3aPP1. The medial olivary complex (MOC) reflex strength of children with auditory processing disorders

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The present investigation is designed to examine speech understanding in noise and the strength of medial olivary complex (MOC) reflex in children diagnosed with Auditory Processing Disorder (APD). APD is a dysfunction associated with limited auditory processing of sounds. Individuals with APD do not show any peripheral hearing impairment but have difficulty understanding speech especially in the presence of noise. Recent neurophysiological studies suggest that the efferent system also make an important contribution. One of the most peripheral parts of the auditory efferent system is MOC system which projects from the auditory brainstem to the cochlea. The MOC system has been known to play an important role protecting the auditory system from intense noise and affecting tone detection or speech perception in noise (Micheyl & Collet, 1996; Kumar & Vanaja, 2004). The strength of this efferent feedback system can be assessed non-invasively through the contralateral suppression of distortion product otoacoustic emissions. It is hypothesized that children with APD show weaker MOC reflex strength compared to the normal peers. Based on the test results, possible efficient testing protocol and intervention program for this special population will be discussed.
INTRODUCTION

Central auditory processing disorder (CAPD) defines a set of constraints that affect the way the central nervous system processes auditory information. Deficits in auditory processing can disrupt an individual’s ability to localize/lateralize sound, discriminate between sounds, temporal patterning abilities and auditory performance with degraded acoustic input (ASHA technical report, 2005). Even with the variety of different processing deficits in these individuals, one relatively defining characteristic of CAPD is the presence of no detectable peripheral hearing impairment. In school-age children, the prevalence of CAPD ranges from 2-3% (Chermak and Musiek, 1997) up to 10-20% (Cooper and Gates, 1991). Auditory processing deficits seen in children may be similar to those found in learning and attention deficit disorder; however, the specific limitation in information processing is specific to the auditory modality. This population exhibits difficulty following oral instruction, understanding rapid or degraded speech and significant difficulty listening in the presence of background noise.

The medial olivocochlear (MOC) bundle originates in the superior olivary complex in the brainstem, which is an efferent pathway of the auditory system (Guinan, 1996). Although its function in auditory perception is not clear, one of the possible roles of the MOC bundle is to suppress the response of the outer hair cells (OHC) in the presence of loud sounds or noise (Giraud et al., 1997), which helps to process speech signal in noise. The function of MOC bundle can be assessed non-invasively in humans by measuring otoacoustic emissions (OAE) in the presence of the contralateral noise. The OAE is generated by the cochlea indicating the motility of the OHC. Several studies reported that the magnitude of OAE can be reduced by contralateral stimulation, which is called the suppression effect of OAE (Collet et al., 1990; Ryan et al., 1991; Veuillet et al., 1991). The amount of suppression reflects the strength of the inhibitory function of the MOC on the OHC (Collet et al., 1992; Guinan, 1996). In the current study, we examined the suppression effect of distortion product otoacoustic emissions (DPOAE) in the children with
diagnosed CAPD. It is hypothesized that the MOC reflex strength of the children with CAPD is smaller than that of control adult listeners with normal hearing, which might contribute to difficulty understanding speech in noise for the children with CAPD.

METHOD

Participants

DPOAEs were measured from six children aged 6-13 with normal hearing who failed the SCAN-C, a screening tool for auditory processing disorder. Initially, they were referred by local audiologists for the further audiological testing. Measurement of hearing sensitivity and auditory processing disorder were done at the University of Texas Speech and Hearing Clinic. The SCAN-C test consists of three screening subtests: gap detection, auditory figure ground, and competing words and diagnostic tests: filtered words, competing words and competing sentences. The purpose of the SCAN is to identify disorders of the central nervous system and children at risk of CAPD (Keith, 1995). Additional testing was administered for children who failed in specific test areas. All children included in the study scored below age specific norms indicative of auditory processing disorder. In addition, twenty seven young adult listeners with normal hearing and no history of auditory processing impairment served as a control group.

Procedure

Following behavioral testing for audiometric sensitivity and CAPD, DPOAEs were obtained in quiet and four noise conditions. DPOAEs were recorded in quiet using the intelligent hearing systems software for SMART DPOAEs and a probe in the test ear. Then, DPOAEs were measured again in the presence of contralateral noise which was presented via TDH-39 headphones. Suppression measurements were obtained from both ears in four noise conditions: broadband noise and narrowband noise centered at 500Hz, 1000Hz, and 2000Hz.
RESULT

For our initial analysis, a two-tailed t-test was used to compare DPOAE amplitude in the quiet condition vs. four noise conditions in both the control and test population. Our control population showed a significant reduction of DPOAE amplitude in the presence of contralateral noise stimulation (p <0.05) in both ears. However, the children in the experimental group, there was no significant difference in the amplitude of DPOAE between quiet and any of the four noise conditions indicating lack of MOC reflex. Results of more completed analyses will be discussed on the poster.

Discussion:

Central Auditory Processing disorder represents a variety of auditory processing deficits that affect the brain's ability to process information from the auditory modality. Since its introduction into the literature, it has been considered a controversial label, difficult to separate from other learning or attention deficits that may also be present in the school-age population. Nonetheless, children with auditory processing disorder exhibit significant difficulty understanding speech especially in the presence of competing signals, with no measurable hearing impairment.

Our preliminary data shows, overall, the children who failed SCAN-C test did not show a significant reduction in amplitude of DPOAE response in the presence of contralateral noise. This is consistent with a previous study done by Michnik et al. (2004) who measured TEOAE from the children with CAPD. These results suggest that children with CAPD tend to have weaker MOC function indicating reduced auditory inhibitory effect. As previous studies suggested (Guinan, 1996; Giraud et al., 1997), this might be a contributing factor that affects their ability to hear stimuli in the presence of noise. This information can help in the treatment of CAPD for the school-age population with treatments designed to improve the signal to noise ratio and exercises to target...
auditory discrimination. Additionally, as assessment tools to diagnose CAPD vary, an objective measure that can reliably indicate and speech in noise deficit may be a useful tool for the assessment of CAPD.

REFERENCES


