LINDS REHABILITATION EQUIPMENT

Measuring Seating Solutions: How to Achieve Optimal Outcomes for Clients

Presented by

Lauren Kerr– Occupational Therapist

OVER 50 YEARS OF

LINDS® REHABILITATION EQUIPMENT

LINDS REHABILITATION EQUIPMENT

About Us

An Australian family-owned and operated business, Linds Rehabilitation Equipment first started selling to the rehabilitation industry in 1965. Almost half a century later, Linds Rehab has grown to become a very well-known, experienced, and respected supplier to the healthcare industry throughout Australia.

Our Goal at Linds Rehabilitation Equipment is to help improve and maintain the life quality, satisfaction, and independence for people with disabilities, through prescribing and providing quality leading products combined with superior service to fulfill the requirements of healthcare professionals and disabled clients.

Lauren Kerr
Occupational Therapist

Objectives:

- Key assessment techniques, including locating bony landmarks and support surfaces to align with product features.

- Measurement strategies—when and how to measure for seating solutions (not always based on wheelchair size).

- Clinical reasoning pathways to optimise positioning solutions for function and comfort.

- Evaluation methods to ensure chosen features align with client-centred goals.

Why do measurements?

5 Main Reasons for measuring and documenting wheelchair / seating measurements:

1) Identify postural problems and set postural alignment objectives
2) Help determine product feature requirements
3) Document postural outcomes before and after seating interventions
4) Measure postural change over time
5) Facilitate research

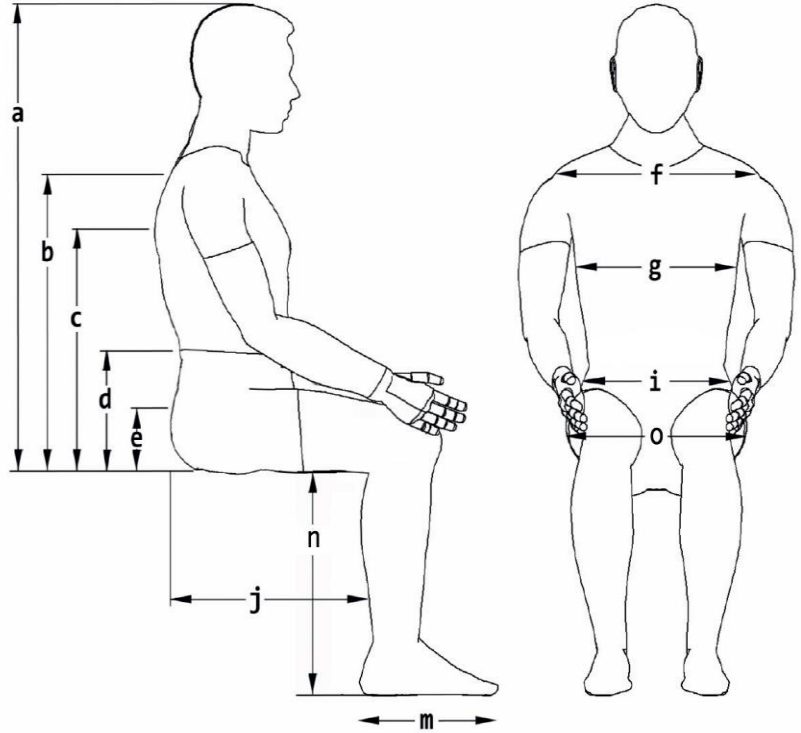
Waugh & Cane, 2018.

Linear Measurements

Linear measurement of a person's body (parallel measurements) in a sitting posture is used to determine the size and placement of seating support surfaces and wheelchair set up.

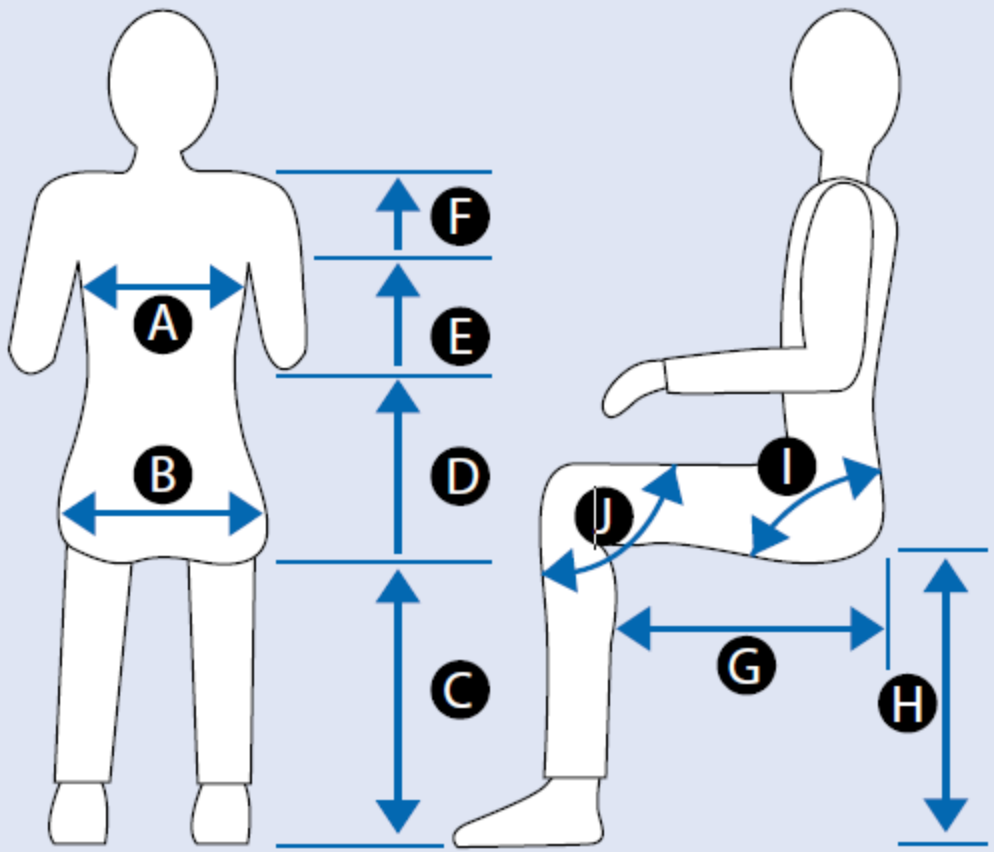
Basic Measurement for Hands free sitter:

- Hip width
- Chest / Trunk width
- Shoulder width
- External knee width
- Thigh depth
- Lower leg length
- Elbow height
- Shoulder height



Measurements required for more complex seating needs:

- Trunk depth
- Ischial depth
- Foot depth
- PSIS height
- Scapular height
- Axilla height



A Chest Width: _____ Shoulder width: _____

B Hip Width: _____

C Lower Leg Length: _____

D Armrest Height: _____

E Thoracic Height: _____

F Shoulder Height: _____

G Upper Leg Length: _____

H Seat to Floor – Front: _____ Rear: _____

I Approximate resting Hip Angle: _____

J Lower Leg Angle: _____

Note: take widest measurement if asymmetrical

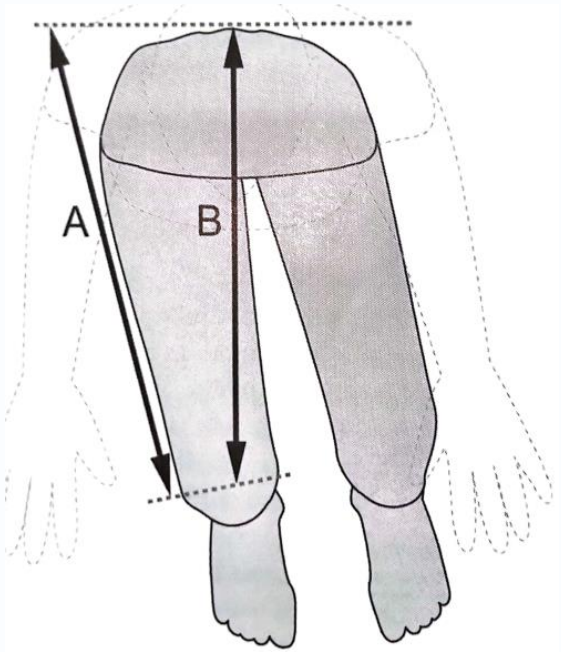
Effective Linear Body Measurement

Case Study: Grace

Grace is a 32 year old lady with a T12 incomplete spinal cord injury from an accident 10 years ago. She is a very active wheelchair user, and users a high performance rigid manual wheelchair with a basic foam cushion and tension adjustable back.

She presents with left hip obliquity and slight right rotation (non-correctable). Due to her fixed pelvis position, she has right windswept lower limbs.

So what is Grace's thigh depth? What size cushion would you go for to provide best support?



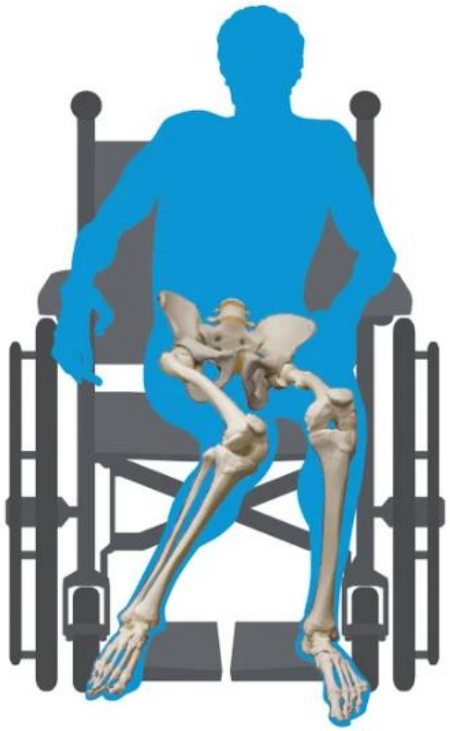
A – Buttock / Thigh Depth
B – Effective Buttock / Thigh Depth

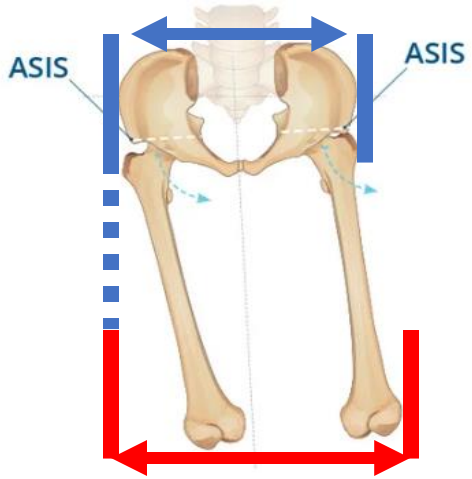
Waugh & Cane, 2013.

Effective linear measurements is the term used to document how much functional depth/ height/ width the body segment will require on the seating surface

Measuring Effective Linear Width

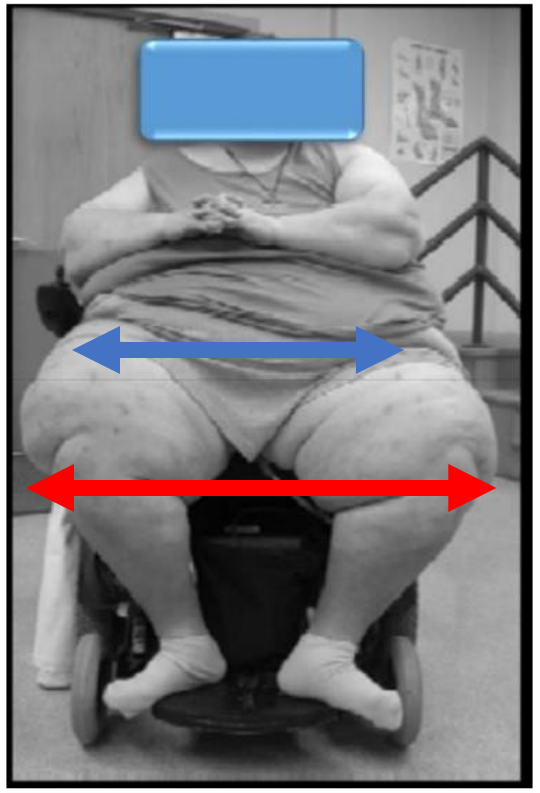
Wind Swept Position





https://hub.permobil.com/blog/windswept-posture-symptoms-treatments-wheelchair-positioning

LL Abduction / External Rotation



Measuring Effective Linear Width / Depth

Posterior Pelvic Tilt

https://www.alimed.com/improve-posture-independence-blog/

Anterior Pelvic Tilt

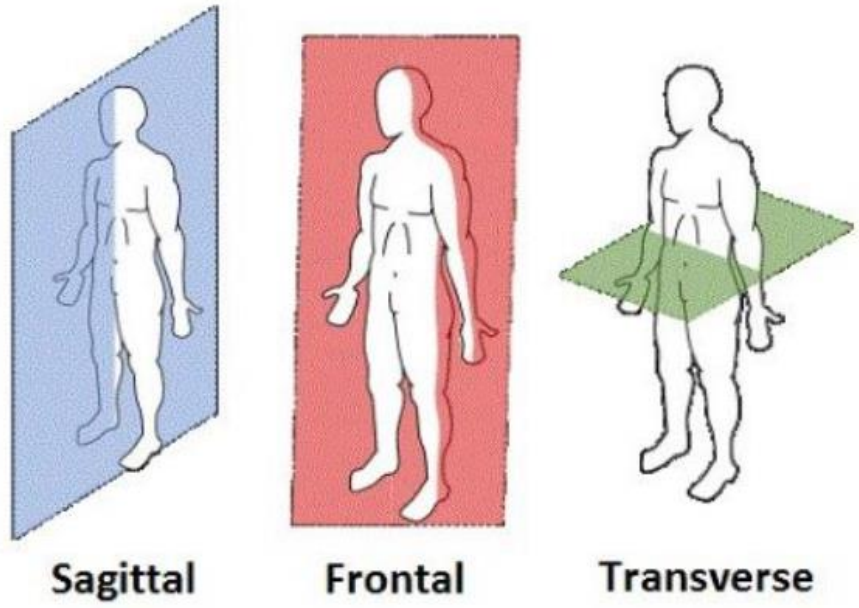
https://www.spexseating.com/knowledge-base/anterior-pelvic-tilt-and-how-to-manage-outcomes-in-wheelchair-seating/

Angular Measurements

"Angular measures are used to document the specific angular orientation of the wheelchair seated persons body to the corresponding seating support surfaces"

Foundational Concepts of Angular Measurements:

- **There is 3 body reference planes (Sagittal / frontal and transvers**
- Body segment lines and support surface reference planes
- Relative and absolute angles

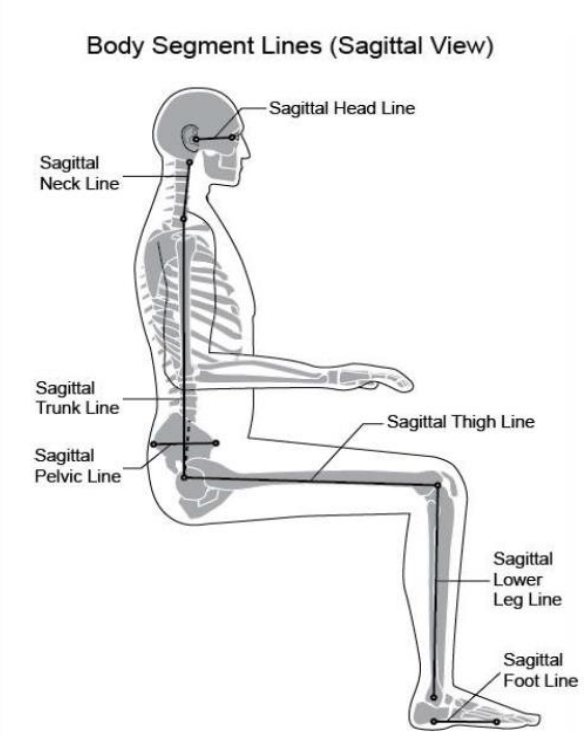


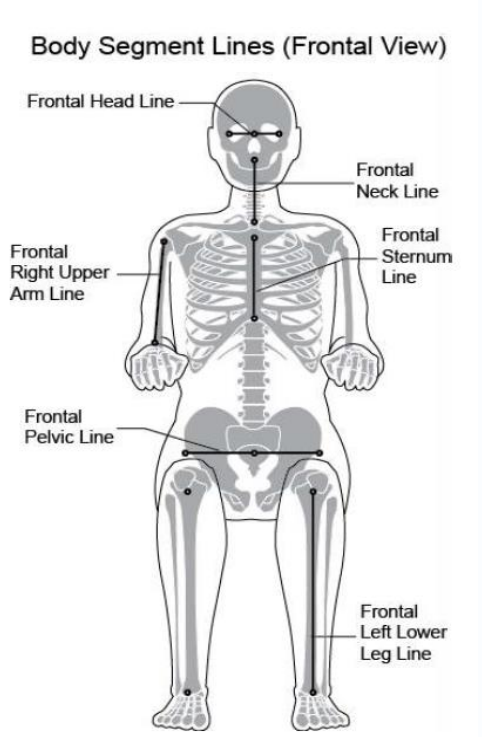
Waugh & Cane, 2013.

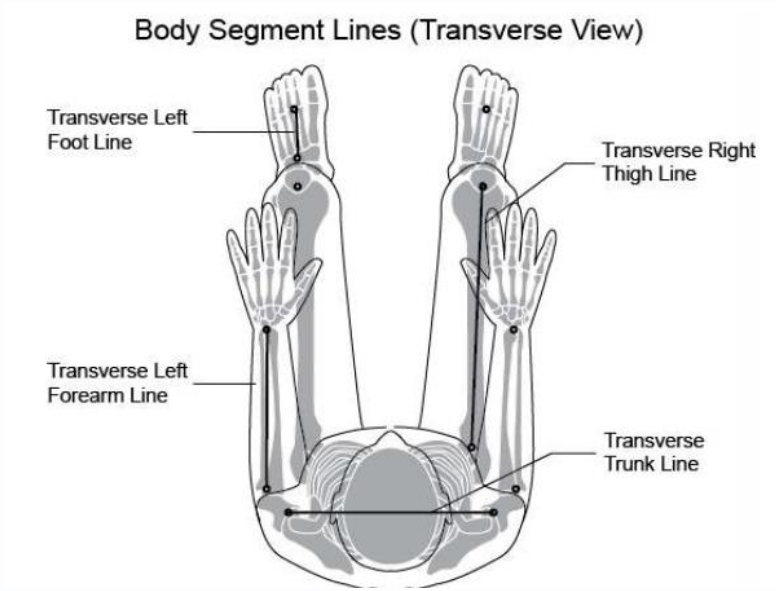
Angular Measurements

<u>Foundational Concepts of Angular Measurements</u>:

- There is 3 body reference planes (Sagittal / frontal and transverse)
- **Body segment lines and support surface reference planes**
- Relative and absolute angles





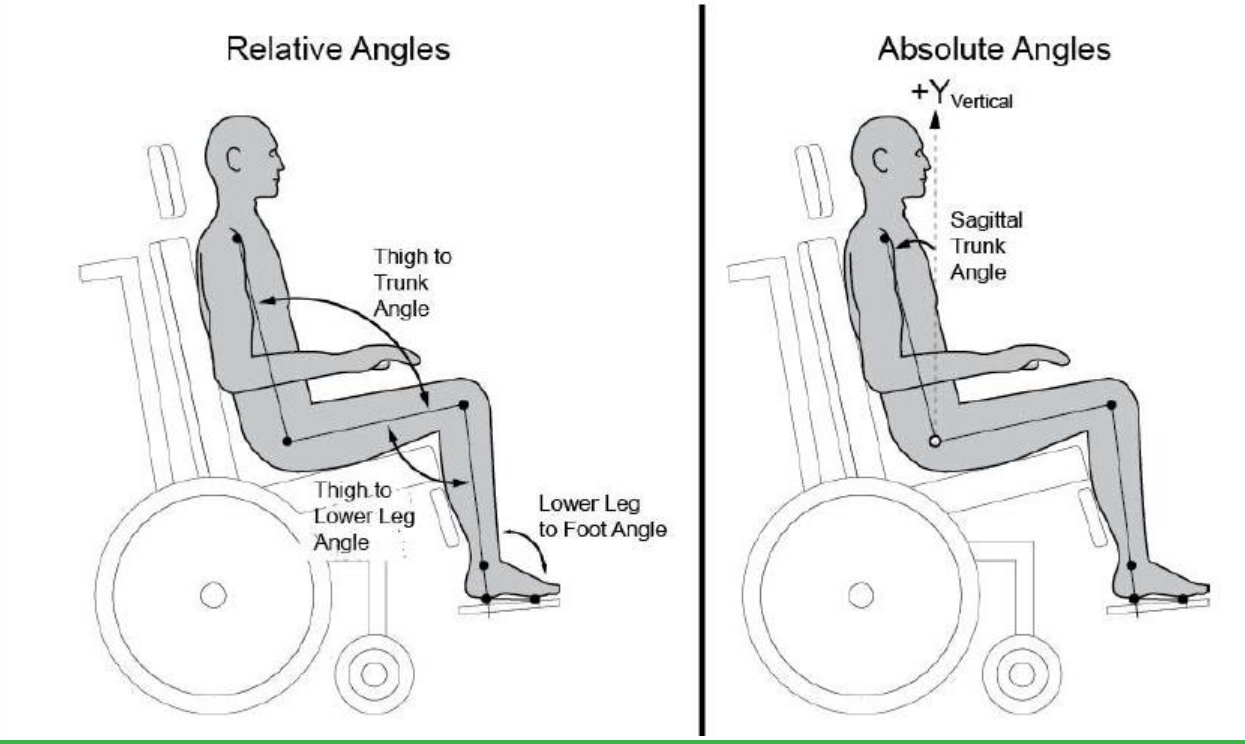


Waugh & Cane, 2013.

Angular Measurements

Foundational Concepts of Angular Measurements:

- There is 3 body reference planes (Sagittal / frontal and transverse)
- Body segment lines and support surface reference planes
- **Relative and absolute angles**



Waugh & Cane, 2013.

Why do a MAT evaluation?

- To gain a deeper understanding of:
  1. Current seating postures
     - Identifying the influencers on posture
  2. Functional postures adopted and participations in ADLs
  3. Biomechanical and physical assessment to identify appropriate seating setup

- Needs to be done in conjunction with a in depth ax on:
  1. history about current and previous equipment
  2. postural changes
  3. skin integrity and pressure care management
  4. Causes of postural deformities (internal / external)
  5. Goal setting

When to do MAT evaluations?

- As therapists, we should be asking “why am I not doing a full MAT assessment on this client”

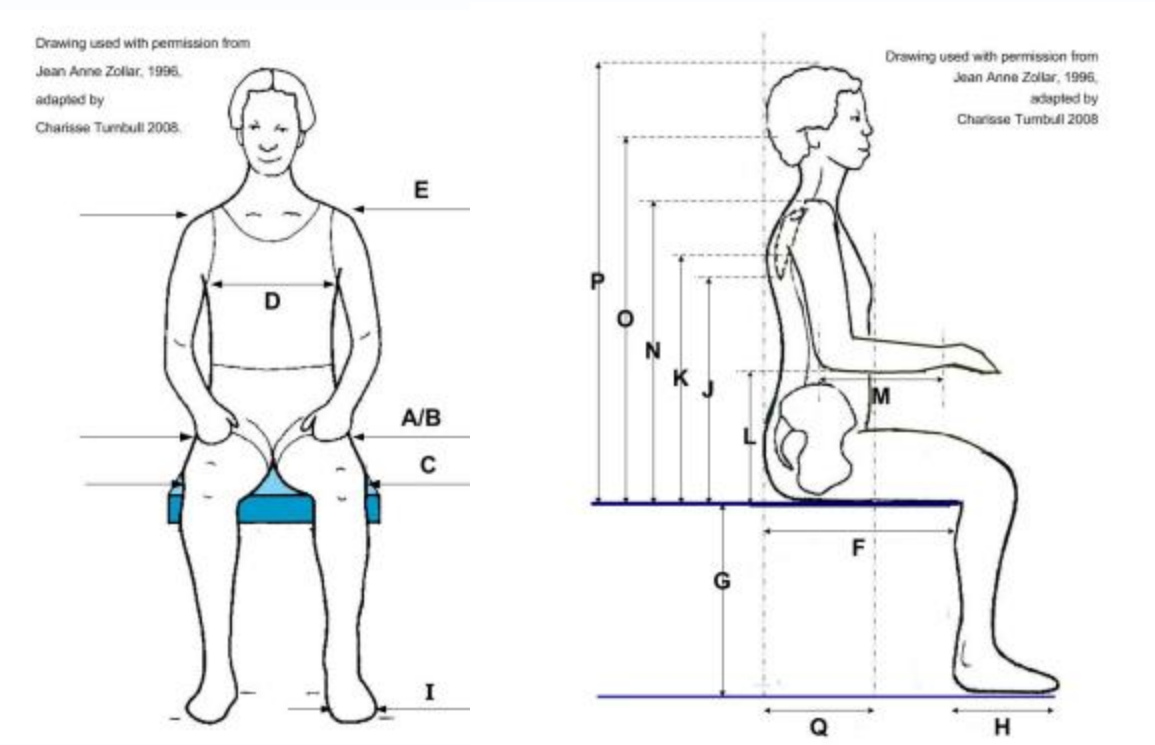
- It maybe because your client is:
  - Currently ambulating
  - Is able to sit on the side of a plinth or bench with no balance problems
  - Has full sensation and the ability to move if uncomfortable and report pain
  - Is able to actively complete a set of hip and spine ROM activities
  - Physical assessment can occur through observation and analysis of activities of daily living
  - Time and funding constrains

- As a “rule of thumb” map everyone's pelvis / collect baseline photos of posture

What is needed?

- Knowing what Neutral Seating is
  - Assist with helping identifying postural tendencies
  - Locating body landmarks of Pelvis – foundation stone of seating!
  - Location of other structures of client's skeleton

- Pelvis upright and levelled
- Shoulder over pelvis
- Spinal curvature in optimal alignment
- Head in midline, balanced over trunk
- Hips and knees in 90 degrees flexion
- Thighs loaded in slight abduction
- Feet below knees



Optimal Vs Neutral Sitting

Neutral sitting – based on anatomical reference point
Optimal sitting – based on patient specific needs (postural control, ROM, tone)

Optimal posture:

- Stable, balanced and as aligned as possible
- Support non-destructive resting posture
- Functional
- Best posture to manage pressure
- Supporting psychosocial / emotional / behavioral functioning

ACI NSW Agency for Clinical Innovation

NSW SSCIS NSW State Spinal Cord Injury Service

Spinal Seating Professional Development Project
Assessment Form AF2.3: Basic MAT Assessment

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: _____° Right: _____°
Degrees Degrees

Position (Frontal View)
☐ Neutral ☐ ABduct° L / R ☐ ADduct° 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: _____° Right: _____°
Degrees Degrees

Lower Leg- Foot Angle
Left: _____° Right: _____°
Degrees ☐ Plantar-flex ☐ Dorsi-flex
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

Summary / Comments:

☐ Consent Obtained
☐ Photo Taken

Produced by NSW State Spinal Cord Injury Service, Spinal Seating Professional Development Program
Illustrations used with permission from Babinec, Michael, 2004 and Zollar, Jean Anne, 1996, adapted by Turnbull, Charisse, (2008) Key Search Words: ACI Seating Basic MAT Assessment
Next Review 2027.

LINDS® REHABILITATION EQUIPMENT

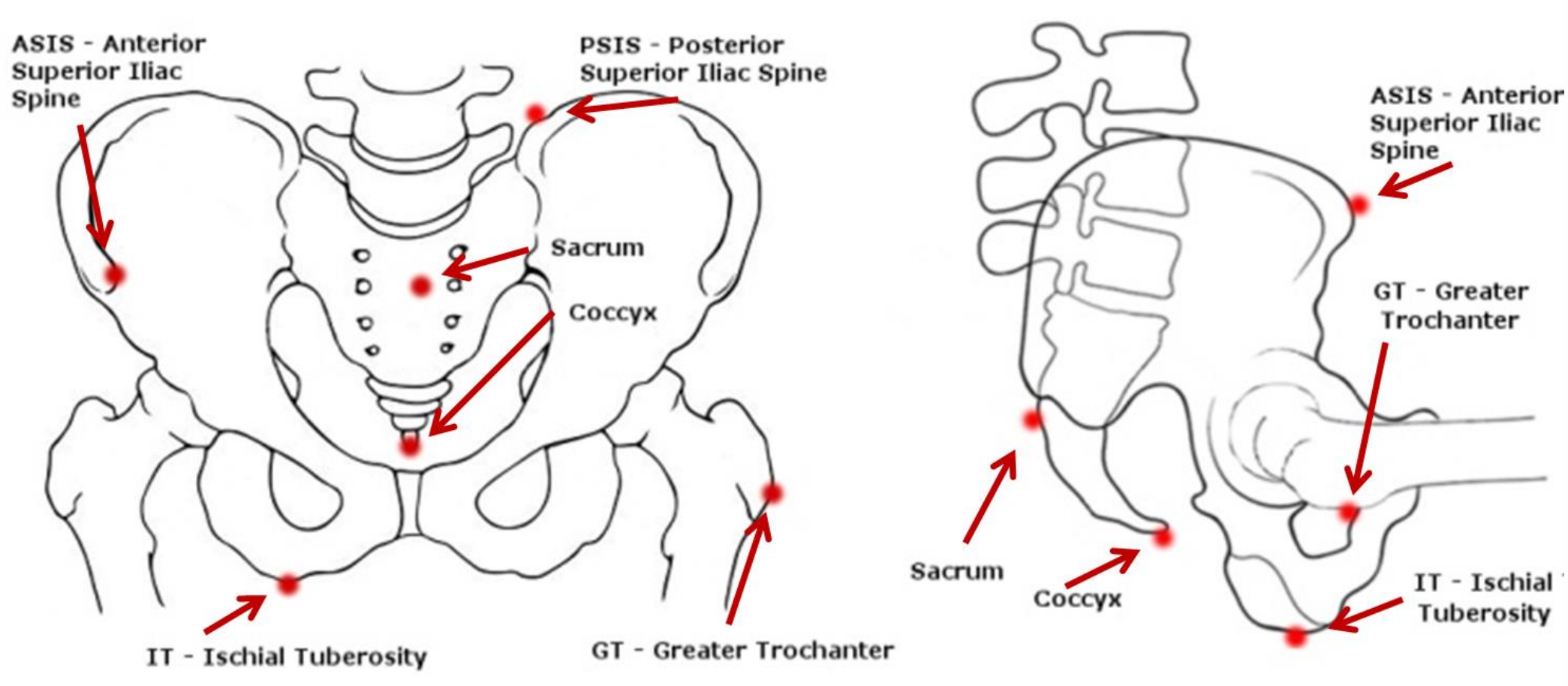
https://aci.health.nsw.gov.au/networks/spinal-cord-injury/spinal-seating/module-3/the-mechanical-assessment-tool-mat

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 the area of distribution.
- Do you need to complete a full MAT Ax to understand the asymmetrical postures?

Hands on Session:



Source: https://aci.health.nsw.gov.au/networks/spinal-cord-injury/spinal-seating/

Talking the talk…….

- **Fixed**-fastened securely in position
- **Flexible / reducible**- able to be easily modified to respond to altered circumstances
- **Accommodating**- to fit in with someone's needs
- **Correcting-** put right back into neutral
- **Obliquity**- neither parallel nor at right angles to a specified or implied line; slanting. Description of higher side.
- **Rotation**- the action of rotating about an axis or from center (neutral)
- **Thoracic Kyphosis**- An abnormality of the spine causing excessive curvature of the upper back
- **Lumbar 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.

- **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.
    - **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

- **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

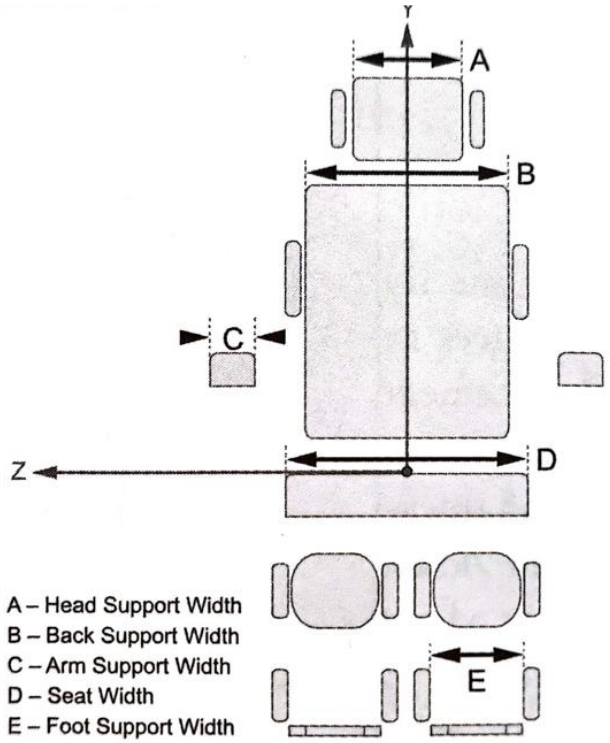
- **ABduct**- Abduction: the movement of a limb or other part away from the midline of the body, or from another part
- **ADduct-** Adduction: the movement of a limb or other part towards the midline of the body or towards another part
- **External Rotation**- rotation away from the center of the body
- **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

Measuring a case study: Yourselves!

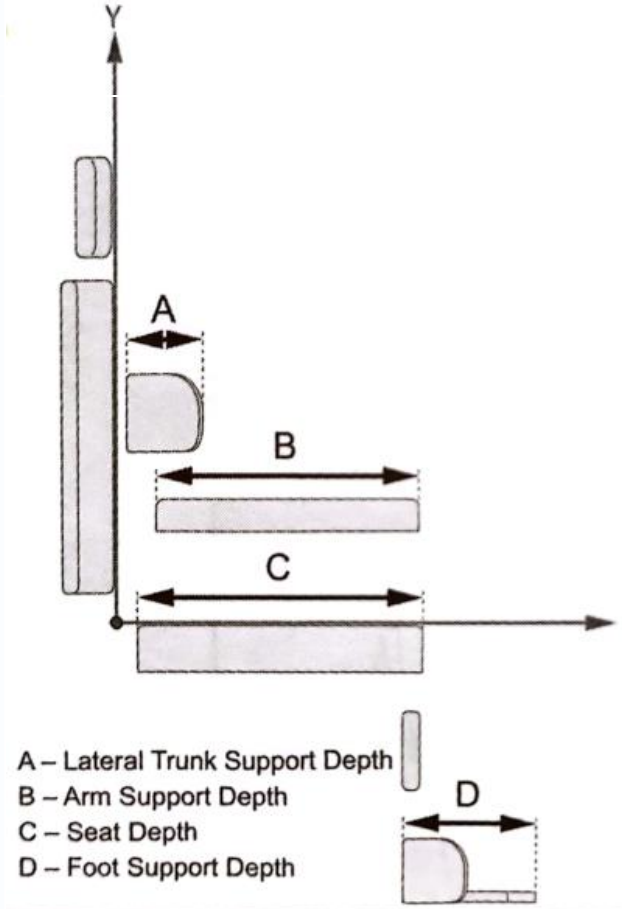
Have a go at measuring each other! Did you notice any discrepancies?

https://www.discountramps.com/how-to/mobility/measure-manual-wheelchair/a/b95/

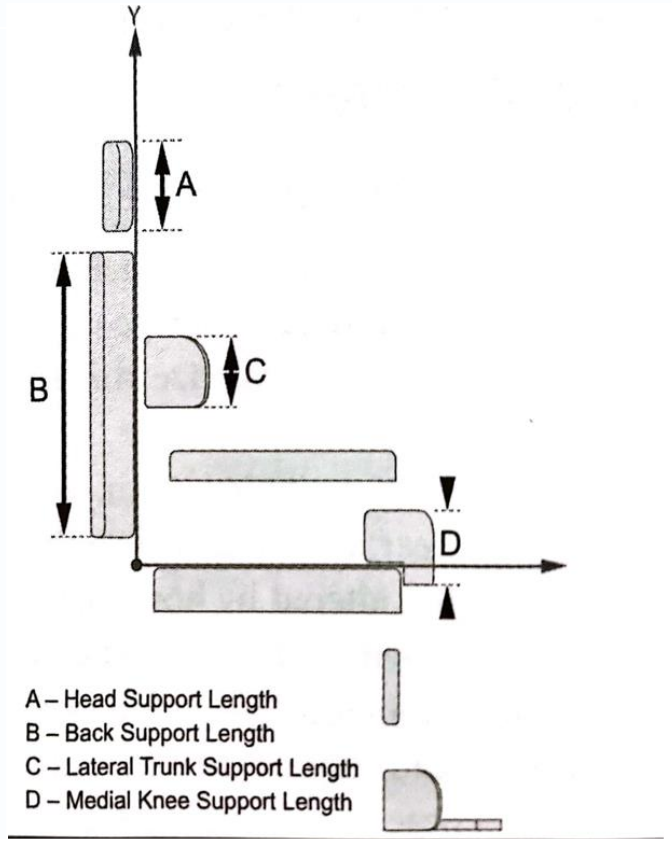
Measuring the Seating System



Linear Seat width Measurement



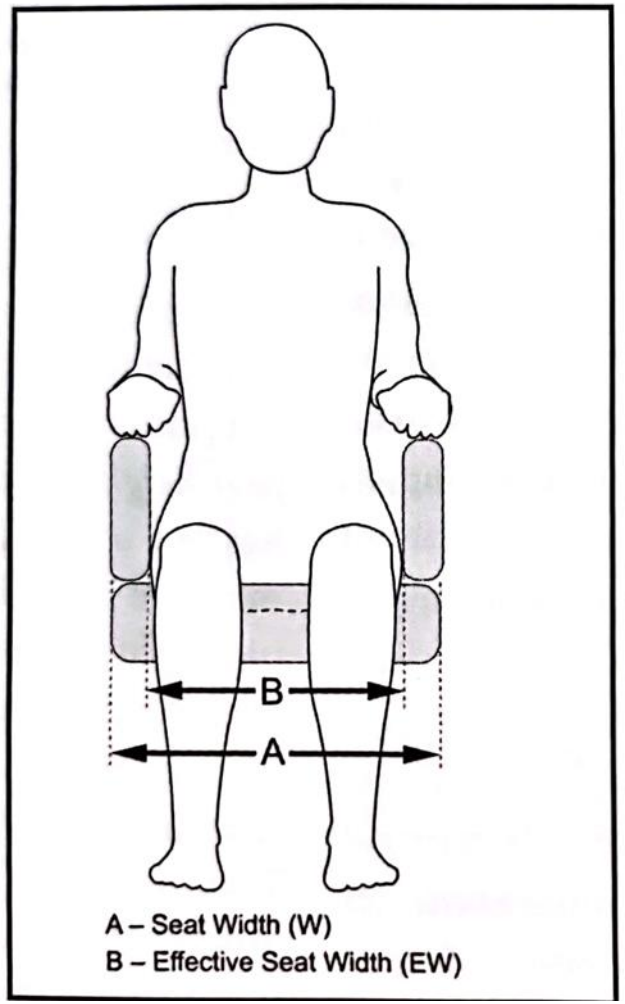
Linear Seat Depth Measurement



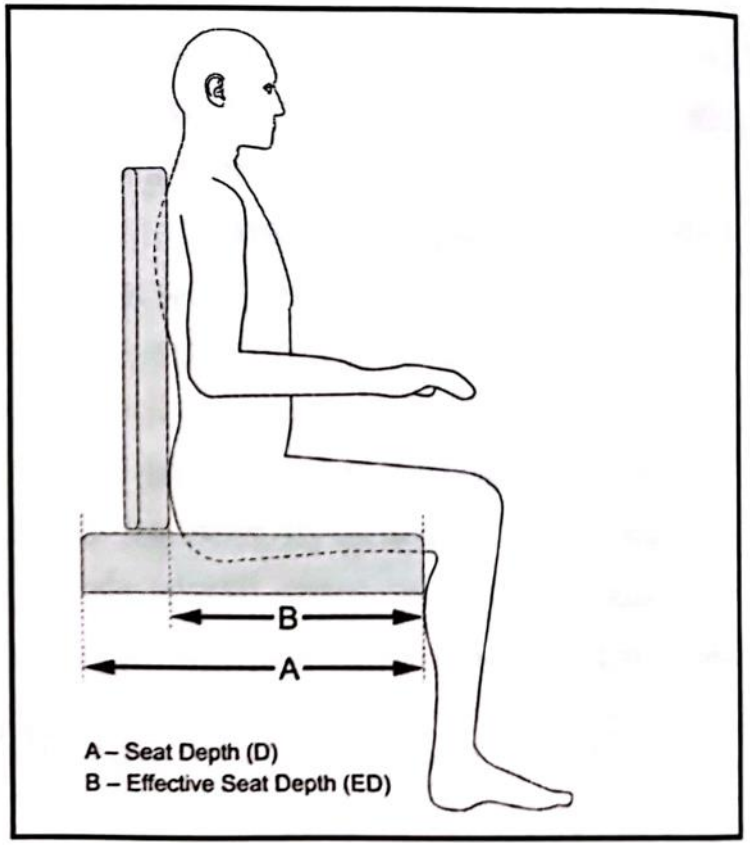
Linear Seat Length Measurement

Waugh & Cane, 2018. Standardized measures of the person, seating system and wheelchair. In Lange & Minkel, Seating and wheeled mobility: a clinical resource guide (pp.85-119). 2018 SLACK Incoprated.

Measuring Effective Width / Depth



Seat Width Vs Effective Seat Width



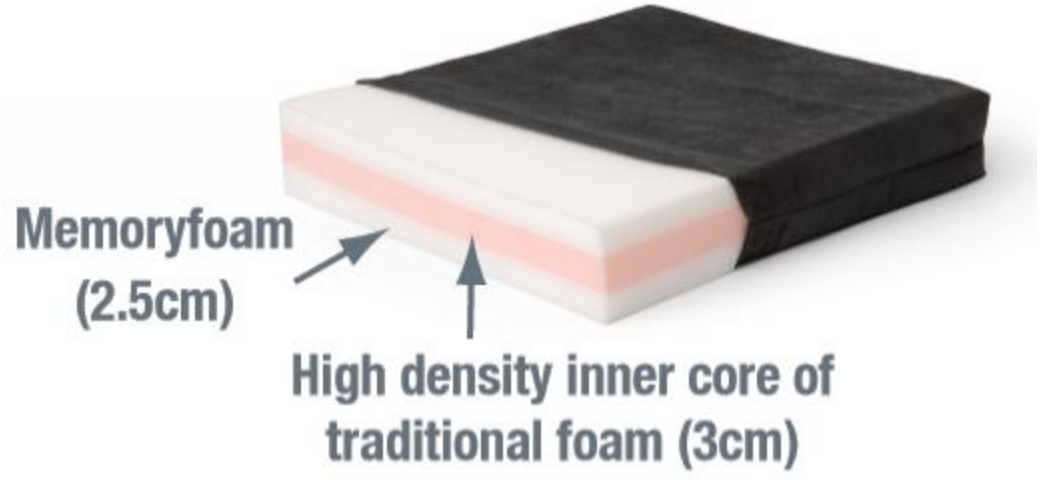
Seat Depth Vs Effective Seat Depth

Waugh & Cane, 2018.

“Choosing a cushion”

Seat Surface:

- Slung upholstery
- Standard foam cushion
- Contoured foam cushion
- Pressure care cushion; with a low, medium or high classification
- Positioning properties



LINDS® REHABILITATION EQUIPMENT

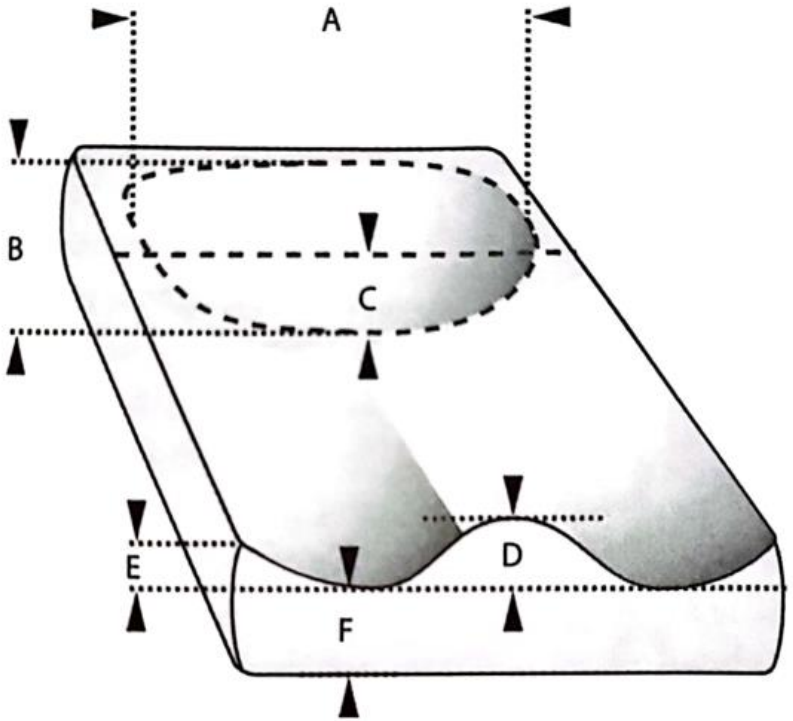
Know what your client needs

Can you answer:

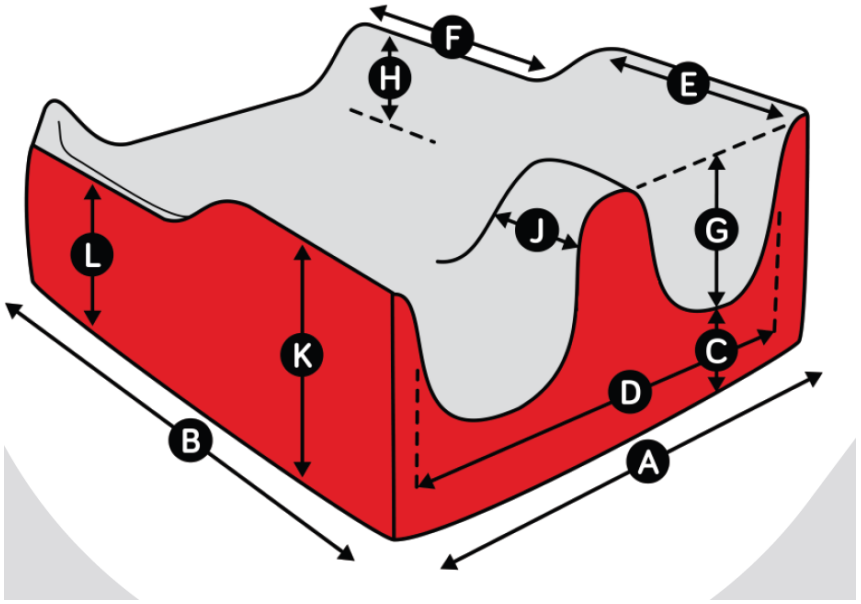
- How long do you spend in the wheelchair?
- Can you reposition yourself?
- How do you function for the wheelchair?
- What are your pressure injury concerns/level of risk?
- Can you maintain the cushion?
- What positioning is required to protect optimal positioning?

LINDS® REHABILITATION EQUIPMENT

Product Measurement - Cushions



A – Pelvic Contour Width
B – Pelvic Contour Length
C – Pelvic Contour Depth
D – Medial Thigh Support Height
E – Lateral Thigh Support Height
F – Seat Thickness at Front

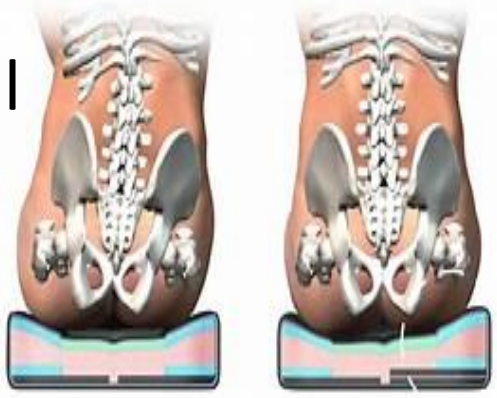


https://www.spexseating.com/product/

How does this relate to setting up the backrest on the wheelchair?

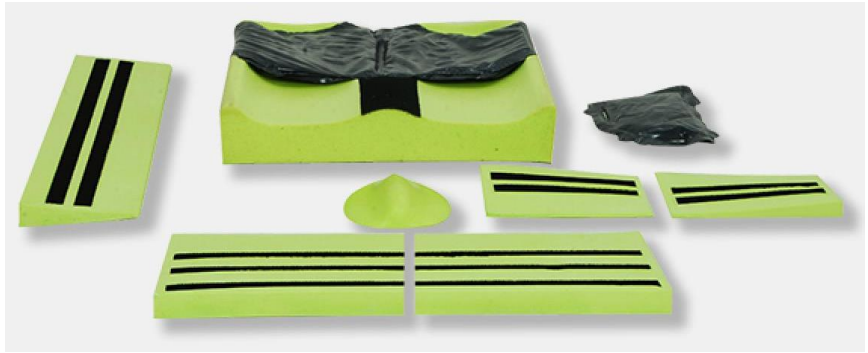
Positioning Properties of the cushions – building the base of support

- Aim is to reduce peak pressures and increase area of contact while providing postural alignment and stability
- Pelvic/ischial well – characterised by a pre ischial shelf, Greater Trochanter (GT) shelves, Ischial Tuberosity (IT) off load area and coccyx off load area. Differing degrees of ischial well depth and length, as well as GT shelf width. Differing immersive materials used in the well: foam, memory foam, gel, fluid gel or air.
- Correct or accommodate obliquity from the pelvic/ischial well by capturing the lower IT/ischium and GT. Build up under the cushion with a firm positioning foam, increase fluid gel or air volume.



LINDS® REHABILITATION EQUIPMENT

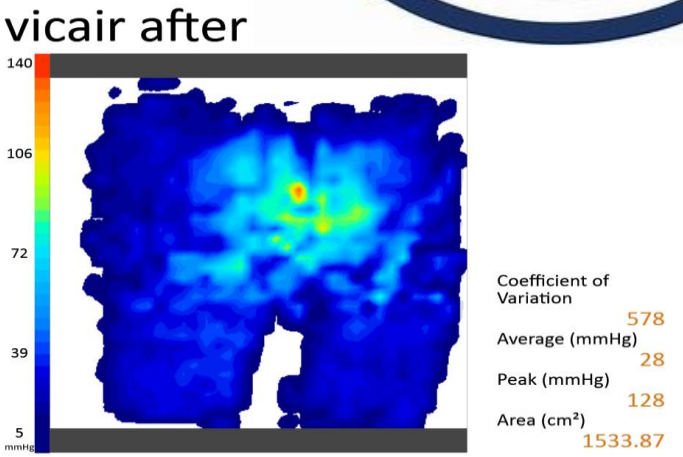
- Hip Guides – used to block the higher hip in a hip obliquity and help prevent hip abduction. Can be built into cushion or installed to the wheelchair frame or positioned between the hip and the arm rest.
- Leg troughs – guide hip alignment. Characterised by inbuilt thigh guides and pommel. Differ in depth with deeper troughs increasing positioning support. Thigh guides and pommels can be added external of the cushion and attached to the frame.
- Raised Front – Increase thigh contact for those with tight hip flexors, create seat rake to assist with a neutral pelvis.
- Hip belts – for pelvic positioning and stability, 4 or 2 point frame connection, padded neoprene or gel



LINDS® REHABILITATION EQUIPMENT

“Pressure Care Immersion”

- Most pressure cushions are made from durable materials that are specifically designed to redistribute pressure away from bony prominences. They ‘offload’ the body’s weight evenly across the cushion surface.
- Reactive surfaces use envelopment and immersion to increase surface area, reducing interface pressure.
- What material is best??? Foam, gel foam, visco foam, memory foam, gel, fluid gel, elastomer and air.
- Maintenance, Maintenance, Maintenance
- Temperature regulation and moisture wicking
- Pressure mapping images

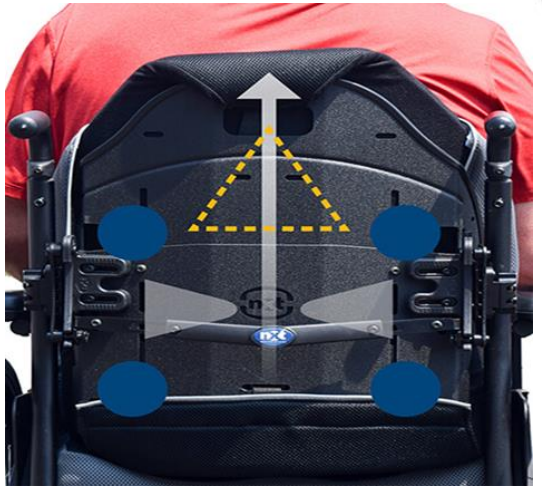


LINDS® REHABILITATION EQUIPMENT

“Choosing a Backrest”

Backrest support:

- Standard tensioned back upholstery
- Tension adjustable back upholstery
- Postural support backrest – solid back
- Active contour vs deep contour
- Adaptive contour support
- Off set lateral support
- Pressure care in the backrest

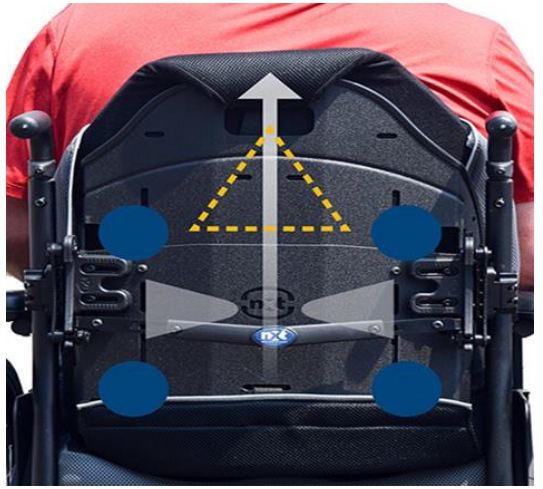


LINDS® REHABILITATION EQUIPMENT

Know what your client needs

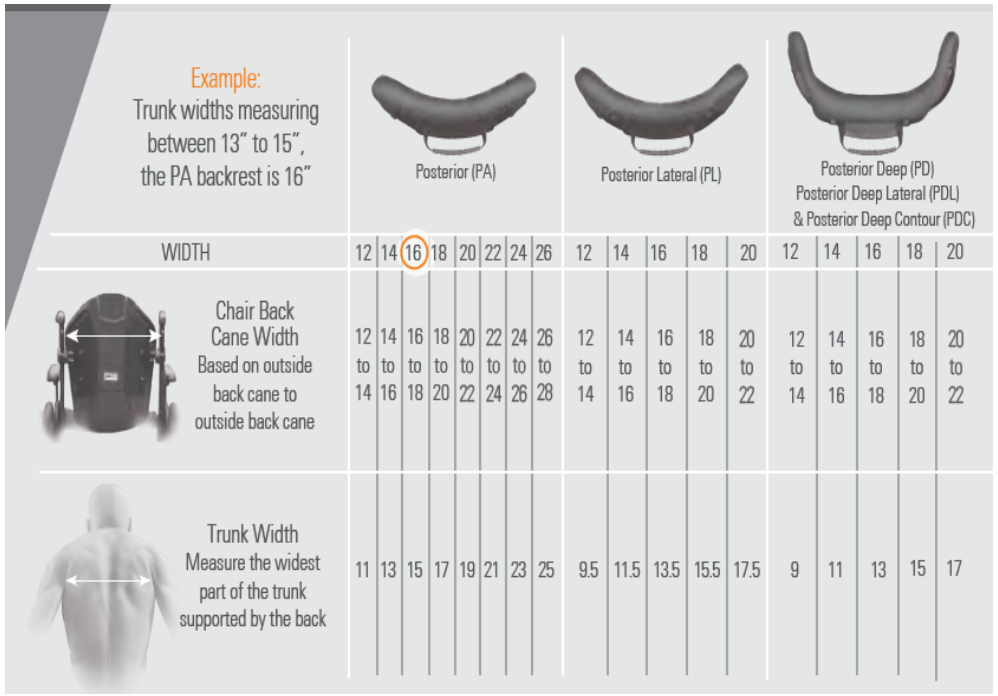
Can you answer:

- What is your posture like after 2hrs?
- How do you function from sitting?
- Do you fatigue throughout the day?
- What upper limb function do you have?
- Do you need to remove the backrest?



LINDS® REHABILITATION EQUIPMENT

Product Measurement - Backrests



https://www.sunrisemedical.com.au/seating/jay/wheelchair-backrests/jay-j3-backrest

https://stealthproducts.com/?p=539

https://www.spexseating.com/product/

How does this relate to setting up the backrest on the wheelchair?

LINDS® REHABILITATION EQUIPMENT

Positioning Properties of the backrest – Supporting the spine and life box

- Aim to help support spinal curves as well as promote a more upright posture, enhance respiration and encourage increased skills such as wheelchair propulsion and reaching.
- Don’t underestimate a tension adjustable back and appropriate back angel to provide optimal support.
- Support and block the posterior superior iliac spine (PSIS) promoting pelvic stability and pressure redistribution. Using increased tension OR solid backrest contact OR specific PSIS foam insert.
- Shell shapes vary from brands – differing depths of concaved with varied degrees of thorax and lumber support heights and depths. Active vs postural deep support.

LINDS® REHABILITATION EQUIPMENT

- Promoting a neutral spine – Spine align foam inserts from Jay, lumber roll supports, Spine fluid pads.
- Adaptive backrests – support asymmetrical postural and boney prominences
- Lateral supports – built into the shell often provides symmetrical support, external hardware/swing away or fix provide targeted asymmetrical support, variety of pad shapes to optimize pressure distribution.
- Pressure Care – off loading property and immersion of the foam, breath ability of the cover and system, temperature regulation properties.
- Hardware adjustments – to support thigh to trunk angle from the backcane or backrest hardware, trunk rotation, quick release for transport, heavy duty
- Positioning harnesses and straps – provide anterior support for the thorax

LINDS® REHABILITATION EQUIPMENT

“Choosing a Headrest”

- Basic headrest supports for transport
- Head support used occasional to support posterior resting position
- Head support used in tilt function only
- Head support required at all times when seated to support postural alignment
- Complex head supports for asymmetrical head positioning and increased lateral and/or anterior supports

LINDS® REHABILITATION EQUIPMENT

Know what your client needs

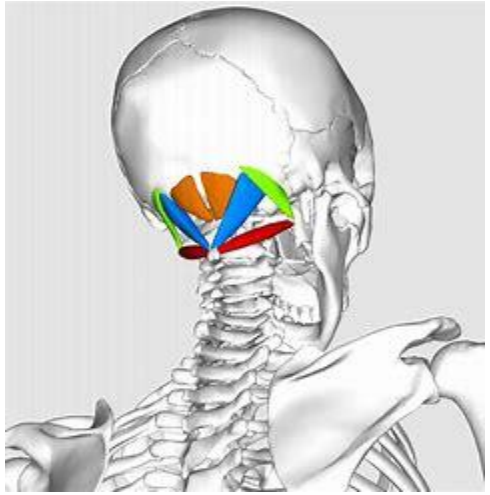
Can you answer:

- Does the headrest need to be removable?
- Is there a recommended positioning for swallowing?
- Does the client push through the headrest?
- Does the head fatigue forward or to the side?

LINDS® REHABILITATION EQUIPMENT

Positioning Properties of the headrest – Supporting head and cervical spine

- Aim to position the head in a neutral position by providing posterior, suboccipital support to open airways and promote optimal feeding/drinking opportunities; eye contact and increased visual field; promote speech. Lateral and anterior support is occasionally required.
- Gravity may be against you.
- Shell sizes and contours vary between brands – matching size not only to the suboccipital region but also range of function, depth of the suboccipital cradle.
- Foam interface –comfort and maintaining skin integrity
- Covers – Lycra - durable, water-resistant material with 4-way stretch; Fleece - natural lambswool that is washable and soft on skin; Dartex Reversed - anti-allergenic, waterproof material with 2-way stretch



LINDS® REHABILITATION EQUIPMENT

- Lateral support – convex of the shell, adjustability built into the headrest, externally applied with adjustable hardware
- Anterior support – applied to the forehead via straps or pads; applied under the jawline from cervical collars
- Hardware – centralised or off set; multi axial; active; extended reach; removeable; flip back
- Consideration for switch access

LINDS® REHABILITATION EQUIPMENT

Positioning properties – Leg supports and foot plates

- Aim to provide an even surface of support that allows for neutral positioning of the feet, assisting the brace and balance posture for stability of the pelvis.
- 90°- 60° range determined by comfort and postural abnormalities. Tight hamstring and contracture management accommodating ≤90°, the impact of shear forces and repositioning plays on leg rest angles.
- Are the foot plates used to bear weight? Is there breakage?
- Consider using the leg rest to protect lower limbs and accommodate foot placement using a depth and angle adjustable foot plate. Legrest covers, thigh guides, knee guides protect skin integrity.
- Elevating leg rest provide angle adjustability and support beyond 60°, consider the shear effects and counter angels at the hip on posture.
- Where is pressure distributed when accommodating compromised foot angels; planter flexion, eversion and inversion?
- How do we need to pad the foot plate area? How much immersion and pressure distribution is required at that surface?
- What foot supports required? Heel loops, calf strap, foot box, shoe strap, ankle huggers and the impact on friction

LINDS® REHABILITATION EQUIPMENT

Positioning properties – Armrests

- Aim to provide “Prop Sitters” with a supportive surface to maintain trunk positioning, positioned to support neutral positioning of the shoulders and neck, creating increased surface contact with the forearm.
- How at risk is the area? Based on bony prominences? Shear forces? Friction? Combination of all?
- Can the amount of direct pressure be reduced through other postural supports?
- Tray support
- Do the armrests need to be wider? Do they need to be soft? (Gel Ovations, waterfall arm pad)
- Arm troughs to support residual limbs. Does it need to come across the body and move away for transfers? Does the elbow need to be blocked to stop the limb falling off the arm pad? Does the hand need position support? What is the impact of oedema on skin integrity?
- When do we consider using dermal saver applications for extremely compromised areas?

LINDS® REHABILITATION EQUIPMENT

Case Study: Complex Seating

Carey is a 76yo lady that presents with a dense right hemiplegia from a stroke 10 years ago.
She is currently sitting in an off the shelf wheelchair, but it is not providing sufficient support, therefore sits in a recliner / bed most of the day.
Staff reports that she “slumps forwards in the chair and tends to lean over right armrest as the longer she sits out (more than 45mins).

Presenting posture:
- Left hip obliquity (1”) non correctable
- Severe posterior pelvic tilt – slight correctable
- Passive Hip flexion of 80 degrees
- Mildly thigh hamstrings with popliteal angles of 100 degress
- Mild planarflexion contracture on his right feet at -5 degrees
- Kyphosis starting from middle thoracic, slightly correctable
- Collapse of right trunk correctable with significant support
- Head and neck alignment able to achieve midline with support

LINDS® REHABILITATION EQUIPMENT

Case Study: Bariatric Seating - Complex

Leonard is a 52 year old gentleman, who has an ABI from an accident approx. 20 years ago. He presents with a hip that is fixed in right obliquity, with reduced thigh to trunk angle of approx. 100degrees. He also has fixed knee range, with each knee to thigh angle of approx. 110 degrees.
Due to his accident, he also suffered degloving injury to his right leg and significant nerve damage to his left. The has caused significant edema on his LLs.

Current Wheelchair measurements:
Width: 24”
Depth: 22”
Gluteal shelf: 2”deep, 7”high
Armrest: 18” from backcanes

Main postural complains:
- significant back pain
- leaning too far to the left
- pressure injury under left side of apron

Non-negotiables: Not able to extend width as he cannot access taxis / doorways of favorite hangouts

LINDS® REHABILITATION EQUIPMENT

LINDS®
REHABILITATION
EQUIPMENT

Conclusion…

Measuring up for a wheelchair / seating system can be dauting, but practice, practice, practice!

Having a second opinion / assistance can help build your confidence

There are many useful resources out there that can assist your assessment process!

- NSW State Spinal Cord Service & Agency for Clinical Innovation modules
  https://aci.health.nsw.gov.au/networks/spinal-cord-injury/spinal-seating/module-1

- WHO Wheelchair service training package (basic and intermediate)
  https://iris.who.int/bitstream/handle/10665/78236/9789241503471_reference_manual_eng.pdf?sequence=1

- Clinical application guide to standardised wheelchair seating measures of the body and seating support surfaces
  https://www.ucdenver.edu/centers/center-for-inclusive-design-and-engineering/clinical-services/wheelchair-seating-measures-guide

- Us @ linds!
  lauren@lindsrehab.com.au & Jacelyn@lindsrehab.com.au

Reference:

Waugh & Cane, 2018. Standardized measures of the person, seating system and wheelchair. In Lange & Minkel, Seating and wheeled mobility: a clinical resource guide (pp.85-119). 2018 SLACK Incoprated.

Waugh & Cane. 2013. A clinical application guide to standardized wheelchair seating measures of the body and seating support surfaces. A revised guide. Accessed on 10.10.23 at https://www.ucdenver.edu/centers/center-for-inclusive-design-and-engineering/clinical-services/wheelchair-seating-measures-guide

Lange & Minkel, 2018. Seating and wheeled mobility: a clinical resource guide. SLACK Incoporated

Agency for Clinical Innovation, 2023. Module 4: Body measures. Spinal Seating modules. Accessed at https://aci.health.nsw.gov.au/networks/spinal-cord-injury/spinal-seating/module-7/recognise-key-relationships-between-the-client-and-the-wheelchair