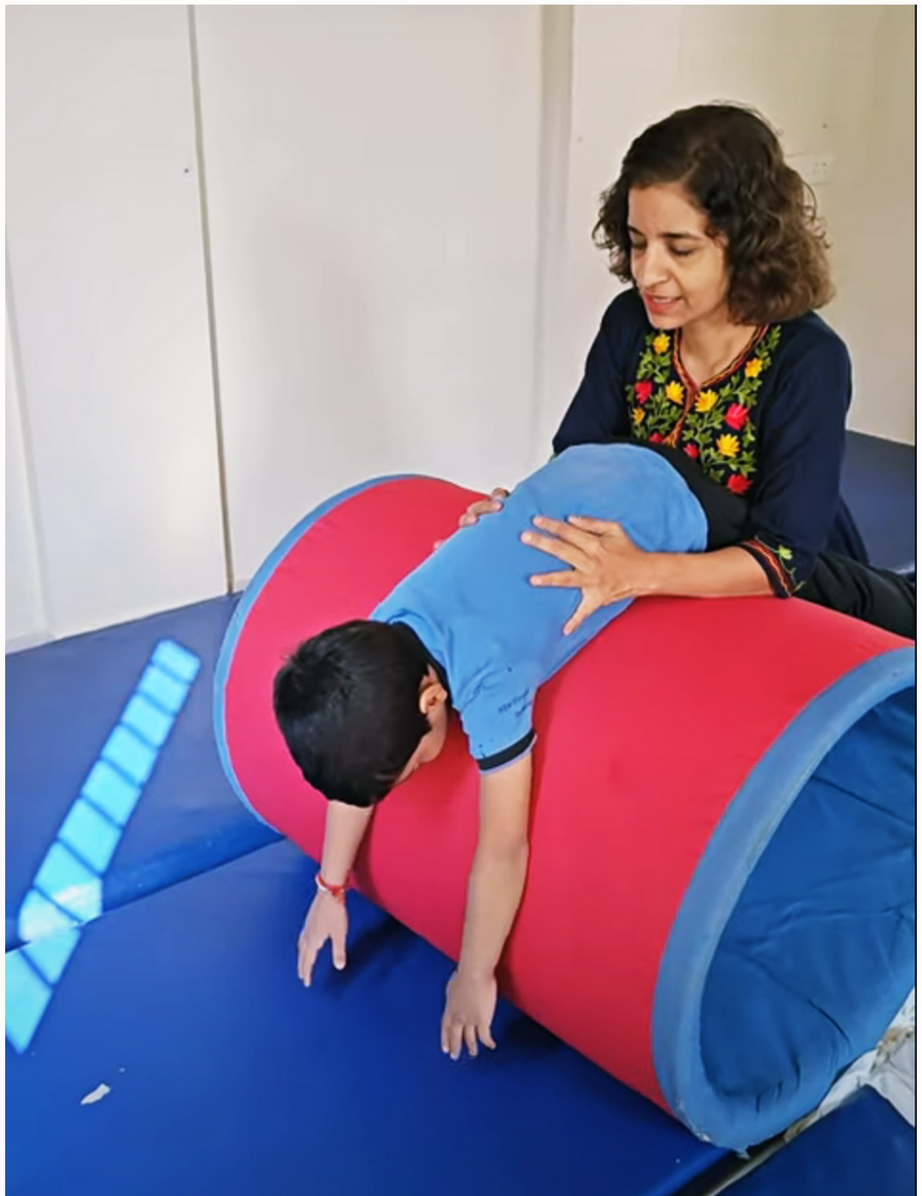
Astronaut training

Sound activated Vestibular Visual Protocol

Vestibular System

- Evolutionarily one of the oldest senses
- First sensory system to mature in utero in the first trimester and capable of supporting orientation of head in space shortly after birth
- However,its influence on balance does not mature fully until late



Vestibular System

- It is crucial for spatial-temporal orientation
- The vestibular system provides orientation based on a gravitational reference point
- Essential for understanding our position in space
- E.g. being in the ocean or in a water park

Directional orientation

- Essential in informing us of the 'up' direction
- Maintains our balance and spatial awareness in various environments
- Operates constantly to adjust to changes in head and body position
- Critical for everyday activities and maintaining equilibrium

Position in space

- Constantly informs us of our location in space.
- E.g. child running or pacing in large open spaces.
- Crucial for understanding our position relative to the environment
- E.g. understanding directions
- Enables navigation and coordination in various surroundings
- Integral for activities requiring spatial orientation and movement precision

Vestibular Processing Challenges

1. Struggles with maintaining balance and equilibrium
2. Exhibiting unusually high or low levels of activity
3. Feeling 'Lost in Space'
4. Irregular Walking Cadence:
5. Aversion to being in dark environments
6. Excessive reliance on visual input

Vestibular Processing Challenges

1. Eye-Head Incoordination
2. Challenges in controlling eye movements
3. Difficulty processing moving visuals
4. Resistance to new or dynamic environments
5. Anxiety about moving on or being moved on unstable grounds
6. Difficulty in organizing tasks or activities
7. Unstable or emotionally fragile

Mastering gravity

1. Natural inclination to conquer gravitational challenges in complex ways
2. Each activity helps refine vestibulo-proprioceptive-cerebellar circuitry for more complex movements
3. Improving efficiency and accuracy lays a foundation for all human endeavors

Mastering gravity

Auditory

- Uses Rhythmic Sounds to Organize and energize movement, and helps in marking time
- Creates a subconscious awareness of the spatial surroundings
- Draws attention to significant environmental sounds
- Directs focus both within and beyond the visual field, enhancing spatial perception.

Vestibular

- Maintains awareness of the head's position in gravity-bound space for balance and spatial orientation.
- Detects and records bodily motions, anchoring our sense of place within the spatial environment.
- Integrates movement with all other senses.

Visual

- Provides an early warning system and alerts to movement
- It is the master integrator of all sensory and motor processing.
- Provides a perceptual context for planning, organizing and modifying behaviour

Body

Space

Near space

Far space

Refinement

Setting of internal rhythm

Modulation

Physiological flexion

Elaboration

- **Flexible, fluid, rhythmical and spontaneous movement**
- **Temporal spatial motor control throughout the range**

Collaboration

- In-utero fluid supported suspension
- Repertoire of reflexive movements

- Gravitational dependency
- Rudimentary movement off support surfaces
- Phasic and tonic reflexive movements

- Challenging and centering gravity
- Setting temporal zero point with trunk and neck co-contraction
- Dynamic postural control

- Precision and mastery of movements
- Praxis, bilateral coordination and complimentary specialisation of body segments

Maturation of auditory localization

- Newborn reflexively turns head toward sound.
- Newborn is adept in horizontal plane

1. Locates only through difference in intensity until 3-4 months
2. Not until 4-5 months can baby figure out the vertical plane (pivot prone)

- Sound localization is mature at birth, but doesn't fully mature until 6 months – myelination of spine, baby has controlled extension through the hips, assumes sitting independently
- Sound localization continues to improve, along with balance, until 7 years of age

Behaviors That Would Signal Spatial Difficulties

- Over-responsivity to low frequency sounds i.e. vacuum cleaner, blender, hairdryers, heating and air vents, public toilet flushing.
- The need to use vision to keep an eye on lower frequency sound to be comfortable with them, i.e. obsessing on following the vacuum or lawn mower.
- When in large spaces i.e. larger room, gym class, large therapy space, open classroom; need to run or walk the parameter of the room, and/or wander or bounce from thing to thing aimlessly.
- Movement and focus lacks direction, attention to events and objects in the space is directed by what is visually close, touched or randomly bumped into.

Behaviors That Would Signal Spatial Difficulties

- When events happen outside of the visual range, need to move the entire body symmetrically instead of staying in place and rotating around the central vertical axis of the body.
- Higher level bilateral integration and sequencing issues may be rooted in the more basic understanding of space, since the auditory draws you up, out and around your center in the spatial envelope creating a context for the temporal ordering of events

Spatial enhancement listening

- Links to space
- Nature sounds
- Nature Pop
- Quickshift space
- Quickshift body and space
- Quickshift gravitational grape
- Quickshift Agile Apricot
- Quickshift motor organization

How to assess

1. Impossible to test vestibular function in isolation because it is so intimately connected to somatosensory, visual, & auditory processing
2. PRN subtest of the SIPT for VOR
3. Duration of PRN is half the duration of rotation
4. Standing & Walking Balance subtest of SIPT for vestibular, somatosensory, & visual integration
5. Observation of any ANS & limbic response to vestibular linear & rotary activation

Program description

There are 3 distinct components

- Preparatory
- Sound activated rotary
- Linear accelearation

Avoiding sensory overload

- There is a wide variation between clients in how much movement they can tolerate
- May vary from one day to another
- May vary from one swing to another
- Start slow and small amount of activation
- Gradually increase as clients tolerance improves
- Do not rely on clients feedback as awareness may be inaccurate or delayed
- Read the motor, behavioural and arousal responses
- Stimulation is always cumulative so consider the stimulation prior to therapy session, during and afterwards.

Signs of sensory overload

- Yawning
- Changes in skin colour
- Headache
- Changes in heart rate
- Changes in breathing
- Pupil dilation
- Prolonged dizziness
- Nausea

Sensory overload

Vomiting is a natural response of the autonomic nervous sustem to bring the system back into balance
It may take time to regain the clients trust and willingness to engage in rotation

Off setting Sensory overload

- If overload happens,proceed quickly to offset the reaction.
- Add self generated proprioceptive input.
- Let the client run, crawl or jump vigorously around the room.
- Place hands on head and press down while jumping in place and sucking vigorously with sealed lips
- Place ice cubes into the clients hands, at the base of the skill and on the temples
- Let the client crash into mattress with full body
- Position child in quadruped or prone on forearms and blow vigorously
- Ear stretching, K27 points and pressure on mastoid helps

CLEAR, PRECISE AND COMPREHENSIVE

- Protocol is comprised of a variety of movements that specify particular head positions.
- Each position provides excitatory input to certain receptors and inhibitory input to other paired recetors

- The duration and intensity is controlled- specific number of rotations and specific speed.
- Precision in the way the head is positioned
- Volitional eye movements build on the reflexive eye movements

CLEAR, PRECISE,COMPREHENSIVE AND BALANCED

- During therapy, receptors may get large or small amounts of input but in this protocol we assure that as many receptors as possible receive input
- Skills develop more rapidly

- All receptors receive comparable amounts of input

How to use this protocol

- This can be done at the beginning of the treatment session to jump start the system
- Balance with intensive proprioceptive activation to regulate the system
- It also helps to integrate the changes.

How often ??

- Start slow with one or two rotations and gradually increase as the clients tolerance gets better to be able to complete the protocol.
- If done twice a day (boost), it helps to increase the tolerance and speeds the process of integration.
- As gains are maintained, the frequency can reduced to twice a week
- Keep continuing till gains are maintained.
- If there is regression when frequency is reduced go back to “boost”
- It helps to maintain the gains and keep getting the gains.

At what age to do this protocol

- This can be done with all ages -infants,children and adults and senior citizens
- Infants and young children are held to maintain the position
- The person holding the child should be prepared before the protocol .

Contraindications

- Not advised if child has a history of seizures.
- May be used with other clients who have seizures without a photic component
- This is done in a totally dark room or with eye masks

Start slow ....

- You can spend more time doing the preparatory exercises
- You can start with lesser number of rotations
- You can start with eyes open
- When music is used, it activates PRN, triggers specific eye movements.
- Music helps to assist with auditory motor integration
- Music helps to direct the speed, direction and duration of movement
- But music is longer than the number of rotations
- Music may help kids to feel more comfortable
- If the music is providing a lot of input, start without the music

Preparation

Preparing for the protocol-Windmill

- If the child is giddy and uncomfortable with preparatory exercises, stay here till comfortable
- If this step is comfortable, only then add the rotatory component.
- Windmill (10 CW and 10 CCW)
- Child should be instructed to find visual target and be “aware” of it but do not fixate on when spinning
- Do not stand in front of client while spinning
- Number of rotations should be to child’s tolerance, up to 10 per direction.
- Child should fully recover before reversing from CCW to CW direction.

Preparing for the protocol-Windmill

What to look for:

During spinning, watch child's quality of:

- Balance
- How well they are keeping their place in space?
- Immediately after spinning, can you observe a PRN?
- Does the client experience a PRN?
- Ask them if the visual target is moving (without fixating on the object)

Preparing for the protocol- robot zapping

- Robot zapping-touch my finger back to back (child should be able to maintain balance and foot placement and change head postions) - should be able to cross midline 7 times to each side with precise finger contact.
- Over head and inversion(catch a falling star) -do at least 5 times

Preparing for the protocol- robot zapping

What to look for:

- Child’s ability to rotate torso and cross midline during task
- Child’s precision with touching fingertips to partner’s fingertips.
- Does the head follow the hands?
- The head should tilt backward fully when hand is over head and tilt forward and down fully when hand is reaching towards feet
- Head should follow hand in full range throughout the task

Preparing for the protocol-moon boot dusting

- Moonboot dusting-touch toes- repeat 5 times with each hand
- What to look for:
- Follow the pattern: rotate torso down into diagonal, come to upright and midline, and rotate down into opposite diagonal
- Degree to which child moves head out of upright position
- Sustained diagonal inversion of head

Preparing for the protocol-moon boot dusting

What to look for:

- Child’s ability to fully extend head back to look for partner’s hands
- Child’s ability to fully invert head forward to look for partner’s hands

Note: Rocking with partner’s hands when fully extended and fully inverted provides sustained positioning of head out of upright

Other Activities for Self-Initiated Vestibular Activation

- Head to toe rocking
- Pencil rolling
- Head pre-birth movements

Rotatory activation

Rotatory input- sitting (horizontal semi-circular canals)

- CCW 10 rotations
- Maintain head alignment throughout (tilted forward 30 degrees)
- Preferred to do with eyes closed (because this elicits more brisk and sustained reflexive eye movements to support volitional eye movement control)
- After 10 rotations, there will be a PRN of 5-15 seconds
- These movements help the child to gain insight for executing the related voluntary eye movements.
- The voluntary eye movements are executed as soon as the PRN subsides.
- CW rotation 10

Rotatory input- sitting (horizontal semi-circular canals)

- CCW 10 rotations
- Maintain head alignment throughout (tilted forwards 30 degrees and turned 45 degrees to the side)
- Preferred to do with eyes closed (because this elicits more brisk and sustained reflexive eye movements to support volitional eye movement control)
- After 10 rotations, there will be a PRN of 5-15 seconds
- In sitting horizontal perirotatory and post rotary nystagmus is elicited
- Rapid, resetting eye movements and slow following eye movements

Rotatory input- sitting (horizontal semi-circular canals)

- These movements help the child to gain insight for executing the related voluntary eye movements.
- The voluntary eye movements are executed as soon as the PRN subsides.
- CW rotation 10
- If no PRN elicited, its important to wait for 10 seconds before continuing

Horizontal Saccadic Eye movements and smooth pursuits

- Hold 2 penlights 30-35 cm apart at eye level and at 16 inches from child’s face.
- Work onsaccades
- Do both rapid and slow saccades if possible
- Child should be able to move eyes rapidly back and forth from one target to the other without over or under shooting target
- Also should be able to do with no head movement
- Follow up after this with smooth pursuits
- Move the pen 6 or more times across midline
- Do rapid and slow pursuits if possible
- Eyes should move smoothly with no midline jerk while following moving target or lose contact of target

Left sidelying - superior and posterior semi -circular canals

1. Child lies down on left side and keep spine in alignment
2. Head is turned at 45 degrees
3. Eyes are closed
4. Rotate CCW for 10 rotations
5. Wait till PRN settles
6. If no PRN, wait for 10 seconds
7. Rotate CW for 10 rotations
8. Do the same from 1-7 for right side
9. Little kids can be placed on tummy with head turned to one side

Left sidelying - superior and posterior semi -circular canals

- Follow this by vertical saccadic eye movements for 6 or more movements
- Do both rapid and slow saccades if possible
- Eye should move smoothly without head movement while following the target
- Follow this with vertical smooth pursuit eye movements
- Eyes do not lose contact with the target

Wrapping up eye movements

- **Do horizontal, vertical and diagonal saccades**
- Eyes should move back and forth rapidly between 2 targets in all planes without over or under shooting target
- **Follow up with figure 8 smooth pursuits**
- Eyes should be able to follow the movements of the target without any head movement
- **Next do horizontal, vertical and circular head movements**
- **Then do near and far teaming (one pen at 3 inches and other at 3 feet)**
- Child should be able to converge and diverge on near and far targets without seeing blurred or double image
- **Then add peripheral vision**
- Goal is to achieve accuracy in all parts of the visual field and that there is simultaneous central and peripheral visual processing

Linear activation

What do we do

- We consider both linear activation and core development
- Rotatory was for semi-circular canals
- Linear movements provide input to utricles and saccules although SCC receive some input too
- Linear activation involes providing heavy,sustained, proprioceptive input with proper body alignment
- Linear activities have a regulatory effect on the system and thus helps with organization
- To provide balanced input, the head is to be placed in as many planes as possible

8 activities for linear activation

1. **Inverted linear movement** (prone on ball, stand and throw a ball to bowling pins with head in inversion)
2. **Horizontal linear movement in prone** (on scooter board or platform swing)
3. **Horizontal linear movement in supine (**swaddling in lycra or on scooter board or on therapy ball)
4. **Orbital input** (hang from trapeze and circle around the tube or prone on lycra, prone or supine on scooter board and orbital input)
5. **Side to side rolling** (pencil rolling and read a visual target on the core side or roll in the lycra)
6. **Head to toe rolling**
7. **Tilting** (crash on pillows that are kept on the left and the right sides)
8. **Linear movement in upright** (Bouncing on ball

Expected benefits

- Helps to adapt (reset the system for improved gaze stability and postural control)
- Habituation- diminish or alleviate motion sickness and dizziness)
- Solid foundation for supporting,integrating and enhancing the combined contribution of all the sensory systems for optimal engagement in ADL
- Enhances learning ,postural alignment and control and confidence in achieving age appropriate skills
- Improvement in academics.

Expected benefits

Centering & balancing body in gravitational space

- Timing and rhythmicity of movement
- 3D spatial awareness
- Adaptive behavior in a dynamic environment
- Regulation of orientation, arousal, & sustained attention
- Emotional stability
- Cervical & spinal motor control for balance
- Ocular stabilization
- Movement tolerance
- Sound & visual localization
- Oral motor control & suck, swallow, breathe synchrony
- Cerebellar function (feed forward physical & mental agility)
- Cognitive multi-sensory processing from self-oriented perspective

Therapeutic strategies that are included

- **Adaptation**: facilitating the efficiency of the peripheral vestibular system to modify the threshold for vestibular activation by dampening or enhancing transmission of vestibular signals into the central nervous system
- **Habituation**: gradually increasing child's tolerance for vestibular activation by carefully grading the frequency, intensity, & duration of vestibular activation
- **Substitution:** enhancing other systems to compensate for vestibular function when the vestibular system has been compromised

Core is important

- Working on core is important
- Prone extension
- Supine flexion
- Lateral flexion
- Lack of inner core activation leads to:
  - Dysregulation
  - Breath holding
  - Ballistic movement
- TLR and righting reactions are important

Basic principles for development and refinement of core

- Elongation precedes shortening
- Movement throughout full range of motion
  - With control
  - Consider limitations and excesses
- Movement out of the upright
- Integrating breath with movement
- Strengthening through muscle loading
- Sustaining effort over time
- Dynamics of holding and moving

Basic principles for development and refinement of core

- True proprioception organizes vestibular input
- Poor alignment = disorganization/lack of clarity in neural feedback loops
- Important to monitor alignment and breath throughout activities
- Vestibular input (particularly activation of gravity receptors) can lead to enhanced core activation

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Thank you!