

Special Edition
"Central Auditory Processing
Disorder in Children"

Mini Review

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Age Related Changes in Central Auditory Processing

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INTRODUCTION

Auditory processing is the processing of information perceived through the auditory sense. Auditory discrimination, lateralization and localization of sound, auditory pattern recognition, temporal aspects including integration, resolution, ordering and masking, auditory performance decrements with competing or/and degraded acoustic signal are the six behavioral processes involved in auditory processing as given by American Speech and Hearing Association (ASHA).¹ Auditory processing disorder (APD) leads to poor input and integration of the information presented verbally. APD has been estimated to occur in 2-3% of children² and in 10-20% of adults³

CENTRAL AUDITORY PROCESSING IN CHILDREN

The APD has been increasingly reported in children. The impairment in the auditory perception might be the cause for problems like learning disability.⁴ Still the disorder has not been recognized as an entity affecting the school aged children (DSM-IV-TR, American Psychiatric Association, 2000). According to Carter and Musher,⁵ auditory-specific perceptual deficit would be the base for learning and reading disabilities. According to Mishra,⁶ children with APD have more difficulties in listening situation that are more complex like in the presence of noise. One of the possible reasons for this has been reported to be the insufficient inhibition of the medial olivocochlear (MOC). Oto-acoustic emissions (OAE) has been used to study this. But, OAE was reported not to be stronger tool to study this effect. Hence, the efferent pathway in these children are poorly studied. In children, APD is not due to a neurogenic disorder largely, but due to an idiopathic central auditory nervous system dysfunction.⁷ However, it has been stated that the central auditory nervous system might be diseased, disorganized or maturationally delayed.⁸ The etiology for APD might also be Bilirubin toxicity.⁹ Hence, the etiology still remains under controversy.

Children with APD have normal intelligence, with or without hearing impairment.¹⁰ These children exhibit behaviors similar to that of children having attention deficit and hyperactive disorder (ADHD),¹¹ learning disability (LD).¹² Keith¹³ has listed out the typical profile of children with APD. This includes mostly male children, having pure tone thresholds at normal range, poor and inconsistent response to the auditory stimuli, decreased attention span, fatigue for auditory information, more distractible, poor localization skills, and difficulty in following complex verbal commands, poor auditory memory and increased reaction time for auditory information.

Screening tests are available which initially helps in screening out children with APD from other children. Those children who fail in the screening test undergo the diagnostic evaluation for each processing skills as listed by ASHA.¹ The management includes auditory training specific to the impairment and environmental modifications.

CENTRAL AUDITORY PROCESSING IN ADULTS

Intact peripheral, central and cognitive processes are prerequisites for good auditory processing abilities. Hence, in older adults as there is a definite decline in peripheral, central and cognitive

processes at varying rates, there is a decline in auditory processing abilities also. Generally, the prevalence of auditory processing abnormalities in older adults has been reported to be 22.6%.³ However, the prevalence of auditory processing abnormalities of older adults in clinical population has been reported to be over 50%. The clinical population includes dementia, Alzheimer's disease.¹⁴⁻¹⁶

Some of the risk factors contribute to the central auditory processing abnormalities among the older adults. The risk factors include cognition related problems,¹⁷⁻¹⁹ history of stroke or heart attack²⁰ and gender.²¹ Some of the other factors include, alcohol consumption and smoking, cardiovascular disease, hypertension, diabetes and systolic blood pressure.²²⁻²⁹ In older adults, the difficulties in speech understanding has also been reported to be as a result of poor interhemispheric information processing.³⁰

Peripheral Changes Due to Aging

Aging is a natural process which results in degradation of performance of the individual as a whole. Age-related decline in the auditory system takes place from the peripheral level to the central level. At the periphery, physiological changes like loss of hair cells and broadening of auditory filters takes place. These changes are reflected in the sensory system as decrease in the audibility, recruitment and widened tuning curves.³¹ These changes are in turn reflected in the auditory behavior as reduction in the understanding of a complex stimulus like speech. Hence, the hearing loss along with the other factors result in the requirement of better signal to noise ratio in older adults compared to younger adults.³² Aging also results in neural degeneration, which leads to reduced rate of transmission of auditory information from the periphery to central level.³³

Changes in Central Auditory Processing Due to Aging

The ability to perceive and detect the order of rapidly arriving sounds is known as temporal resolution; the ability to perceive a complex signal and to isolate and discriminate its components is known as frequency resolution. Deficits in temporal and frequency resolution affect the central auditory processing due to aging. These deficits in turn reflects on the speech perception skills of the individual in the presence of noise.^{34,35} Memory, intelligence, attention, learning, perception, motivation, language age and language impairment are also important for a good auditory processing.^{36,37} In older adults, decline in the ability to focus attention and attention switching results in poor cognitive skills, which is in turn reflected in the auditory processing skills.

Cognitive Changes Due to Aging

Changes in the peripheral sensitivity correlate well with the decline in the cognitive ability of an individual due to age.³⁸ The speech understanding difficulties are still under debate, whether it might be due to the cognitive decline or due to the peripheral changes. Speech perception in the presence of more complex

signal declines with age.³⁹⁻⁴¹ This is seen reverberant listening situations,⁴² competing speech⁴³ and interrupted noise.⁴⁴ This might be related to the reduction in the mental processing.⁴⁵ Hence, secondary to the deficits in the temporal auditory processing, age related declines are observed in comprehension of spoken language.⁴⁶

SUMMARY

Auditory processing is crucial to perceive and process verbal information in our day to day life. APD are common among children. As age increases, there is a general decline in the auditory processing abilities which is reflected as APD in older adults. In older adults, APD could be the result of one or the combination of the following: peripheral changes in the auditory system, cognitive decline and the changes in the central auditory processing. Knowledge about APD is necessary among professionals like audiologist, otolaryngologist, speech language pathologist, neurologist, special educator and school teachers to screen, diagnose and to rehabilitate them appropriately.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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