Learning Objectives

The participant will be able to:

• List two important guidelines to follow when problem solving regarding complex postural deviations in seating

• Identify which direction the head will fall based on the location of the head’s center of mass relative to the centers of rotation for cervical spine movement

• Explain at least one way to manage or reduce a forward head posture in a wheelchair seating system

A Biomechanical Approach to Managing Abnormal Postures of the Head & Neck

- INTRODUCTION TO PROBLEM SOLVING
- GENERAL GUIDELINES FOR HEAD/NECK
- KEY BIOMECHANICS PRINCIPLES
- FORWARD HEAD POSTURE
- FULL NECK FLEXION
- LATERAL TILT
- ROTATION
- CASE STUDY
Successful intervention requires good problem solving

Addressing Difficult Postural Problems

**Problem Solving Guidelines**

1. **Always ask WHY**
   - Remember to address the source of the problem, not just the symptom
   - What is the cause of the postural deviation?

2. **Always assess flexibility**
   - Correct the flexible components within comfort, accommodate fixed components.
   - The body “core” (pelvis/trunk/head) usually takes priority for orientation when there are fixed components, to maximize function

3. **Simulate the basic seating equipment parameters first**
   - Determine 3 primary seating angles and basic dimensions, based on mat exam, then simulate.
   - Many postural problems can be solved, or lessened just by providing the correct angles and dimensions.
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Addressing Difficult Postural Problems

**Problem Solving Guidelines**

4. Differentiate between active movement and postural collapse
   - If postural collapse: balance forces to decrease gravity’s mechanical advantage (the “gravitational load”)
   - If active movement: what is cause, or what facilitates the movement?

5. Be least restrictive - you must have a rationale for blocking movement
   - The client or caregiver has the final say

6. Set very specific postural objectives
   - What is this person’s most optimal aligned position for health, comfort, and function?
   - Each body area
   - Especially critical if planning to do a custom contoured seating system.

In general, dealing with one of three situations:

1. **Posture is totally flexible:**
   - Goal is neutral alignment, control of undesired movement patterns, and support of function (and functional movement)

2. **Posture is partially flexible, with some non-reducible component:**
   - Goal is to maintain optimal alignment by accommodating non-reducible component, and then correcting the flexible portion and/or blocking the abnormal movement or postural collapse causing an increase in deviation

3. **Posture is totally fixed/non-reducible, with no flexibility:**
   - Support the body area in the most appropriate orientation for function, comfort and health
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➢ General Guidelines for Head/Neck

- Use same problem solving strategies as in other areas of the body, but usually have to address the head last

- The head is at the top of the pelvic/spine column
  - The posture and orientation of the pelvis will dictate the orientation of the lumbar and thoracic spines...
  - The posture and orientation of the thoracic spine will dictate the orientation of the cervical spine... and the orientation of the cervical spine will dictate the direction the head will fall

➢ What body segment is most important?

- If cannot achieve neutral alignment in all body segments, what takes priority?

- The body “core” (pelvis/trunk/head) usually takes priority for orientation when there are fixed components (vs. lower extremities) to maximize function
  - eg. It is usually best to allow legs to be windswept in order to achieve a de-rotated pelvis and trunk when there are fixed abduction/adduction contractures of the hips

- But what takes priority within the core - Pelvis vs. Trunk vs. Head?
POLL #1

When positioning the body, what segment takes priority for neutral orientation when there are fixed components (e.g. not all segments can be positioned in neutral alignment/orientation)?

A. Pelvis
B. Upper trunk/shoulders
C. Head
D. It depends on client’s unique characteristics, problems and goals

➢ The head is difficult to control

- Lots of Range of Motion in Cervical Spine
  - 50% of flex/ext and rotation occurs in upper cervical
  - Lateral neck flexion—not a pure motion, always occurs with rotation (lat flex to right + rotation left)

- The head can be very unstable and difficult to control – like a heavy bowling ball balancing on top of small, flexible base

- The head is an extremity that is used for a lot of functional activities! You may need to allow some abnormal postures and movements so as not to take away function!

➢ General Guidelines:

  Determine cause of the abnormal posture first

HOW? Remember to:

1. Assess flexibility of cervical spine in addition to thoracic/lumbar spine during mat exam
2. Observe shape and contour of head, and fit/location of head support
3. Assess posture and active movement of head in sitting position, after desired alignment of trunk, pelvis and legs is simulated
Abnormal postures of the head/neck can be due to:

1. Range of Motion Limitations in the neck, TL spine (scoliosis, kyphosis), hips and knees
2. Abnormal tone or spastic movement in neck muscles
3. Postural collapse in cervical spine due to low tone, weakness, poor head control
4. Attempts to function (vision, switch access, breathing)
5. Poor match of shape of head with contours of head support
6. Improper fit or placement of the head support

Abnormal postures of the head/neck can be due to:

➢ General Guidelines for Head/Neck:

   Set client specific objectives

   • General objective is to support the weight of the head in a position that promotes neutral alignment of the cervical spine, and allows functional movement as needed.

   • Define the desired resting posture, and describe what specific movements (passive or active) you may need to block, and which movements need to be allowed or facilitated

   • The desired resting posture takes into consideration client’s range of motion, tone, functional needs and preferences

   If person does not have good head control and strength, you MUST provide a resting position for the head!
➢ Torque and Moment Arms

- **Torque** is the measure of a force's tendency to produce rotation about an axis

\[
\text{Torque} = \text{Force} \times \text{Distance}
\]

- The torque, or moment, of a force about any point is equal to the magnitude of the force times the perpendicular distance from the action line to that point (the moment or "lever" arm)

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Activity

- Hold one arm out to side and other arm angled up above horizontal
- Which arm gets tired faster
- Why?
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The Gravitational Moment Arm

GL = gravitational line (acting at the center of mass of arm)
GM = gravity moment arm (distance)

The gravitational moment about the shoulder joint is LESS in this position, because the distance from the center of mass to the pivot point at shoulder is LESS, therefore you don’t have to generate as much force via your deltoid muscle to hold your arm up.

Center of Mass (COM)

• Also referred to as the Center of Gravity (COG)
• Definition
  ➢ point at direct center of a body’s mass
• Location
  ➢ depends on how mass is distributed, so location of COM is affected by body posture

Center of Mass (COM)

• If this person flexes his elbow to 90 degrees, the COM moves closer to shoulder – gravitational load decreases
• If the person adds a weight to his hand with arm in same position as in picture, COM moves toward hand – gravitational load increases.
Center of Mass of the Head

Position of the center of mass of the head (M) in relation to the pivot point (S) at upper cervical joint

From: Staarink, H. & Packwood, L. (2011). All there is to know about sitting: sitting behavior, seats and wheelchairs. Netherlands: Royal Van Gorcum, p.45, fig 2.26:
Position of the centre of mass: M in relation to the pivot point: S

POLL #2

With the head in the vertical orientation pictured here, is the gravitational moment arm tending to cause upper cervical neck flexion or extension?

A. FLEXION
B. EXTENSION
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The Forward Head Posture

Direction of Movement

Normal posture sagittal plane

Forward head posture

Center of mass of head

Upper cervical extension

Centers of rotation

Lower cervical flexion

Normal posture sagittal plane

Forward head posture
The Forward Head Posture

**Blocking Forces Required**

- Gravitational bending moment is encouraging lower cervical flexion
- Choose back support which supports upper thoracic extension, and/or
- Use anterior chest or shoulder restraint to limit forward excursion
- Use tilt or more open seat/back angle
- Provide support under occiput
- Position spine to get COM of head over or behind the center of rotation at C7, to decrease gravitational moment arm.

**Intervention Strategies**

The Forward Head Posture

- Use orientation in space to decrease gravitational moment encouraging collapse, either with more open seat/back angle or tilt
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**Forward Head Posture**

Very common to drop into full neck flexion (lower and upper cervical) from a forward head position. When he lifts his head he extends in upper cervical, not lower cervical.

**Forward head posture**

Seating simulation

If we bring him more upright in space, what do you think will happen?
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Full Neck Flexion

Direction of Movement

- Forehead straps or pads
- Anterior neck supports
- Anterior shoulder support

These are not very good options!!

Full Neck Flexion

Intervention Strategies

A better option is to position body so that gravity is encouraging neck extension:
- Use tilt or more open seat/back angle
- A back support which supports upper thoracic extension

Active Persistent Neck Flexion

- Fair to good trunk control in sagittal plane, despite kypho-scoliosis
- Can actively lift head, but prefers flexion
- If tilt back she pulls forward
- Actively resists attempts to pull her head up
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Lateral Head Tilt

Determine direction of movement or collapse, and think about 3-point control

Active Persistent Neck Flexion

- New wheelchair; back support allows space for upper thoracic kyphosis
- Mild fixed tilt to encourage head up position
- Client sits in other chairs and walks with a walker daily
- Trialing external adjustable thoraco-lumbar brace and cervical collar
Support pelvis, trunk, and legs in desired posture and position first, then determine support needs at head.

Blocking lateral neck flexion with lateral temporal pad:
- If person slides forward on seat, pad becomes too high.
- If head drops forward and then laterally, head can get caught under side pad—common in kids with CP.

Blocking lateral neck flexion with lateral temporal pad vs. sub-occipital pad that wraps laterally:

In seating simulator with molding bags, correcting pelvic/spinal alignment, and assessing different head support features.
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Balancing the head when there is a partially fixed scoliosis

- Slight correction of upper trunk lateral tilt and rotation via new custom back support
- Shifted head support hardware mount to the left 1" and rotated pad to the right slightly

Balancing the head with scoliosis

- Priority PELVIS: Frontal trunk angle = -5 degrees
- Priority HEAD: Frontal trunk angle = +5 degrees
- Priority TRUNK: Frontal trunk angle = 0

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Neck Rotation

- It is very restrictive to block neck rotation, as this movement is a fundamental means of interacting with one’s environment through visual scanning and attention.

- However, there are times when it is necessary to control neck rotation movement in order to keep someone safe, comfortable and improve their functional skills.

Neck Rotation

*Center of rotation and direction of movement*

Is head rotating about a central axis, so back of head moves one way, front of head another?

Or, is head is rotating about a point at back of head, where it rests on the headrest?
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Restricting head/neck rotation in one direction in order to improve access to switch on other side

Addressing abnormal extension/rotation/lateral flexion movement

Custom head support with surfaces to block/inhibit excessive extension and lateral flexion to right, but allows right rotation to hit switch, and full left rotation
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Case Study: Lateral Head Tilt

Assessment revealed:
- Pelvis and spine flexible to neutral
- Fixed Lateral neck flexion to left at lower cervical
- Attempts to correct head to neutral exacerbating right pelvic obliquity

Problems:
- Head falls left, worse as day goes on
- Recent pressure injury right buttock
- Spine collapses into right low convexity

Molding Simulation
- Slightly better correction with mold; but parents need swing away LTS
- Silhouette back with separate laterals

IPM on 3 cushions:
- Jay 2 Deep; Jay Fusion; Ride Java
- Chose Java – offloaded plus level upright pelvis
Case Study: Lateral Head Tilt

Seating Simulation
- LTS low, angled right ribs, and LTS high, curved left side
- Pelvis level; if over correct upper trunk to get head to midline, pelvis drops down into right obliquity
- Build up behind scapula on left to derotate trunk
- Whitmeyer Contour Cradle offset to left

Final solution/plan:
- Quickie Iris, with Java seat cushion and Silhouette back support, with adjustable swing away LTS
- Contour Cradle head support, adjusted to allow some rest in upper cervical extension, on slide mount so can position to the left of center
- Left lateral head pad at left temple
- Forehead strap
- Desired seating angles set up:
  - Seat/back angle to be 100
  - Seat/L5 = 120
  - LL5/F5=135 Right, 90 Left

Questions or comments?
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Contact Information- Instructor

Kelly Waugh, PT, MAPT, ATP
Clinic Coordinator | Assistive Technology Partners
University of Colorado Denver | Department of Bioengineering
UCD Auraria Campus - Hub
1224 5th Street • Denver, CO 80204
303-315-1280 (main office) • 303-315-1951 (direct) • Fax 303-315-1270
www.assistivetechnologypartners.org • generalinfo@at-partners.org

References