

Vestibular and Balance in the Pediatric Population

Kelly Peczka, MSPT



Children'sSM
Healthcare of Atlanta
Dedicated to All Better

Balance Overview

What is balance and how is it achieved?

Balance: The ability to maintain our bodies center of mass over our base of support so that we can:

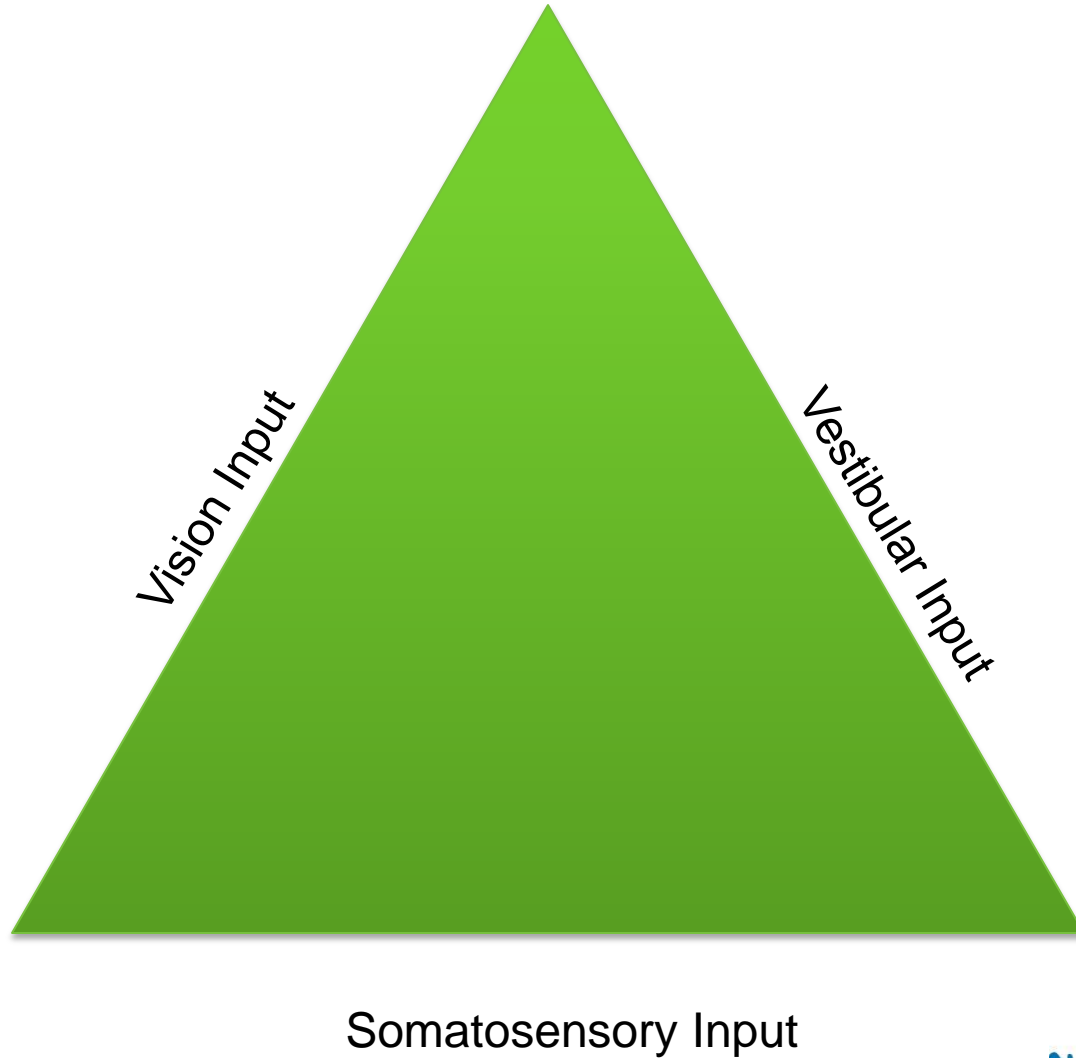
- See clearly while moving
- Orient with gravity
- Determine direction and speed of movement
- Make postural adjustments to stay stable

How is balance achieved?

- Through sensory input from vision, touch, and the vestibular system.



Balance System



How is balance achieved?

Vision

- Tells how person is oriented relative to other objects

Touch

- Cues used from skin, muscles, and joints

Vestibular system

- Organs inside the inner ear detect linear and angular movement

The combined information from the above sites is sent to the brain which controls the reflexes to keep us upright and able to see clearly while moving.

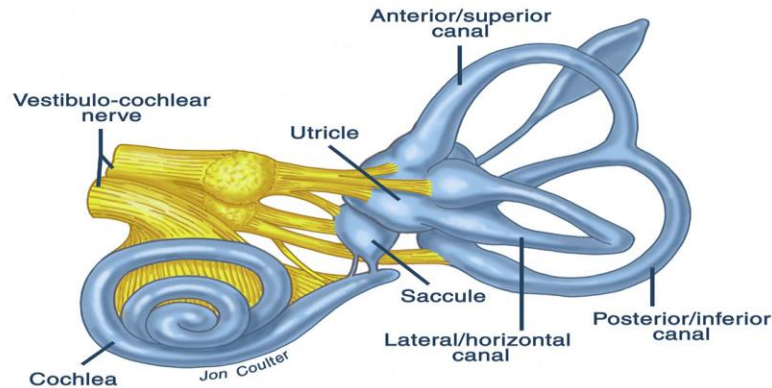


What happens if this system is disrupted?

A system that is damaged by disease or injury can lead to inappropriate cues to the brain that will result in abnormal information about motion. This will then cause abnormal sensations and symptoms regarding motion.



The Vestibular System



Vestibular Signs/Symptoms in the School Aged Child

- Falling out of chairs
- Delayed motor skills
- Nausea or vomiting
- Migraine
- Imbalance
- Motion sickness
- Reading difficulties
- Vision disturbance: acuity (stationary or with head movement), blurry, double
- Poor spatial relationships: skip words or letter while reading or disorganized writing
- Hearing loss, tinnitus, aural fullness



Diagnoses Associated with Vestibular Dysfunction Common in the School Aged Child

- Concussion/cranial trauma
- Chronic Otitis Media
- Sensorineural Hearing Loss or Cochlear Implants
- Ototoxicity/vestibulotoxicity
- Unilateral or bilateral vestibular hypofunction
- Superior Canal Dehiscence or Perilymphatic Fistula
- Brain tumor
- Panic/Anxiety Disorders
- Functional Disorders



Syndromes with Vestibular Expressivity

- Pendred
- Cogan's
- Neurofibromatosis type II
- CHARGE
- Marshall
- Spinocerebellar ataxia
- Usher
 - 10% of children with severe congenital hearing loss have Usher Syndrome which is also characterized by vestibular hypofunction and retinitis pigmentosa



Prevalence of Vestibular Symptoms or Disorders

- General pediatric population:
 - Ranges between 0.7% and 15%
- Cochlear implant population:
 - 80% showed reduced or complete loss of function
- Hearing loss population:
 - 30% to 40 or 50% of children with hearing loss have unilateral or bilateral vestibular loss
- Otitis Media population:
 - 50% with serous otitis media may have vestibular disturbance



Prevalence of Vestibular Symptoms or Disorders

- Migraine population:
 - ~10% of children meet International Headache Society (IHS) criteria for migraine headache
 - Vestibular symptoms occur in 25% of migraine children
 - 30% to 50% of patients with vertigo have migraines
 - Migraines are reported in children as young as 3 to 4 years of age



Prevalence of Vestibular Symptoms or Disorders

- Concussion population:
 - ~30% report symptoms of varying balance impairments as long term sequelae.
 - Cincinnati Children's Hospital reports that post-concussion dizziness is the 2nd most common reason for referral to their pediatric vestibular clinic
 - 38% of TBI-related patients complained of having auditory symptoms. After testing 53% actually had auditory disorders (mainly high frequency hearing loss).



Importance of Vestibular Assessment

Early identification of vestibular impairment:

- Can lead to the formulation of an effective (re)habilitation plan
- Can help identify a serious pathology that may be easily treatable or rule out a more significant diagnosis
- Can help prevent delay in the achievement of developmental milestones and cognition, in mainly reading
- In the cases of syndromal hearing loss, can help differentiate the type of syndrome (i.e. Usher Type I vs. Type II)
- Can assist with the choice of side for cochlear implantation.



Vestibular Assessment and Treatment Options

Who We Are: CHOA's Vestibular Team

- A group of physical therapists and audiologists who have received specialized training in the assessment and rehabilitation of a variety of vestibular disorders including the post concussive and sensorineural hearing loss/post cochlear implant populations.



Why is Vestibular Testing important?

- Vestibular disorders can be difficult to uncover
 - Symptoms are common for many diseases
 - Symptoms can be common side-effects from medications
- Medical doctors look to rule out life threatening conditions first
- After ruling out life threatening condition, symptoms are treated without determining a cause



How to determine which testing to recommend

We will often speak with your physician to determine what testing is appropriate. We use things such as patient age, developmental level, and symptoms to determine if testing is completed with audiology or physical therapy.

Audiology and physical therapy will often discuss our results to determine if further evaluation is needed from the other discipline.



Physical Therapy Evaluation

- Physical Therapy Evaluation
 - You may have been referred to providers for Developmental Delay, Delayed motor skills, hypotonia. In conjunction with hearing loss, these could be a result of an underlying Vestibular disorder that traditional therapy will be less effective at treating.
- Vestibular Physical Therapy Looks at:
 - Ocular Motor
 - Canal Function
 - Gaze Stability
 - Otolith/utricle
 - Physical



5 yo Case Study

- Annabeth is a 5 Y 7 M old female who was referred for a Physical Therapy evaluation and treatment for concerns regarding:
 - poor motor awareness
 - frequent falls off of raised objects
 - as curbs and out of chairs.
 - Has above average reading skills but often skips words



5 yo Case Study

- Assessment results revealed:
 - Normal gross motor skills in a controlled environment
 - Deficits in oculomotor tasks
 - tracking and saccadic movements
 - VOR & COR
 - gaze stability (20/16 static, 20/70 dynamic)
 - optokinetics
 - Romberg on conditions 3
 - Falls on Romberg condition 4
 - Ambulation and running with head turns caused near falls in a controlled environment
 - Unable to ascend/descend stairs in a forward direction



5 yo Case Study

- After 8 Vestibular Physical Therapy Visits:
 - Parents report no longer falling
 - Teachers report that she is no longer falling out of chairs
 - Increase in reading fluency
 - Able to track with minimal deviations in all directions
 - Dynamic visual acuity 20/40
 - Romberg: Passing conditions 1,2, and 3 and falling on condition 4 at 25 seconds.



Vestibular Rehabilitation Therapy – Physical Therapy

- Adaptation
 - Long term changes in the neuronal response to stimulus
 - Includes motor learning
 - Improve postural stability, motor development, alignment
- Substitution
 - Alternative strategies to replace lost or compromised function
 - Central pre-programming
 - Train the sensory re-weighting and integration
- Habituation
 - Reprogramming of postural responses to decrease sensitivity to movement or visual stimuli



Diagnostic Vestibular Testing - Audiology

- When more information is needed to confirm a diagnosis
- Document unilateral/bilateral dysfunction, the involved ear, and compensation
- Confirm BPPV
- Detect central issues that are missed during physical exam
- Decide if additional testing or therapy is needed
- Provides **quantitative** information
- To monitor progress with treatments or therapies
- To obtain pre and post operative information



A Multi-disciplinary Approach

- Neurology
- Neuropsychology
- Otolaryngology (ENT)
- Ophthalmology
- Sports Medicine
- Hematology/Oncology
- Physical Therapy
- Audiology
- Concussion Program/ATC



References

- Chien et al., 2001. Superior Canal Dehiscence Size: Multivariate Assessment of Clinical Impact. *Acta Otolaryngol Suppl.* 545:41-9.
- Crumley-Welsh (2014). “Helping people with vestibular disorders.” *Hearing Review.* 21(9):38-40.
- Furman et al., 2006. “Vestibulo-ocular function in anxiety disorders”. *J Vestib Res.* 16(4-5):209-15.
- Hong et al., 2011. “Vestibular-Evoked Myogenic Potentials in Migrainous Vertigo.” *Otolaryngol Head Neck Surg February.* 11(2): 284-287



References

- Struebel et al., 2001. “Vestibular-evoked myogenic potentials in the diagnosis of superior canal dehiscence syndrome”. *Acta Otolaryngol Suppl.* 545:41-9.
- Taylor, R. L., A. P. Bradshaw, et al., (2012). "Augmented ocular vestibular evoked myogenic potentials to air-conducted sound in large vestibular aqueduct syndrome." *Ear Hear* 33(6): 768-771.
- Telian et al., (1991). “Bilateral vestibular paresis: diagnosis and treatment”. *Otolaryngol Head Neck Surg.* 1991 Jan;104(1):67-71.

