



An Inter-Disciplinary Approach to Development of a Pediatric Vestibular Program

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Other than the salary that I receive from Duke Health, I have nothing financially to disclose.



- Identify the need for pediatric vestibular assessment and treatment based on risk factors.
- Define the role of individual specialties in a multi-disciplinary clinic.
- Explain the desired outcomes of a pediatric vestibular program.



- Cyr and colleagues in 1980 and 1983 discussed lack of formal pediatric assessment/management
 - Infants/children often do not know how to describe symptoms
 - Limited verbal skills
 - Do not know that what they are experiencing is abnormal
 - Parents may not note concerns
 - Prior examination has been more subjective than objective
- Multiple articles have looked at the prevalence of pediatric vestibular disorders
 - O'Reilly et al., 2010
 - Review by Beck, Madrell, Petrak, and Bahner (2015)
 - Li et al, 2016
 - Various hospitals have done internal reviews

Why is it important?



- Vestibular system along with vision and the proprioceptive system all factor into key development of various functions
 - Rolling over, crawling, walking, etc.
- Impairment of these systems can cause delays/problems with development and potential future problems academically (McCaslin, 2016)





- Delayed motor milestones
- Problems with activities that require postural control/motor skills
- Reading deficits due to abnormal ocular reflex function (Braswell & Rine, 2006)
- *Possible cochlear implant failure (Wolter, et.al 2015)*
 - *Possible damage after CI surgery (Cushing, et.al., 2008)*



- Most diagnoses of pediatric dizziness (90%) fall into an unspecified category
- Migraine is the most common cause of dizziness in children
 - Another common cause is otitis media although neither are the most common cause of vestibular impairment



- Risk factors
 - **SNHL**
 - Up to 85% of children with hearing loss have some associated vestibular loss while other statistics of etiologies with the presence of vestibular loss is more variable
 - Multiple articles have cited or stated an association
 - Greater degree of hearing loss associated with potential vestibular deficit (Janky and Rodriguez, 2018)
 - Additionally, certain syndromes with associated hearing loss have greater likelihood of associated vestibular impairment
 - **Delayed Gross Milestones** (McCaslin, 2016, Rine and Weiner-Vacher, 2013)
 - Sit later than 7.25 months
 - Walk later than 14.5 months
 - Parental concerns
 - OME
 - Head Trauma
 - Congenital/Acquired Diseases



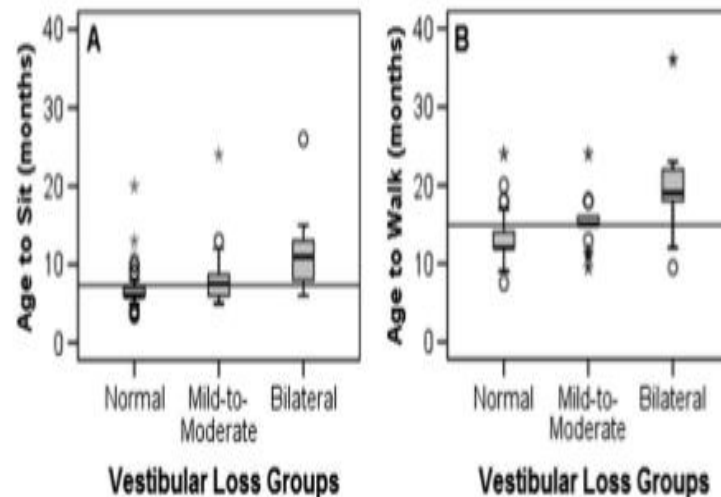


- Janky, et al 2018
 - Retrospective chart review of 2 groups of children with hearing loss seen for routine vestibular testing
 - Part of a neurosensory genetics clinic or as part of their CI candidacy evaluation
 - 253 charts reviewed, not all included
 - Patient testing
 - Vestibular testing with rotary chair, vHIT and VEMP testing
 - Audiologic testing
 - Imaging
 - Comorbidities
 - DP-3 – screener for developmental delays



– Test results

- 38% had some degree of vestibular dysfunction
 - 115 normal, 31 had BVL, 40 mild to moderate vestibular loss
 - 47% of CI candidates were noted to have a vestibular deficit
- Children grouped according to vestibular loss severity.
- Significant relationship noted between
 - Age to sit
 - Age to walk
 - PTA
 - Parental concerns





- Pediatric Dizziness Handicap Inventory for Patient Caregivers (McCaslin & Jacobson, 2015)
 - Ages 5-12
 - Impact of dizziness via caregiver's perspective
- Pediatric Vestibular Symptom Questionnaire (Pavlou et al 2016)
 - 6-17 years of age
- Ages and Stages (ASQ-3)
 - 1 month to 5.5 years
 - Several different domains
 - Gross motor section



- Age 0-2 years
 - Rotary chair, cVEMP, and vHIT (if remote system available)
- Age 3-7 years
 - vHIT, cVEMP/oVEMP
- Age 8+
 - vHIT, caloric testing if vHIT is normal (using monaural screening if needed), cVEMP/oVEMP
 - Other tests can be incorporated to gain a “full picture” of a child’s vestibular system
 - DVA
 - Posturography
 - Oculomotor Exam
 - BOT-2
 - 9 point dynamic/balance exam (Cushing, et.al., 2008)



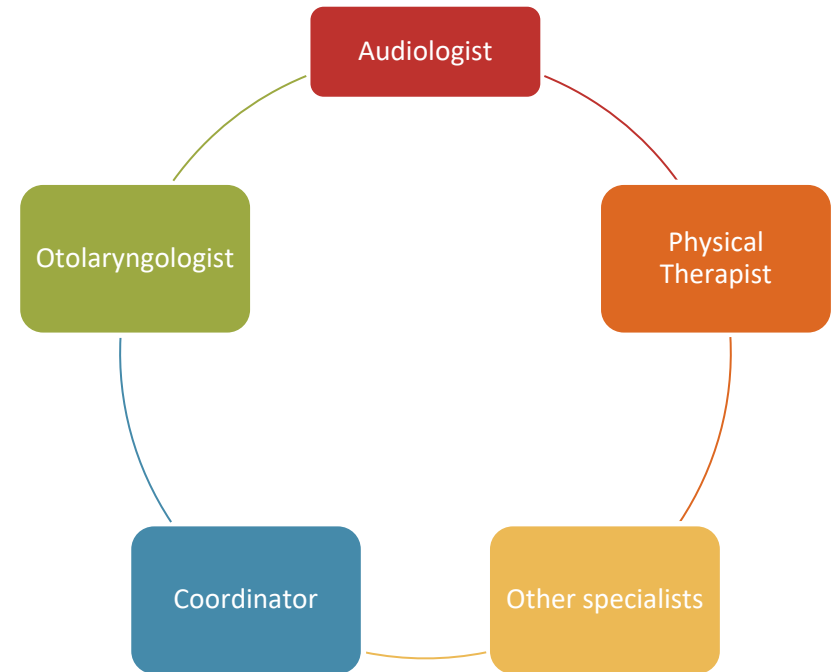


- Critical to adopt a team approach (Valente, 2007)
- Helps families stay connected and informed
- “Integrated care requires professionals and practitioners from across different sectors to work together around the needs of people, their families and their communities.”
 - Multidisciplinary teams have been shown to be an effective tool to facilitate collaboration between professionals and hence improve care outcomes. (*Social Care Institute for Excellence*)
- Ten principles of good interdisciplinary team work (Nancarrow et al, 2013)
 1. **Leadership and management**
 2. **Communication**
 3. **Personal rewards, training and development**
 4. **Appropriate resources and procedures**
 5. **Appropriate skill mix**
 6. **Climate**
 7. **Individual characteristics**
 8. **Clarity of vision**
 9. **Quality and outcomes of care**
 10. **Respecting and understanding roles**

Treatment



- Audiologists
 - Diagnostic evaluations and knowledge/training in vestibular assessment & diagnosis
 - Specialists working with children
- Physician
 - Knowledgeable about vestibular pathology & treatments
 - Manage patient's medical care including any interventions including medication
 - In a position to make referrals to other specialists
- Physical Therapists
 - Can specialize in vestibular rehabilitation
 - Qualified to evaluate patients for their balance or dizziness
 - Specific courses available for pediatric vestibular rehabilitation
- Coordinator
 - Dedicated individual or team of individuals
 - Triage patient needs through the scheduling center
 - Check referrals and coordinate appointments
- Other
 - Neurology, mental health





- Few studies for rehabilitation for vestibular dysfunction in children (Rine et al, 2018)
 - Rehabilitation varies depending on type/nature of impairment
 - Using adaptation, habituation, substitution strategies with focus on gaze stabilization and balance
 - Success is dependent on active participation and attention

Vestibular Rehabilitation



- Assumption among many PCP and pediatricians that plasticity of the developing nervous system can “solve” the problem of vestibular dysfunction without intervention.
 - There are a few objective studies that demonstrate this is false in children.
 - Latest research (Janky and Givens 2015): “Children with vestibular loss do not naturally recover to levels of their healthy peers, particularly with activities that utilize vestibular input, and attention should be given to vestibular loss in the pediatric population.”





- Rine et al 2004
 - Determine effect of intervention on motor development delay and postural impairment in children with SNHL and vestibular impairment
 - 21 children (age 4-7), 2 groups (exercise and placebo)
 - 3 times a week, 12 weeks
 - Pre/post motor development and posturography testing
 - Motor scores improved significantly following treatment. Posturography improved as well but was not shown to be statistically significant

Long Term Implications



- Children with sensorineural hearing loss and bilateral vestibular loss have been found to have significantly worse dynamic visual acuity (DVA) during head movement – (Braswell, 2006, Martin, 2012, Rine, 2003, Rine, 2013)
 - Reading acuity* scores were significantly worse in children with vestibular loss (*smallest print size that can be read)
 - Reading acuity scores correlated with dynamic visual acuity



Implications for Cochlear Implants



- Potential risk for vestibular impairment post implant may indicate problems with implant function
 - Significant cVEMP abnormalities likely due to distortion of saccular membrane (Cushing, 2008)
 - However, pre-implant vestibular testing is not routinely done in the pediatric population due to the need for early intervention for hearing loss.
 - May already have risk factors for vestibular dysfunction due to etiology of hearing loss or severity of hearing loss.
 - Wolter et al 2015
 - 36 patients with device failure from 1990-2014
 - 22 underwent vestibular testing and re-implantation
 - 12/22 had etiology commonly associated with vestibular dysfunction
 - 31 of the original 36 had experienced 1 fall resulting in medical attention (70% of these falls in patients with diagnosed vestibular loss)
 - Results showed that children experiencing device failure had greater prevalence of vestibular dysfunction and subjectively noted worse balance
- Bilateral v. unilateral implantation?
- Known vestibular function pre-implant may help determine side to implant
 - Jacot, et al 2009
 - Assessed 224 bilateral SNHL patients (7 mo. to 16.5 years) pre and post implantation
 - Results pre-implant were used to determine side of implantation based on vestibular function
 - Only half had normal, symmetric function pre implantation





- Need for pediatric vestibular assessment and treatment
 - Mirror similar to pediatric hearing loss and management
- Offer services similar to adults to yield better:
 - Access to care, close gap in health care
 - Outcomes in gross motor development
 - Outcomes related to potential education effects
 - Outcomes for cochlear implantation

Pediatric Vestibular Program



- Duke is developing a pediatric vestibular program
 - Literature review completed
 - Established communication with other, successful pediatric vestibular programs
 - Provided continued education for staff including otolaryngology, audiology and physical therapy
 - Research component completed
 - “A Systematic Review on the Association between Vestibular Dysfunction and Balance Performance in Children with Hearing Loss.”
 - “Vestibular Dysfunction and Gross Motor Milestone Acquisition in Children with Hearing Loss: A Systematic Review”
 - Established relationship with ENT and PT
 - Current work includes protocol development and educational information for both parents and referring providers
 - **Visit Cincinnati Children’s Hospital (plan post Covid)**
 - “Development of a pediatric balance center: a multidisciplinary approach”, Bachman et al, 2018.”

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