Canadian Audiologist

The Official Publication of the Canadian Academy of Audiology

Auditory Implications in Pediatric Mild Traumatic Brain Injury: Where Do We Need to Go?

Published August 31st, 2020

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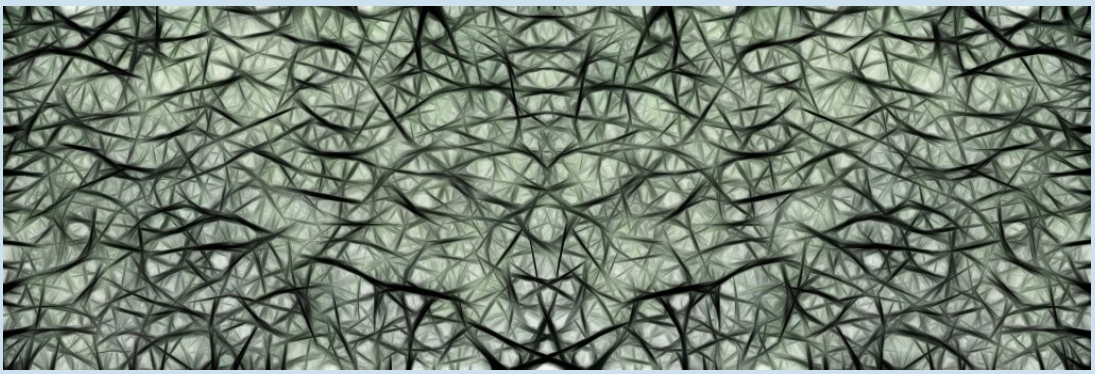

The detrimental effects of a mild traumatic brain injury (mTBI) on the paediatric population has been previously established by studies reporting that between 9%[1] and 31%[2] of children are still symptomatic 3 months post injury. Symptoms following mTBI in children are generally heterogenous (emotional, physical, behavioural or sensory) and their variety and duration following mTBI may make it very difficult for some children to return to school and/or regular activities.[3] As returning to school and routines are usually a priority for the children and their families, proper diagnosis and management of symptoms and conditions is highly important.

Over the years, guidelines for brain injury have been published and it has become clear that not all mTBI symptoms have benefited from the same research /investigation. In fact, the vast majority of guidelines published in recent years regarding diagnosis and management of mTBI in the paediatric population include recommendations for the diagnosis and treatment/or rehabilitation of vestibular dysfunction.[4,5] Unfortunately, despite the structural proximity of their respective peripheral systems, the auditory system does not benefit from the same abundance of literature. Review of guidelines for

paediatrics demonstrate recommendations regarding symptoms associated with the vestibular system, but few to no recommendations are made for the auditory system.[5] Studies of auditory sequelae following mTBI are rare, especially in the paediatric population. However, the available studies show that damage to the peripheral and central auditory systems are likely.[6]

The proximity of the vestibular and auditory peripheral systems to the brain puts them in a position where an impact to the head could result in damage to those systems. Peripheral vestibular damage following mTBI, appears to account for approximately one-third of vestibular dysfunction following mTBI.[7] Peripheral damage to the auditory system following mTBI injury could potentially cause conductive or sensorineural hearing loss.[6,8]

Beyond the peripheral auditory system, research has shown that impairments of centralvestibular and auditory functions can be the result of an mTBI[9,10] as symptoms are observed despite the absence of damage to the periphery (an indication of the possibility of damage to the central systems). Indeed, in some cases, injury mechanisms involved in mTBI can reduce processing capacities of vestibular, auditory or other sensory information, causing difficulties relaying information between these systems and structures in the brain.[11] Various symptoms may include a feeling of permanent dizziness or vestibular headaches when vestibular structures are affected[9,12] while difficulty understanding in noise appears to occur when the auditory system is compromised.[10,13]

Difficulties with understanding in noise have been also shown in pediatric populations.[13,14]However, information on other central auditory functions such as temporal processing, sound localization or dichotic listening which have shown deficits in adult population is still needed.[15] Other auditory dysfunctions such as tinnitus or hyperacusis have been found in adults with mTBI[16,17] but have yet to be detailed in children. Questionnaires such as the Post-Concussion Symptoms Scale (PCSS)[18] record that a subset of children report noise sensitivity following the injury, without greater details.[2,12]

Although there is a notable difference between vestibular (dizziness, vertigo, nausea) and auditory (difficulty hearing in noise, auditory hypersensitivity, tinnitus) symptoms,

the nature of their effects on a child's life can be similar. Indeed, these symptoms will reduce their quality of life by hindering their return to activity or school. In a recent study,[3] more than 70% of the parents surveyed reported that their children benefited from school accommodations during their recovery.

To summarize, vestibular rehabilitation is recommended by concussion management guidelines[19] and demonstrates positive results and remediation of some or all vestibular symptoms.[20] Despite a recognized lack of studies on the auditory system, specifically in the pediatric population, it was noted in the available studies that mTBI can have detrimental consequences on several structures of this system.[6,8,10,13,14] It is therefore of the utmost importance to develop this knowledge in order to increase our understanding of the impact of a mTBI on the pediatric auditory system. Investing in this field would be instrumental in the diagnosis and would therefore allow for better symptom remediation.

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