Forward Head Posture In Elderly: CoNECKtion to Vestibular Deficits

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Objectives

1. Identify the “best practice” definition and clinical assessment of forward head posture.
2. Determine appropriate assessment strategies and outcome measures for fall risk and vestibular function in older adults with forward head posture.
3. Design a rehab program for an older adult at risk for falls due to forward head posture and vestibular dysfunction.

Poll Everywhere

In the ‘To’ box enter: 22333
In the text message enter: emmawhite890 and submit.
You will receive a response within a few seconds, now able to participate in the poll

Would you consider this- Forward Head Posture? Y or N
Is this FHP - Y or N

How this research started?  Neuro and Ortho

Falls are a major societal problem

This lead to: The Relationship between Forward Head Posture, Vestibular Function, and Falls in Older Adults (unpublished, 2013-2015)

• Falls are the leading cause of injury-related deaths in individuals 65 or older.¹
• About 33% of those who experience a fall decline functionally as a result of the incident.¹
• Around 30% of community-dwelling individuals at this age fall at least once per year.²

Combine Neuro and Ortho

• Is there a coNECKtion?
  • Forward head posture AND
  • Increased risk for falls and potential vestibular deficits

Purpose
1) To determine the correlation between several methods of measurement of FHP, visual observation, Cervical Range of Motion (CROM), craniovertebral angle, etc.
2) To assess differences in photographic angles in FHP in sitting versus standing.
3) Is there a relationship between FHP and fall risk in older adults
Study Results

**FHP and Fall Risk Measures**

 estud

### Conclusion

- **Photographic FHP (CV angle) correlated to:**
  - ABC scores
  - SOT Conditions 4, 5, and Composite scores
  - FHP CROM measures did not correlate to any measures

- *Moderate correlations were found to support FHP as a contributor to fall risk*

### Clinical Relevance

- When performing a comprehensive fall risk evaluation, an assessment of FHP should also be included as a possible contributor to increased fall risk.
- Based on this study's findings, we suggest taking a photographic assessment of FHP using the craniovertebral angle.

### What we discovered?

- We haven't defined FHP!
- We assess it everyday in clinical practice as part of the initial examination
- Aids diagnosis
- Determine treatment strategies
- Monitor patient progress
- Several assessment methods
  - Visual assessment/plumb line
  - Cervical Range of Motion Device (CROM)
  - Craniovertebral angle
  - Forward Shoulder angle, etc.
- No standard measure currently exists

### Epidemiology- FHP

- Current evidence has associated FHP with neck pain
  - Prevalence of neck pain 0.4-86.8% at some time in their lives
- Percent of population with FHP
  - Large % of population
  - Tends to be associated with elderly
  - BUT given computers, cell phones, aligned with younger age as well
- FHP aligned with weakness of the deep cervical flexors
  - Has been linked to scapular dyskinesia

### This is what we DON'T know-

- We have no standard measurement of what truly represents FHP
- How far forward does the head have to travel before it elicits a pain response
- FHP has not been looked at as a possible contributor to fall risk.
- For certain we don’t know how/if it impacts vestibular function
FHP - the JOURNEY

- JOURNEY to discovery
- Significance of good posture recognized despite the conceptual complexity and measurement challenges
- Commonly assessed in sagittal plane
- Used as a diagnostic procedure for patients with cervical pain and many other musculoskeletal conditions - LBP

Definition for Normal Head Posture

- In order to be assessed, the variable must be clearly defined.
- HP refers to the alignment of the head in relation to the rest of the body, per Kendall on the sagittal view HP assessed via an imaginary line external auditory meatus
  - Bodies of MOST of cervical vertebrae
  - Shoulder at AC joint
  - Bodies of lumbar vertebrae
  - Slightly posterior to axis of hip joint
  - Slightly anterior to axis of the knee joint
  - Slightly anterior to lateral malleolus

HOW POSTURE ASSESSED - Plumb line/visual assessment

BUT is it reliable?

Another method - Using the CROM but again we have no numeric value for FHP - it has been found to reliable

Method 3 - Photographic measure of craniovertebral angle

- Involves an extra step - taking a photograph
  - Identify landmarks
    - Intersection of horizontal line through SP C7 and from C7 through tragus of ear
    - <60° considered FHP
    - normal - consider 55.02 ± 2.86
  - Measure angle
Craniovertebral Angle - has been found to be reliable

- CV angle found to be reliable whether photograph taken in sitting or standing position
- Method used to obtain patients resting head posture was that used by Yip, adapted from Watson.

Here's what the evidence shows:

<table>
<thead>
<tr>
<th>Study Population</th>
<th>FHP Measurement</th>
<th>Study Population</th>
<th>CV Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy adult 23-65 yrs</td>
<td>&gt;20.5 cm</td>
<td>Adults with neck pain with CVA &lt;44°</td>
<td>&lt;49°</td>
</tr>
<tr>
<td>60 females w/ wo headache 25-40 yrs, compare CVA</td>
<td></td>
<td>Healthy females 20-32 yrs</td>
<td>&lt;50°</td>
</tr>
<tr>
<td>Adolescent idiopathic scoliotic patients</td>
<td></td>
<td>Adult population comparing effect of FHP on proprioception via CV</td>
<td>&lt;53°</td>
</tr>
<tr>
<td>Neck pain (mean age 40 yrs and no neck pain (mean age 42 yrs)</td>
<td></td>
<td>Healthy adult ♂/♀ population with unilateral headache</td>
<td>42° to 53°</td>
</tr>
</tbody>
</table>

Angles representing - head tilt, Craniovertebral, and shoulder angles

Another angle commonly identified in the literature is Forward Shoulder Angle (FSA) also referred as sagittal shoulder posture (SSP)

- Again requires a photograph with landmarks identified
- Angle formed by intersection of horizontal line from tragus to C7 and horizontal line from C7 to the acromion.
- 52° considered reference angle; <52° protracted shoulder
- Nam etal defined FHP as a FSA of 54° or less
- NO clear consensus

Aim of 2nd Study (White et al) was to quantify FHP to CROM

- PT's from North Carolina who were members of NCPTA
- 4 categories by years of experience
  - 1-5 years
  - 5-10 years
  - 10-15 years
  - 15+ years
- Indicate specialty certification
  - Orthopedic
  - Neurologic
  - Geriatric
  - Any specialty assigned
Study sample - physical therapists

- In 2014 we aimed to quantify FHP based on PT opinion via visual observation
  - 2,624 NCPTA members were sent survey link to participate in study
  - 1,077 opened the email
  - 245 opened the survey
  - 186 actually completed the survey
  - Of the 18 that did not complete-16 exited before the end, one was a PTA and was excluded, one PT could not view the images

Study sample - participants

- 12 participants agreed to be photographed in varying degrees of forward head posture.
  - 4 photographs/participant
  - Participants were recruited from the Winston Salem State University faculty, staff and students (6 men, 6 women).
  - All participants were between the ages of 23-65 years

Study- methods

- Each participant started in a neutral position and was moved forward in 2 cm increments up to four times (or to end-range) and a photograph was taken at each position.
  - All photos taken from the right side.
  - All seated in a chair where hips/knees in ~90° and feet resting comfortably on floor.
  - Participants wore a shower cap over hair to reduce age bias.
  - 15 photographs were selected, ~3 photos from each grouping
  - We measured and recorded each participant using the CROM
  - PT participants only saw the photographs

Study continued

- Participants could not go back to analyze the photos, only ONE photo could be advanced at a time
  - Must give response before they could advance to next slide

RESULTS

- We determined, based on our responses that a measurement of 20.5 cm or greater on the CROM was representative of true FHP.

Where are we headed, still more needs to be done….

- As a follow-up to the 2014 study, we looked at “FHP and It’s Relationship to Neck Pain”
  - Purpose to determine IF:
    1. Those w/neck pain have FHP ≥20.5 cm on CROM
    2. Is FHP more prevalent in those with vs. without neck pain
    3. Is the severity of FHP greater in those w/chronic vs. acute pain

No Neck Pain

Acute Neck Pain

Chronic Neck Pain
Exclusion criteria
- < 18 years old
- Neurologic impairments
- Cervical fusion or surgery

Participants completed
- Written consent form
- Demographic questionnaire.
- Neck Disability Index (NDI) questionnaire

Participants
- Completed: 82
- Excluded: 8

82 Participants
76 Excluded

Avg. Age: 48.28 years
Avg. NDI Score: 9.76 ± 7.151
Avg. CROM in cm: 20.033 ± 2.79 cm

44.7% 20.5 cm 53.3%
NECK PAIN VS NO NECK PAIN

- 35.50% (N = 27) with NECK PAIN
- 64.50% (N = 42) NO NECK PAIN

ACUTE VS CHRONIC*

- 15.80% (N = 8) ACUTE
- 84.20% (N = 29) CHRONIC

*3.9% (N = 2) were excluded due to no response to the question.

IMPlications

Limited conclusions to be drawn singularly from the objective measurement of forward head posture.

There are more factors leading to cervical pain than posture alone than we originally theorized.

In 2017 we looked at neck pain and CVA

- We thought perhaps CVA was a more sensitive measure
- The objective of this research study to utilize evidence-based photographic methods to assess the CVA and determine whether a meaningful correlation exists between CVA, neck pain, and previously defined values for FHP.

PURPOSE

Is FHP more prevalent in those with vs without neck pain?

To investigate if the severity of FHP is greater in those with chronic vs acute neck pain?

Implications

Limited conclusions to be drawn singularly from the objective measurement of forward head posture.

There are more factors leading to cervical pain than posture alone than we originally theorized.

In 2017 we looked at neck pain and CVA

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Participants

- 104 community-dwelling adults
  - 35 males, 69 females
  - 22-90 years of age (mean 48 years)
  - Participants were 18 years or older with or without neck pain
  - All had no history of cervical fusion or head/neck surgery within past 3 years
  - Completed the NDI and NPRS

Test Set-up

- PVC pipe attached to posterior left leg of chair.
- Biomarker placed at spinous process of C7:
  Participant moved neck through full flexion and extension three times, and then assumed “normal” resting posture while looking straight ahead.
- Chair positioning: back in contact with chair, back and feet flat on ground so hips ~90 deg flexion.
  - Identified via palpation as the vertebrae that remains relatively immobile compared to the superior C6, which should move in and out as participant moves neck.30
- Photograph taken in sagittal view: Nikon D5200 camera.

Assessing CVA

- Previous evidence supports sagittal photographic method of measurement for CV angle as reliable.10,12,14,15,17,20,22,23
- 5” by 7” photograph
- Standard protractor
- Angle calculated by utilizing marker on C7, the tragus, and the vertical reference line established by the PVC pipe.
- Inter-rater reliability with Protractor: ICC of 99%

NO clear definition of what constitutes FNP using the CVA

- Literature has a varied definition of the craniovertebral angle that is associated with Forward Head Posture (FHP):
  - ≤ 44° to 53.6° 7,12,14,22

CVA and NECK pain

- NO significant association between:
  - CVA and NPRS (r=0.08, p=0.42)
  - CVA and NDI (r=0.19, p=0.06)
  - CVA and age (r=0.148, p=0.13)
  - CVA defined as <53°

Discussion

- No significant association was found between CVA and NPRS, CVA and NDI, or CVA and age.
- There was a statistically significant difference with gender and CVA, with males more likely to have increased FHP compared to females.
- However, the clinical significance of this remains unclear.
- When using the CVA that has previously been defined as FHP, no significant difference was found with NDI or NPRS between those with and without FHP.
Clinical Relevance

• Despite the high prevalence of postural assessment in the clinic, this study suggests that sagittal cervical posture is not associated with cervical pain or disability.
• Pain is multifactorial and while cervical posture might be a secondary contributor to pain in some patients, clinical assessment and intervention should address other primary drivers of pain and disability.
• If a physical therapist determines that static postural assessment is indicated in a specific case, the therapist should measure using the CVA as opposed to visual assessment.
• The process of measuring CVA takes less than 5 minutes and provides a more valid and reliable measure of cervical posture than subjective visual assessment.

OVERALL Conclusion’s and clinical relevance

• An unexpected inverse relationship btw FHP and neck pain was found.
• NDI scores did not correlate with FHP nor did acute versus chronic neck pain, which suggests that FHP alone is not a predictor of neck pain.
• Limited conclusions can be drawn singularly from the objective measurement of forward head posture.
• While a postural assessment remains a major part of the IE; we have to take in account other factors that contribute to neck pain in our patients.

Key points raised:

• A visual assessment of posture is subjective and may not be reliable.
• A CROM measurement of >20.5 cm has been determined to represent true FHP.
• CROM has been shown to be reliable.
• The craniovertebral angle has also been shown to be reliable.
• A CV angle <50° has been associated with neck pain; average CV angle in healthy adult mean 55.02 ± 2.86.
• We did find a relationship between fall risk using the CV angle vs. CROM.

References Part ONE

References


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Best Practice for Measuring FHP

- Photo craniovertebral angle: vs. CROM (unpublished data, 2013-15)
- Observational method is not reliable
- FHP App –free (different angle)

Determining Fall Risk Using Posttest Probability

- Systematic Review by Lusardi, et al, 2017, examined 59 studies that contained data which allowed prediction calculations
- No single test/measure demonstrated strong PoTP values
- Five history questions, 2 self-report measures, and 5 performance-based measures may have clinical usefulness in assessing risk of falling on the basis of cumulative PoTP (posttest probability of falls)

PoPT Recommendations

**Medical history questions**
- Any previous falls: Yes/no
- Psychoactive medication: Yes/no
- Requiring any ADL assistance: Yes/no
- Self-report fear of falling: Yes/no

**Self-report measures**
- Geriatric Depression Scale-15 < 6 points
- Falls Efficacy Scale International > 24 points

**Performance-based functional measures**
- Berg Balance Scale < 50 points
- Timed Up and Go Test > 11 s
- Single-limb stance eyes open > 6.5 s
- Five Times Sit-to-Stand Test > 12 s
- Self-selected walking speed < 1.0 m/s

Interventions: Community-Dwellers

- Community-dwelling, fit
  - Good evidence for individualized multi-factorial program with balance, gait, strengthening, flexibility and endurance (good)
  - Group or individual exercise programs (fair)
  - Stepping On
  - Matter of Balance
  - Tai Chi: Moving For Better Balance (YMCA)
  - Home environmental assessment (good)
  - Assess use of assistive device (recommended)
Interventions: Homebound & Long-Term Care

- Homebound, at risk for falls or have fallen
- Otago exercise program
- Long-term care facility, high risk for falls, fallen
- Multifactorial program (no recommendation against)
- Assess for frailty (no recommendation against)
- Fried model of frailty assessment
- Dementia (insufficient evidence)

Best Practice for Decreasing Fall Risk

- From: "Prevention of Falls in Older Persons: AGS/AGS Clinical Practice Guideline" and "Management of Falls in Community-Dwelling Older Adults: Clinical Guidance Statement From the Academy of Geriatric Physical Therapy of the American Physical Therapy Association"

- Interventions by fall history
  - Fit older person who has not fallen
  - Adults at risk for falls
  - Those experiencing single or recurrent falls

- Interventions by living environment
  - Community-dwelling older adult
  - Long-term care
  - Hospital based

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Joint Position Error (JPE) Test

- Patients sit 90 cm away from target and measurements can be taken for right and left rotation, flexion & extension
- Patients can be given 3 practice trials with eyes open in each direction before 3 trials with eyes closed
- Averages can be recorded following the 3 trials
- Abnormal is >4.5 degrees

Limits of Stability (LOS)

Dynamic postural control can be measured several ways:
- NeuroCom Balance Master system
- Other stationary forceplates (Biodex, EMED)
- Functional Reach in multiple directions (2 practice trials, 3 trials averaged)
- Can predict fall risk (Bahrami, 2002); cutoffs vary by diagnosis (generally < 7 inches)
Potential Vestibular Etiology Buckets Impacted by FHP

Central Nervous System  
Peripheral Nervous System  
Cervicogenic Etiology

Which bucket might contain results of FHP?

Neurologic Causes of Vestibular Symptoms

- Central Nervous System
  - Stroke
  - Multiple Sclerosis
  - Cerebellar dysfunction
  - Brainstem tumors/dysfunction
  - Vertebrobasilar insufficiency
  - Migraine
  - Trauma/Injury

Causes of Peripheral Vestibular Deficits

- Benign Paroxysmal Positional Vertigo (BPPV) is most common (50% of cases of dizziness in elderly)
- Vestibular neuritis (15 in 100,000 people, 630,000 visits/yr.)
- Labyrinthitis
- Meniere’s disease
- Acoustic neuroma/vestibular schwannoma
- Perilymphatic fistula
- Otootoxicity (bilateral loss)
- Age and immobility (avoidance behaviors)
- Peripheral neuropathy (DM)

Cervicogenic Bucket

- Typically associated with cervical trauma and/or injury (Whiplash)
- Symptoms are provoked by moving the “body on the head” versus moving the “head on the body”
- Impaired cervical kinesthetic sense associated with injury impacts the VOR reflex and DVA, resulting in a feeling of “dizziness”
- Manual therapy to decrease pain and increase ROM, joint position sense retraining, VOR (vestibule-ocular reflex)/DVA (dynamic visual acuity) retraining

Central Versus Peripheral Symptoms

**CENTRAL**
- Sudden onset of dizziness associated with the D’s:
  - Diplopia
  - Dysphagia
  - Dysarthria
  - Dysmetria
  - Asymmetric muscle weakness

**PERIPHERAL**
- Sudden, notable onset of vertigo often described as “spinning”
- You might hear a patient say, “It just hit me out of no where and I couldn’t move because the room was spinning round and round”

Red Flags: Signs of Central Pathology

- The D’s: diplopia, dysphagia, dysarthria, dysmetria & asymmetric muscle weakness
- Vertical nystagmus
- Blurred vision
- Abnormal eye tracking with oculomotor testing
- Hearing loss without dizziness
- Change in consciousness
Baseline Tests and Typical Results

<table>
<thead>
<tr>
<th>Measure</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitals + Orthostatics</td>
<td>+ Orthostatics</td>
</tr>
<tr>
<td>Oculomotor : VOR Head Thrust &amp; DVA</td>
<td>+ VOR Head Thrust, &gt;2 lines difference on DVA test1,3</td>
</tr>
<tr>
<td>Sidelying/Dix-Hallpike/Roll for BPPV</td>
<td>+ Sidelying/Dix-Hallpike/Roll for BPPV (50% chance), - for PVH1</td>
</tr>
<tr>
<td>ROM, strength, reflexes/coordination if thinking CNS involvement</td>
<td>Impaired cervical/trunk ROM, potential changes in strength, esp. LE14</td>
</tr>
</tbody>
</table>

Additional Tests and Typical Results

<table>
<thead>
<tr>
<th>Measure</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall history</td>
<td>Falls in last 12 months, esp. injurious</td>
</tr>
<tr>
<td>Hearing</td>
<td>Note permanent or temp. loss</td>
</tr>
<tr>
<td>Motion Sensitivity (MSQ)</td>
<td>Motions result in min-mod dizziness1</td>
</tr>
<tr>
<td>Dizziness score</td>
<td>0-10 scale, score over 3</td>
</tr>
<tr>
<td>Visual or verbal</td>
<td></td>
</tr>
</tbody>
</table>

Making Sense of Your Vestibular Findings

<table>
<thead>
<tr>
<th>CENTRAL</th>
<th>PERIPHERAL</th>
<th>CERVICOGENIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dysdiadochokinesia or dysmetria</td>
<td>+ Orthostatics</td>
<td>Vitals WNL</td>
</tr>
<tr>
<td>Abnormal oculomotor exam</td>
<td>+ VOR Head Thrust</td>
<td>+ VOR</td>
</tr>
<tr>
<td>+ VOR Cancellation</td>
<td>+ Sidelying/Dix-Hallpike for BPPV</td>
<td>BPPV</td>
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<tr>
<td>ROM, strength, reflex, sensation, proprioception or balance deficits</td>
<td>ROM, strength, sensation, proprioception or balance deficits, motion sensitivity</td>
<td>ROM</td>
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<tr>
<td>Ataxic gait</td>
<td>Ataxic gait</td>
<td>FHP</td>
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<tr>
<td></td>
<td></td>
<td>IK of Cervical injury</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cervical proprioception</td>
</tr>
</tbody>
</table>

Cervicogenic or Peripheral Bucket? Big Picture Research Question for FHP

Changes in cervical proprioception?
Yes, in whiplash patients.4

Changes in peripheral vestibular sensory organs?
No evidence at this time for this theory.
Argument for Cervical Bucket

- Alterations in cervical proprioception measured by JPE
  - Post whiplash
  - With prolonged computer use
  - After 10 or 20 minutes of smartphone use
  - In both younger and older adults (Migliarese, 2018, unpublished)
  - Unpublished 2019 data by Migliarese did not find a correlation between FHP and JPE in community-dwelling older adults, but in FHP & fall risk and LOS
  - Continuing this research looking at FHP, JPE in all planes including transverse, and general health (results anticipated in summer 2020)

Are those with FHP at a higher risk for falls?

- Those with FHP are at a higher risk for falls based on the FGA outcome measure (p = 0.039, p≤0.05)

Peripheral Vestibular Hypofunction (PVH) Clinical Picture

- Differs from BPPV
  - Dizziness versus true vertigo
  - CC are imbalance, motion sensitivity, avoidance behaviors
  - Can be unilateral (UVH) or bilateral (BVH)
  - BVH change driving habits (44%), reduce participation in social activities and ADL difficulties (55%)
  - Increases with age, as does BPPV and FHP!
  - Increase incidence of falls, decreased gait speed, decreased head movement

Evidence-Based Clinical Practice Guideline

- Neurology Section of the APTA, April 2016 in JNPT
- Review of 14 full-text articles, Jan. 1885 – Feb. 2015
- Review again in 2020
- Evidence was considered
  - Strong
  - Moderate
  - Weak
  - Expert opinion

PVH Definition for the CPG

- Peripheral Vestibular Hypofunction (PVH)
  - Confirmed using vestibular function laboratory testing, either caloric or rotational chair testing
  - UVH = at least 25% reduced vestibular responses on one side
  - Our “Clinical definition”: evidence of vestibular deficits that impact gaze stability, balance, gait, function, community engagement
**Evidence-Based Clinical Practice Guideline**

What works:
- Rehab for UVH & BVH with impairments and functional limitations related to the vestibular deficit
- Specific exercise to target impairments or functional limitations
- Supervised vestibular rehabilitation (range of 2-38 weeks; mean = 10 weeks)
- Minimum of 3 x/day for gaze stability exercise in HEP (12 -20 min. total)
- Pt. Ed. on goals & how to progress themselves
- UVH = 1x/week for 2-3 weeks (uncomplicated cases, acute or 1st 2 wks after onset & subacute or 3-12 wks after onset)
- UVH chronic cases (longer than 3 mon.) = 1x/wk for 4-6 wks
- BVH = 1x/wk for 8-12 wks
- All need daily HEP

What does not work:
- Voluntary saccadic or smooth-pursuit eye movements in isolation, which means without head movement, in order to treat gaze stability for UVH or BVH
- Vestibular suppressant medications for chronic patient management
- General conditioning (e.g., stationary bike)

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**EB Practice Guidelines: PVH**

What does not work:
- Voluntary saccadic or smooth-pursuit eye movements in isolation, which means without head movement, in order to treat gaze stability for UVH or BVH
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**Best Practice for Identifying Vestibular Deficits in Older Adults**

- Rotary Chair if available
- NeuroCom if available (abnormal in positions 5, 6 suggests difficulty using vestibular input for stance)
- mCTSIB with head shake for a clinical measure

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**mCTSIB for Sensory Integration**

Modified Clinical Test for Sensory Interaction in Balance

- 30 seconds in each of 4 positions, gait belt
  - Feet together, EO
  - Feet together, EC
  - Foam, EO
  - Foam, EC

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**Head-Shake Nystagmus Test**

Procedures
- Horizontal, vertical, or lateral head movements standing EO while on firm surface and while standing with eyes closed
- Head tilted ~ 30 degrees downward, oscillating horizontally (passively) 20-30 cycles at 1-2 Hz. EO, or should open eyes before the end of 30 cycles if EO.

Outcomes
- 3 or more beats of nystagmus = vestibular imbalance with quick phase eye movements beating toward the more neurologically active side.
- Higher likelihood of vestibular dysfunction when both the HSN test and Head Impulse Test are both abnormal.
**Head-Shake Sensory Organization Test**

**Procedures**
- Repeating SOT condition 2 & 5 while the patient wears a head movement monitor and performs a continuous rhythmic head movement about a specified yaw, pitch, or roll axis.\(^{9,30-32}\)
- Add for patients who perform WNL on SOT, but are still symptomatic.

**Outcomes**
- Compare pre-post
- No cutoff measures available
- May have floor/ceiling effect unless tested at faster speeds
- All the studies investigated the HS-SOT with people doing a yaw movement.\(^9\)

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**Best Practice for Measuring Fall Risk in Older Adults with FHP and Possible Vestibular Deficits**

**Outcomes**
- Fall history and age
- Dynamic Gait Index (DGI)
- Functional Gait Assessment (FGA)\(^{12,14,33}\)
- TUG app
- Others: Berg Balance Scale, Functional Reach\(^1,9\)

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**Treat the Deficits**
- Clear Canals if BPPV present
- Decrease fall risk
- Normalize posture & CVA angle
- Improve balance and LOS
- Normalize gait pattern and speed
- Improve VOR
- Improve DVA
- Improve sensation – cervical proprioception/decrease pain

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**Treatment Order**
- Clear canals
- Motion sensitivity ex. (habituation) after canals are clear
- VOR/DVA exercises
- Postural education
- IPE exercises
- Dynamic balance & LOS exercises
- Address gait deviations & mobility limitations
- Decrease fall risk
- Improvements may take longer with advanced age, but they can still improve\(^{30-35}\)

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**Recommendations for Addressing FHP**
- Normalize activation and strength of the deep cervical flexors\(^{42-45}\)
- Decrease activation of the sternocleidomastoid muscles (SCM)\(^{42-45}\)
- Improve neck position sense\(^1,20-22\)
- Normalize scapular muscle activation\(^{42-45}\)
- Lengthen cervical extensors\(^{42-45}\)
- Normalizing upper thoracic slope/FHP may indirectly improve balance\(^{46-50}\)
Recommendations for Treating Vestibular Hypofunction

- Remember the Clinical Practice Guideline
- Daily HEP
- VOR with head movement
- Exercises that target specific impairments, activity limitations, participation restrictions
- Balance
- Avoidance behaviors
- Walking endurance
- App aVOR

Potential Interventions: FHP & Vestibular Function

- Longitudinal studies are needed to determine when changes occur in fall risk and cervical proprioception in adults with FHP and if changes can be reversed
- Intervention studies are needed to explore if fall risk is impacted by
  - Decreasing the angle of FHP
  - Improving cervical proprioception in multiple planes, including the transverse plane
  - Performing proprioceptive exercises in standing positions on variable surfaces
  - Improving anterior/posterior limits of stability

Summary

- Clinical practice varies for assessment of FHP
- Craniovertebral angle appears to identify falls in elderly adults
- Adults with FHP are at greater risk for falls
- Found in our unpublished data 2013-2015, 2019
- Adults with FHP may be at greater risk for vestibular deficits
- Found in healthy, long term computer users with FHP, and our unpublished data for older adults
- Adults with FHP may be at greater risk for deficits in cervical proprioception
- Adults with FHP should be assessed for fall risk and cervical proprioception, regardless of pain
- Compelling evidence exists that links FHP with vestibular deficits, increased fall risk, and impaired cervical proprioception. Further research using CVA and a consistent definition of FHP is needed to determine causal relationships and develop clinical practice guidelines.

Questions?

- Thank you for your attention on this first day of NCPTA Fall Conference!
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References

References


