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Dynamic Manual Wheelchairs for Function and Independence

Presented by: Lauren Hunter, Occupational Therapist and Clinical Educator Linds Rehab

RESNA Position on the Application of Dynamic Seating

"For the purposes of this position paper, "dynamic seating" is defined as movement which occurs within the seating system and/or wheelchair frame in response to intentional or unintentional force generated by the client. Dynamic components absorb force. When client force ceases, the stored energy is returned through the dynamic component, which in turn assists the client back to a starting position."

"Dynamic seating moves in response to client forces."

Lange, et al, 2020

LINDS® REHABILITATION EQUIPMENT

Adjustable Manual Wheelchairs for Function and Independence –

Overcoming static sitting postures

Presented by: Lauren Hunter, Occupational Therapist and Clinical Educator Linds Rehab

Presentation objectives:

Develop

Develop an understanding of the movement components in wheelchairs that provide active seating solutions and their associated benefits for the end user

Understand

Understand the evidence-based research associated with using active features in wheelchair prescription

Look

Look at the process of prescription to ensure we are matching the model features of the wheelchair to the user to maximise outcomes

Explore

Explore the range of manual tilt in space wheelchairs and dynamic components available on todays market to discuss the points of differentiation to help refine your wheelchair prescription process.

Define Active Seating

- Active sitting occurs when seating allows or encourages the seated occupant to be active even whilst seated. The concept is that flexibility and movement while sitting can be beneficial to the human body and make some seated tasks easier to perform.
- The wheelchairs role in being active offers repositioning benefits to wheelchair users who are unable to provide movement for themselves, so we look to the wheelchair components to do it for them. Moving out of gravity and moving into functional positions.
- In contrast to static seating systems dependent on the wheelchair user to change positions to counteract the potential harm of sedentary seating.

What Does Static Sitting do to the Human Body?

- The human body is not well adapted for long hours spent sitting in a restrictive or constrained posture.
- Static sitting occurs when seating is rigid, and results in sustained mechanical tissue loading. Current recommendation is to move out of static positions every 60minutes.
- In static sitting:

➢ The abdominal muscles may instinctively relax and even atrophy over prolonged periods

➢ Prolonged postural loading of the spine

➢ Decreased circulation, particularly of the legs and buttocks

➢ And the effects of fighting gravity can place the upper back and neck muscles into positions of strain that contribute to muscle tension resulting pain

What Does Static Seating do to the Wheelchair User?

- Many wheelchair users are positioned in seating devices that result in static body posture for the ability to have a lightweight wheelchair to increase maneuverability and active function from the wheelchair.
- For some, reduced postural stability in prolonged sitting may cause them to adopt a compromised postures such as a flexed spinal and posteriorly tilted pelvis, lateral lean.
- As these individuals may be unable to physically reposition without considerable assistance (dragging from under armpits and shearing the body), their bodies can be subject to considerable positional strain and immobility, with detrimental physical repercussions.
- Research tells us the adverse health effects for such wheelchair users include the formation of pressure ulcers, low back pain, neck pain and lumbar immobility, joint stiffness and adverse physiological effects on the cardiovascular, respiratory and digestive systems.

Gravity & Seating

- Gravity is always the greatest force acting upon our bodies. Without gravity, all people and other objects would go floating off into space.
- Gravity affects posture even in a seated position. Because of this, the body has developed natural active responses to gravity. Rarely does one sit still for extended periods of time. Our bodies need to exert sufficient force against gravity to keep us upright and midline.
- Kay Koch, OTR/L, ATP, tells us “There is no single ideal sitting posture beyond the anthropometric reference to a sitting posture of 90°-90°-90°. Eventually everyone fatigues out of this posture and slides into a position of comfort and support.”
- But what happens when the static seating system prescribed doesn’t provide adapting support?

Why & when do we consider movable features in wheelchairs for function and independence?

Adaptable vs Static wheelchair solutions?

Wheelchair prescription process: Identifying Occupational Performance Issues

- Kicking off our assessment processes with a referral to assess for a wheelchair
- Collaboration with the client, family, treating health professional and support workers to gather a thorough background
- Standard initial assessment practices help to identify:

✓ Medical Hx (clinical condition, comorbities, acute, progressive or palliative)

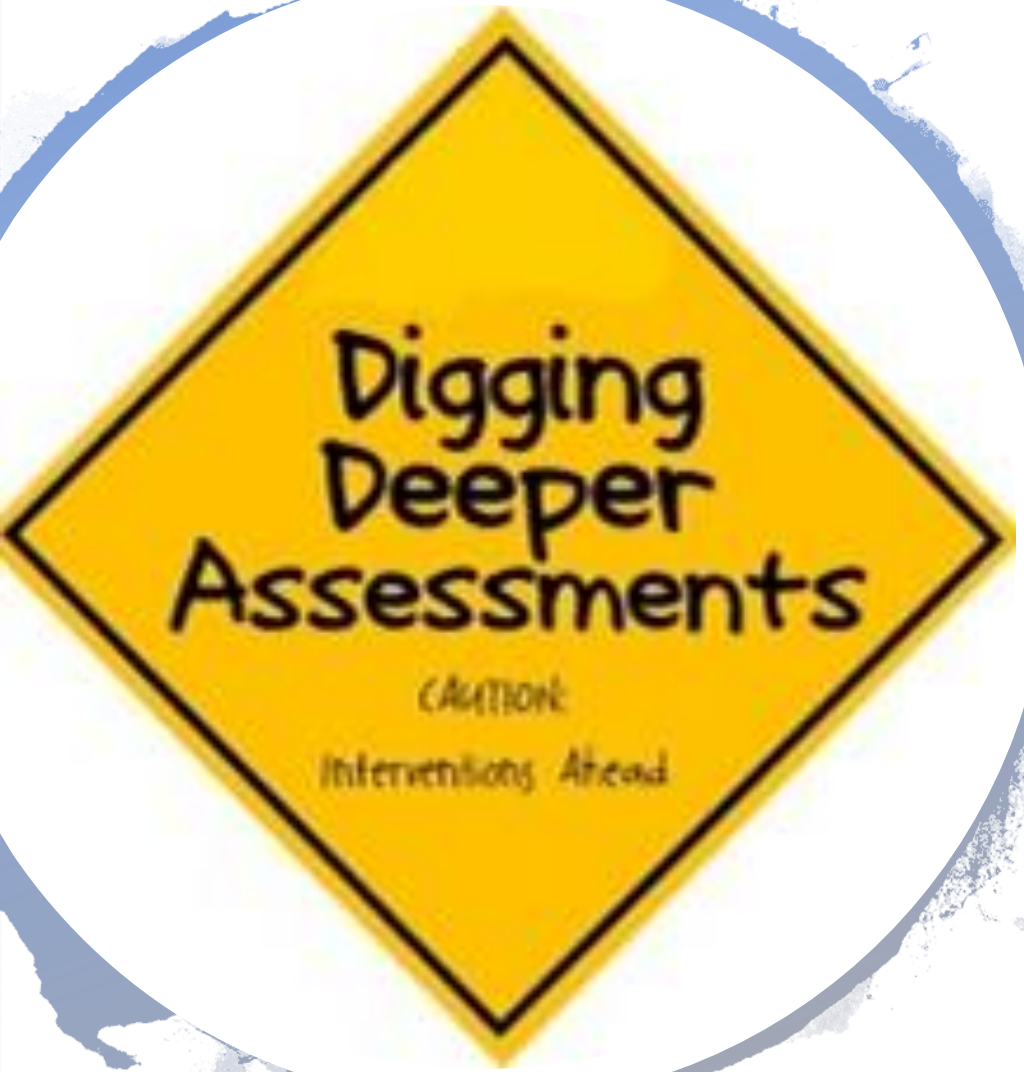
✓ Physical and cognitive symptoms

✓ Level of independence (pre-morbid, current, foreseeable)

✓ Other assistive technology used

✓ Their life roles and responsibilities

✓ The environments they frequently interactive in



Other assessments specific to wheelchair prescriptions

- Organisation specific proforma
- Pressure risk tools
- MAT (mechanical assessment tool) evaluation for complex clients
- Cognitive screen
- Sensory Profile
- Wheelchair skill specific

Draw out details of intended use to make clinical decision about prescribing tilt in space and dynamic wheelchairs

- How long will you be in the wheelchair for? How many times do you typically transfer out of the wheelchair to achieve a change in positioning?
- How are you managing pressure care/ how do you intend on managing pressure care?
- Can you weight shift? Best practice – either ischium is partially unloaded (> 30% pressure reduction) for > 15 seconds; if yes, how often is it being done? Is it done through ADL engagement? Is there a shift in weight every 20mins? Show me!
- How do you intend on achieving pressure relief every hour? Best Practice – left and right ischium fully unloaded for > 15 seconds and < 2 minutes. Show me!
- Do you want to be independent in changing your position or do you have support from others for this?
- What functional tasks do you complete independently from when in the wheelchair? E.g. I must be able to don/doff my pants in the wheelchair for toileting; I need to be positioned and supported upright when drinking and eating…
- Will you be transported in the wheelchair?

Setting Goals for Mobility & Seating

- Collaboration between therapist/s & consumer/their support network
- Will it be independent or assisted mobility? Or a combination of both.
- Does the seating system need to be dynamic or is the user able to change position throughout the day? Or a combination of both.
- Does the seating system need increased postural supports and pressure care?
- Are you setting S.M.A.R.T goals? (Specific; Measurable; Achievable; Relevant; Time Bound)
- Example: “Mary will be able to independently and safely mobilise around her home using a manual wheelchair to complete her activities of daily living as a part of her daily routine, post participation in a 1 month wheelchair skills intervention program”
- Example: “Mary will be supported to remain in her tilt-in-space manual wheelchair for an 8hr day with independent use of power tilt following a pressure relieving regime provided by OT to shift between 0°-30° for comfort and function, using 45°-50° for pressure relief every hour > 15 seconds and < 2 minutes; measuring change in grade 2 pressure wound post 3month healing and application of regime”
- Identifying what daily tasks will be completed by the consumer while positioned in the wheelchair (performed independently vs with assistance)
- Short-term vs long-term goals

Identify the features in the assistive technology that are MUST HAVES to achieving the consumer goals

- It helps if you can develop a consumer priority list and a therapist priority list
- You will tackle this next step differently, depending on your level of experience prescribing the specific type of wheelchair the consumer needs
- An experienced therapist will start thinking about a specific product and its features, and will build the assistive technology prescription they want trial at this stage
- A therapist with limited experience wont always feel confident in this step… but they know the outcomes they want to achieve
- As the therapist; our priority should also be to protect the life box, protect the skin, create function & reduce risk to further disability.

Differentiating between the models of wheelchair and seating system that are available to prescribe… Specifically for adaptable and active wheelchair prescription

- Features of dynamic wheelchairs :

➢ Tilt in space

➢ Recline

➢ Elevate/Anterior tilt/ transfer assist tilt

➢ Elevating leg rests

➢ Dynamic footrests

➢ Dynamic back canes

➢ Dynamic headrest

Tilt In Space

- Tilt-in-space refers to changing the orientation of one sitting in a wheelchair, but keeping the hip, knee, and ankle angles the same.
- Designed to provide very specific benefits for both the wheelchair user and the caregiver to overcome the effects of gravity
- Management of tone and abnormal reflexes
- Available in set ranges from 20°-50° of tilt
- Assists in positioning during initial transfer and repositioning throughout the day
- Assists in maintaining posture to reduce the need for repositioning throughout the day reducing shear forces
- 20° of tilt used for postural positioning, promoting open postures aids in physiological functioning, improves line of vision, allows for better access to the wheel for propulsion with the ability to come flat for function and transfers
- 30° of tilt proven to be beneficial for weight shifting posture and managing the effects of gravity on the posture over time
- 45°- 50° best practice for pressure relief every hour for > 15 seconds and < 2 minutes

Tilt Mechanics:

- Gas assisted with no adjustment drops into frame
- Gas strut spring loaded with weight support options drops into frame
- Rocker arm with pins to lock and release
- High pendulum points with pins to lock and release
- Power tilt

Gas strut no adjustments

- **Pros**
  - Aid the ergonomics and comfort for conveniently changing seated positions
  - Lockable gas struts make it possible to variably lock them in any stroke position
  - Found in more economic models for applications in facility environments
- **Cons**
  - Carers often feel the weight of the person and need two hands to adjust the person and seating system

Gas strut spring loaded with adjustment for weight drops into frame

- **Pros**
  - Same ergonomic and positioning benefits as previous slide; however now calibrated to occupant's weight to aid in ease of movement of the seating system
  - One handed effortless adjustments for carers
  - Front floor to seat height does not change when tilted, assisting foot propellers with positioning
- **Cons**
  - Must have weight on the system to adjust seat position, more crucial when bringing out of tilt as it can have a catapult effect

Rocker Arm

- **Pros**
  - Ease of tilt comes from a balanced seating system and aligned centre of gravity assisting with manoeuvrability of the base.
- **Cons**
  - Dirt and bodily fluids are drawn to the centre of gravity on the track, if not cleaned regularly becomes sticky and disrupts ease of adjustment.
  - Mechanical lock mechanism is always under load when in tilt, resulting in increased effort to disengage (especially larger clients and forward mounted seating systems) and the clunk/drop when trigger is squeezed. This clunk can trigger tone/spasms in many clients

Pendulum Pivot

- **Pros**
  - Perfect centre of gravity pivot positioning already set at point of pendulum
  - High pivot point is virtually impossible to contaminate
  - High pivot point facilitates almost effortless tilt movement- today and years down the road.
  - Mechanical lock never under load, eliminates the “clunk” and reduces wear and damage.
- **Cons**
  - Reduced mounting options for pelvic positioning products
  - Side mounting plates can reduce pelvic access

Power Tilt (on manual wheelchair)

- **Pros**
  - Independent repositioning for occupant
  - No weight bearing for support person to alter seat position
  - Allows client to retain some control of their world
  - Facilitates subtle time sensitive adjustments – slight tilt to watch television or talk to someone who is standing (change visual plane)
- **Cons**
  - Requires cognition, must be able at control switch in and out of tilt consistently
  - Some models can add substantial weight to the chair.
  - Some models are not able to be retro- fitted in the field, require factory installation(usually in the US)

Recline

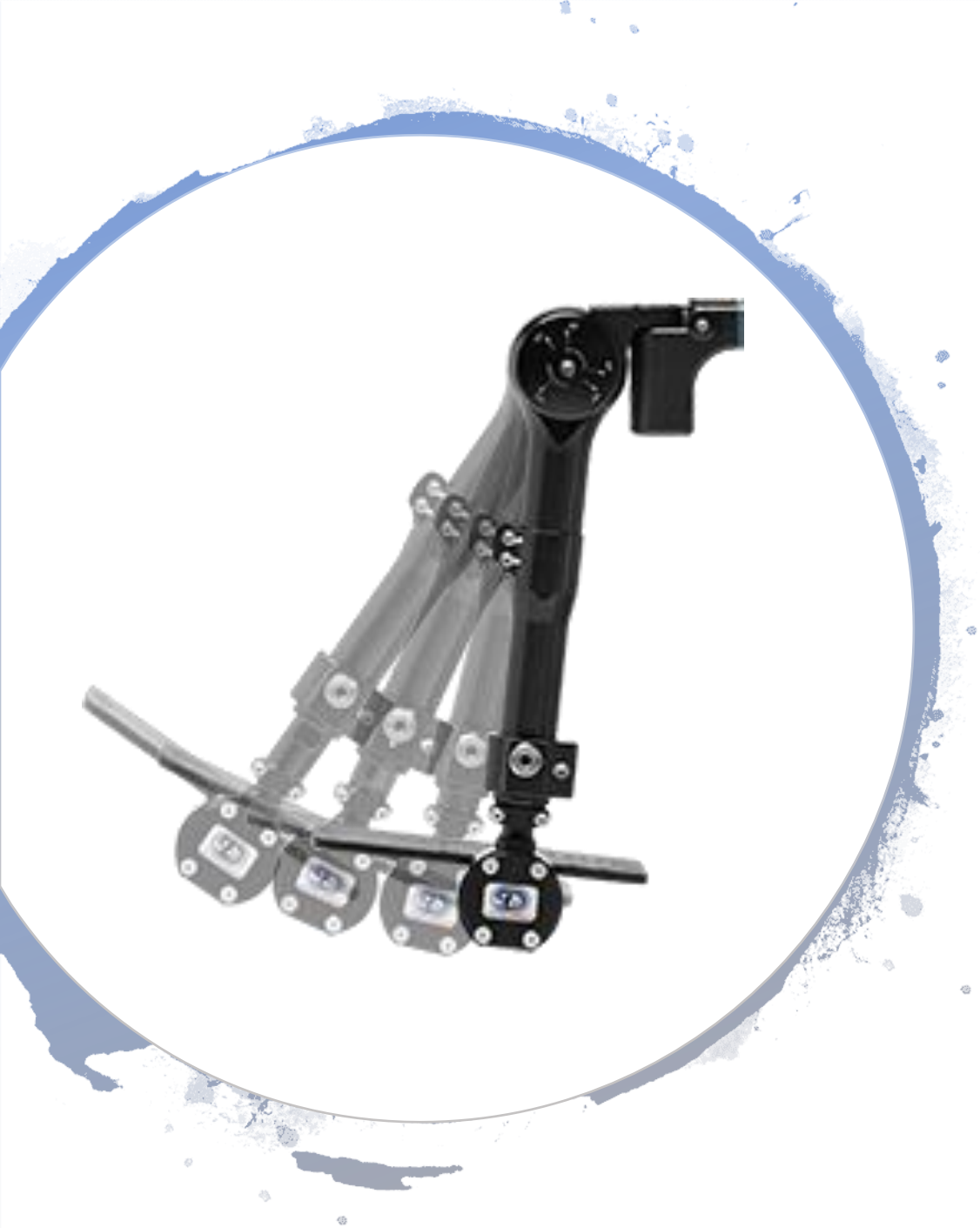
- Recline systems provide a change in seat to back angle orientation while maintaining a constant seat angle with respect to the ground
- Tilt, recline and elevating leg rests together provide a means for gravity assisted positioning. Most individuals generally need recline angles that can be changed, especially with poor trunk or head control. Tilt and recline together can alter the user's center of gravity to gain balance and stability for functional tasks and positioning, with feet properly supported through the leg rests.
- Opening back angles on active systems can also provide functional opportunities to don/doff pants for toileting and self catherization / who gets catharized in the chair; allowing for taller back supports in active use as well as providing positions of comfort.
- Proper postural alignment using tilt and recline may also aid in maintaining vital organ capacity and has several physiological implications including managing orthostatic hypotension; visual orientation, speech, alertness, arousal, respiration, and eating; as well as bowel and bladder management
- Recline functions can be prescribed as manual release or tool adjusted on manual dynamic seating systems
- Protect against shearing for compromised users when prescribing dynamic recline options

Elevation/ Anterior Tilt

- Dynamic adjustment in an ultra lightweight wheelchair allows the user to go from an optimized propel position to an optimized comfort/sitting position on the fly
- Setting degrees of seat elevation for active users allows them to embrace daily activities, assisting them to adapt to a variety of environments that aren’t necessarily going to adapt to meet their needs.
- Gas strut adjustments allow for on-the-fly changes in seat height, turning a functional high seat height into a dump and squeeze active user position in a second.
- Anterior tilt in the seat from a dump position also has positive implications to assist with transfers, including wheel clearance in a slide transfer
- Any change in dynamic seating position assists with weight shift

Elevating Legrests

- Offer changes in lower limb position for comfort in knee joints and to protect from excessive swelling of the feet and ankles
- Provide positioning for NWB limbs, distributing weight through the calf muscle instead of the foot
- Work in conjunction with other dynamic components to offer weight shift and pressure off load opportunities for occupants as brace to prevent pelvic tilt



Dynamic Footrest

- Dynamic Footrests provide up to three types of movement – a telescoping movement, knee extension, and plantar/dorsi flexion
- Provide movement in response to client movement
- Forces are absorbed, protecting both the client and the wheelchair frame and seating system from harm
- Extensor tone is absorbed and diffused, reducing overall tone and repositioning
- Movement is provided to sensory seekers, which can increase sitting tolerance, decrease agitation, and increase alertness
- By providing movement within a limited range, the lower extremities may experience strengthening
- Separate footrests capture movement in each leg during extension
- A footboard provides a wider surface to accommodate unique foot placements.

Dynamic Back Canes

- Dynamics back hardware is installed between the seat and the back of a wheelchair and provides movement of the back to absorb forces and assist the client back to upright
- This movement can protect both the occupant from injury and the seating system and mobility base from breakage
- Movement can also reduce extension tones to increase function, sitting tolerance, and conserve energy.
- Active range of motion at the hips is also provided, reducing risk and progression of range of motion losses.
- Back movement provides vestibular input, increases alertness, decreases agitation, increases sitting tolerance, and increases function. This movement works well with clients who like to rock and seek out movement.
- Provides movement for the client against resistance to increase trunk strength and improve postural control.

Dynamic Head Rest

- As with the dynamic back and dynamic footrests, dynamic head support hardware moves in response to client force
- The Single Axis Dynamic Head Support Hardware moves up to 9 degrees posteriorly in midline, with the Multi-Axis Dynamic Head Support Hardware capable of movement up to 10 degrees in any direction up to 360 degrees (Asymmetrical Tonic Neck Reflex)
- Protect against concussion; a concussion can occur when the head collides with force against a surface. Some clients using wheelchairs bang against the head pad with significant force, perhaps even enough force to cause brain injury. Degree of force and repetitive impacts only increase risk of injury. Dynamic components absorb force, reducing this risk
- Occupants who extend against a head support with sustained force are at risk of neck injury (including strains) due to forces occurring through the soft tissue and vertebrae of the neck
- Absorb forces exerted by the user which may have led to equipment breakage in the past and can prevent future breakage
- Dynamic Head Support Hardware can diffuse forces and provide movement for decreased agitation and increased sitting tolerance, function, energy conservation, and alertness.

Assessing to Prescribe Dynamic Hardware

- Observation of the user in their existing seating system
- History of wheelchair use and typically how long these systems have lasted/ what maintenance issues have they had in the past
- Understanding the clinical condition e.g. Huntington's chorea, Spastic CP, ATNR, ABI, stroke… any diagnosis where high tone may be a symptom
- Observe the pattern of tone; understand where it originates from to plan to diffuse force here first
- Differentiate what is behaviour and what is sensory seeking

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