R ☐ ADduct^{n} L / R

☐ External Rotation: L / R

☐ Internal Rotation: L / R

Windswept (Frontal View)

☐ Neutral ☐ Left ☐ Right

Simulated Sitting Angles:

Outcomes:

Head and Neck

Cervical Curve (Side View)

Neck Position (Frontal View)

Control

Accommodations / Corrections:

Outcomes:

Upper Limbs

Shoulder Positioning

☐ Level ☐ Asymmetry

Describe:

Elbow and Forearm Position

Describe:

Hand and Wrist Positioning

Describe:

Accommodations /Corrections:

Outcomes:

Photos of Measurable Outcomes

Outcomes – identify supports required

Anatomical Area	Existing Relation to neutral on all 3 planes	MAT outcomes	Counteracting forces & location	Outcomes to base of support
Pelvis	(F) Moderate LHS obliquity (S) Mild anterior pelvic tilt (T) Mild Left rotation	(F) Non- reducible (S) Reducible towards N (T) Reducible to N	- LHS P GT - ≥ D thigh support - Leg length discrepancy RHS	- Cushion GT buildup under cushion to maintain envelop and immersion , Lateral R hip support - Posterior slope in cushion from front of cushion, lumber + PSIS back support, pelvis position belt - Custom cut out RHS 1" accommodation of leg length discrepancy, IT well, pelvic positioning belt

Outcomes – identify supports required

Anatomical Area	Existing Relation to neutral on all 3 planes	MAT outcomes	Counteracting forces & location	Outcomes to base of support
Lower Limbs	(F) IR + ADduction RHS, ER + ABduction LHS (S) ≤90° thigh to trunk angle, 90° thigh to shin, N foot PF (T) RHS rotating to Left	(F) Reducible towards N (S) Reducible towards N (T) Reducible towards N	- Reducible allowing RHS thigh discrepancy - ≥ Distal thigh loading - Reducible allowing RHS thigh discrepancy	- Custom cut out RHS 1" accommodation of leg length discrepancy, Thigh trough contouring medial and lateral thigh supports in cushion - Posterior slope in cushion from front of cushion, accommodating FP height - Custom cut out RHS 1" accommodation of leg length discrepancy, IT well, accommodating FP placement

LINDS® REHABILITATION EQUIPMENT

Outcomes – identify supports required

Anatomical Area	Existing Relation to neutral on all 3 planes	MAT outcomes	Counteracting forces & location	Outcomes to seated supports
Trunk	(F) Moderate Convex Scoliosis LHS (S) Mild lumbar lordosis (T) Neutral	Prop sitter (F) Mild Reducible towards N (S) Reducible towards N (T) Reducible towards N with Pelvic rotation correction	- Reducible allowing LHS Obliquity support, - Lateral dispersed force to convex apex LHS - Lateral dispersed force above concave apex RHS angular - P thorax LHS, A thorax RHS de-rotation support	- Off- set lateral back support, broad surface with angle adjustments - Standard contour back support with combined PSIS and Lumber adjustment, firm positioning for RHS thorax support - 90° thigh to trunk back angle

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Outcomes – identify supports required

Anatomical Area	Existing Relation to neutral on all 3 planes	MAT outcomes	Counteracting forces & location	Outcomes to seated support
Upper Limbs	(F) Forearms toward midline (S) Mild Shoulder protraction, Elbow F ≤90°, no wrist supports (T) Neutral	Prop Sitter Sustained trunk extension through forearm support ≥ functional output within midline power zone	- Disperse forearm support across power zone	- Tray surface for positioning elbows at 90° with neutral shoulders - Height adjustable wide arm pads water fall when tray not it use with neutral shoulders
Head	(F) Midline (S) Mild Cervical hyperflexion (T) Neutral	Independent head control Cervical stacking toward	- Head support for car transport only	- Maintain PSIS and lumber spine stacking to support cervical spine alignment

Make comment on :
Position of Symmetry
Position of Comfort/Tolerance
Position of Function

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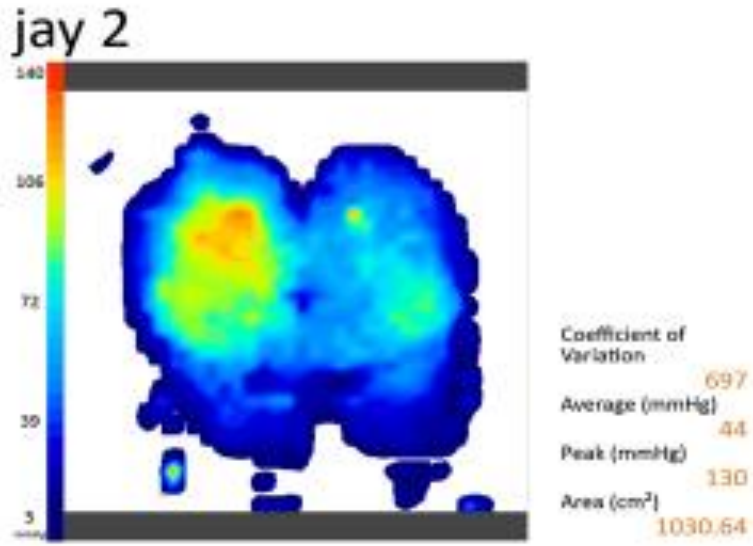
Complimentary Tools

- Pressure Map Imagery
- Loop+ Activity tracker data reports



Functional Task Analysis

Using the data you have collected

- With deeper understanding comes the ability to set clear seating, mobility, and functional goals. Identify problems you want to fix, and non-negotiable compromises.
- Cover off the key seating principles:
  - Base of support
  - Know the positions of alignment vs comfort vs function
  - Know where supporting forces need to be – match these with equipment features
- Collaborate with your suppliers and share your outcomes. The supplier will help you match the features of the wheelchair and seating systems to support your findings
- Use this data in your outcome measures. Before and after photos and a simplified explanation of the person's physical capacity will help to strengthen your clinical reason

Take Home Messages:

- Take away confidence from what you have learned today to feel postures and create balance for improved function.
- There is always more to learn! We have just scratched the surface. An in-depth understanding of muscle tone and spasticity and their impact on musculoskeletal position is essential in a holistic physical examination. Specific diagnosis and other considerations also.
- Teamwork makes the dream work! The more hands the merrier! Take a multidisciplinary approach. Know the role of your supplier in the process
- State Spinal Cord Injury Service NSW has developed an online Spinal Seating Education Modules; https://aci.health.nsw.gov.au/networks/spinal-cord-injury/spinal-seating

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Please remember to fill out our survey

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