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Quantification of the effect of distraction in Recording Auditory Late Latency Responses

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Abstract

ALLR is presently of importance as it has evolved as an important tool for the neuro-diagnosis of the central site of lesion apart from the peripheral test for hearing sensitivity. Through ALLR the areas in the cortex that responds to the verbal stimulus can be studied intensively and the manner in which the processing of each speech sounds occur can be studied and analyzed, however it has been reported that the processing of the speech sounds gets affected in pathological conditions like persons with hearing impairment, LD, ADHD, CAPD etc,This main aim and objective of this work is to compare the latencies of ALLR waveforms obtained between different modes of presentation for adults and children.

Introduction

Brain responses reflect more than just activity evoked by a sensory stimulus, hence the term event related potentials emerged [1]. ERPs are brain responses that are time locked to some specified event. The event may occur within a sensory modality or across modalities[2]. The most currently used classification of AEP is based on latency which was adapted from the work of Pi[3,4,5].

Based on the latency epoch, the responses can be classified into Short latency responses (SLR), Middle latency responses (MLR), Long latency responses (LLR) AEP occurring within the first 10-15 milliseconds following stimulus onset are generally referred to as the early or short latency responses (SLR)[6,7,8,9]. The term “middle latency response” (MLR) is used with reference to those components in the latency epoch of 10-50 milliseconds. The middle latency components are typically indicated by Na, Pa, Nb and Pb[10,11,12].

The components generated beyond 50-80 milliseconds post stimulus onset are considered to be the "slow" or "long" latency responses (LLR) or late potentials[13,14,15]. Auditory Late latency responses (ALLR) are recorded from the vertex[16]. It consists of four peaks denoted by P1, N1, P2 and N2. The ALLR is maximal when recorded over the vertex at Cz position. Since LLAEP may become contaminated with eye movements, electrodes are placed lateral to the orbit of one eye and superior to the orbit of the opposite eye[17,18,]. This will permit the simultaneous monitoring of the vertical and horizontal eye movement and eye blinks[19,20].

The present study focused on obtaining normative (children and adults) and studying the variables affecting ALLR using GSI Audera

Material and methodology

Subject Selection Criteria

A total of 40 subjects (20 males and 20 females) participated in the study. These subjects were divided into two groups: Group A and Group B having individuals in the age range of 5-15 years (children) and 18-25 years (adults) respectively. Subjects in each group underwent otoscopic examination, tympanometry, reflexometry and pure tone audiometry. Subjects having middle ear pathology, hearing loss, speech and language problems, neurologic problems, visual problems and metabolic disorders were excluded from the present study.

Administration of the Test

Testing environment and Instruments: Testing was carried out in a sound treated audiometric room at National Institute of Speech and Hearing, Thiruvanathapuram. The instruments used for the present study were calibrated prior to data collection, and it's as follows Puretone audiometer: GSI 61, a calibrated pseudo dual channel clinical audiometer was used to assess the pure tone threshold for all the subjects Middle ear analyser GSI Tympstar, a calibrated middle ear analyzer was used to check the middle ear status Cortical evoked potentials GSI Audera database version 5.0 and pc version 2.6.740813 was used to present and record the responses.

The auditory stimulus was presented through the ER-30 (Etymotic research) Model tip-50 insert ear phone and the visual stimulus was presented using Dell Inspiron n Series.

Testing procedures

Puretone audiometry Modified Hughson and Westlake procedure was used for air conduction and bone conduction hearing threshold estimation.Tympanometry and acoustic reflex thresholds were obtained using a 226 Hz probe tone with a pump rate of 50 daPa.Auditory Late Latency Response (ALLR) - Stimuli were presented through insert ear phone (model tip-50) and Dell Inspiron n Series laptop to all the participants. ALLR was recorded using GSI Audera database version 5.0, pc version 2.6740813. The electrode skin sites were cleaned with spirit and NU-Prep gel (a mild abrasive). Conduction gel (10-20 conduction paste) was then applied to silver chloride (AgCl) electrodes. The non-inverting electrode (Cz) were placed on the vertex and the inverting electrodes, A1 and A2, were placed over the right and left mastoid. It was held in place by placing a surgical tape (surgipore). The insert earphones were placed in the ear. It was ensured that electrode impedance was less than 5 KΩ. ALLR was recorded by presenting a 500 Hz tone burst to both the groups at the intensity of 80 and 70 dBnHL, to right and left ear. After acquired the waveforms, its repeatability was obtained, only the repeatable responses were taken for the study. The same procedure was carried out using 1000 Hz tone burst.Along with that the same procedure is repeated while showing animated cartoon series in a laptop.

Statistical Analysis

The latency of P1, N1, P2 and N2 were obtained. It is Mean and Standard deviations were computed. Descriptive analysis was administered to obtain the mean latency response for children and adults.Independent‘t’-test was used for comparing the latencies response within Group, across different intensities, frequencies, sex and modes of presentation.Paired‘t’-test was used for comparing the latencies between Groups .

Results

Table 1: shows the means and SD for P1, N1, P2 and N2 values at 80 dBnHL for A and AV mode, using a 500 Hz tone burst; Comparison between Two Modes

N	Mode of presentation	Mean Latency (ms)	SD	Mean Latency (ms)	SD	Mean Latency (ms)	SD	Mean Latency (ms)	SD
		P1		N1		P2		N2	
20	A	56.3	11.7	90.7	14.5	157.4	12.9	212.4	19.9
20	AV	60.0	11.7	93.3	12.2	163.9	9.6	219.8	12.0
t	2.566	0.973	3.306	1.989					
p	0.019	0.343	0.004	0.061					

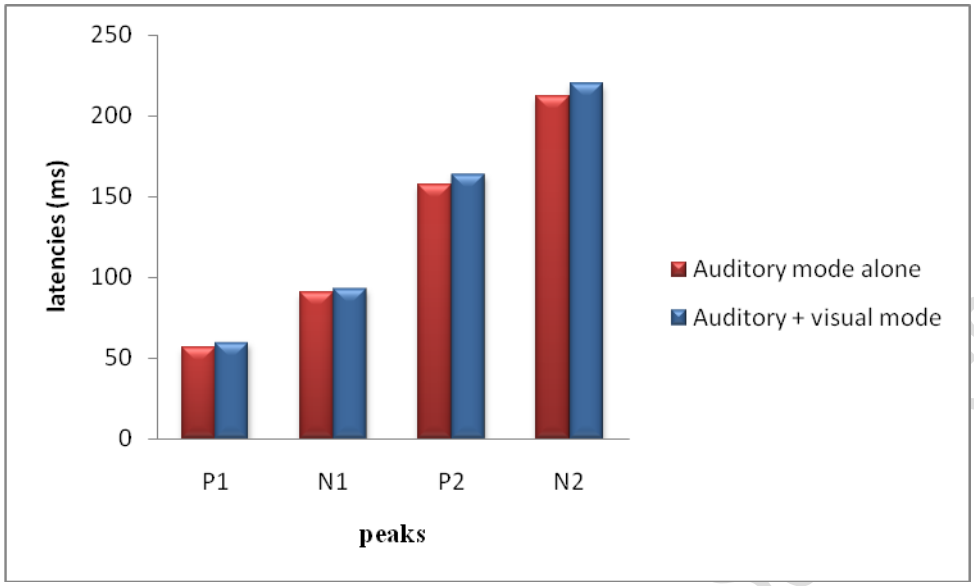

Figure: 1 shows the mean latencies of P1, N1, P2 and N2 using auditory and auditory - visual mode, using a 500 Hz tone burst, at 80 dBnHL

Table: 2 shows the mean, SD, t and p value of adults and children at 80 dBnHL using a 500 Hz tone burst; Comparison Between Groups

N	Age	Mean Latency (ms)	SD	Mean Latency (ms)	SD	Mean Latency (ms)	SD	Mean Latency (ms)	SD
		P1		N1		P2		N2	
20	Adults	56.3	11.7	90.7	14.5	157.4	12.9	212.4	19.9
20	Children	70.1	11.5	108.3	9.2	169.3	13.2	221.0	13.3

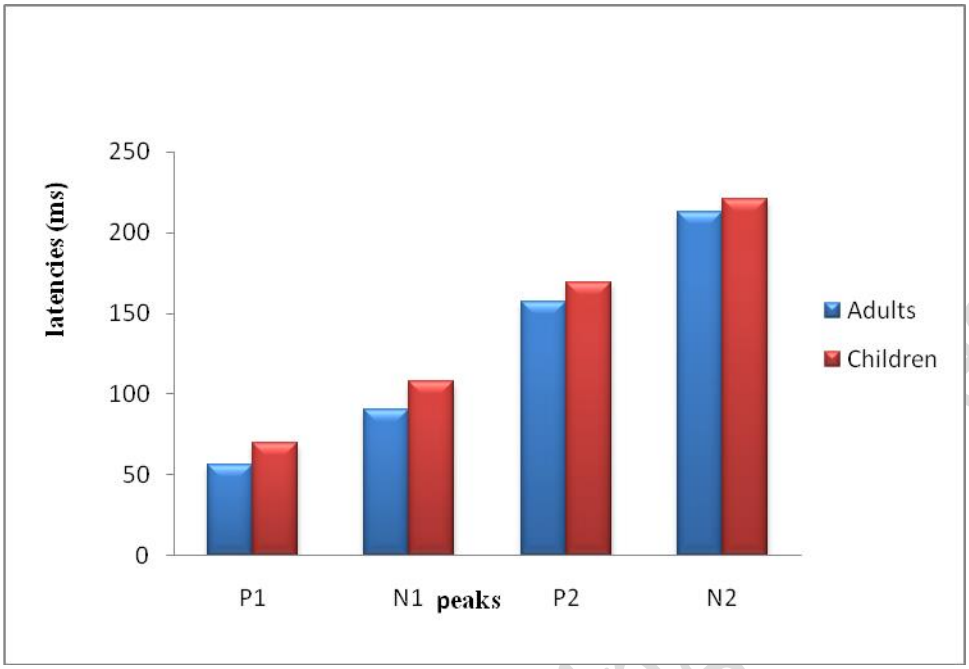

Figure: 2 shows the mean latencies of P1, N1, P2 and N2 at 80 dBnHL using 500 Hz tone bursts for adults and children.

Table: 3 show the mean, SD, t and p value for adults and children at 80 dBnHL, using 500 Hz tone burst using auditory-visual mode of presentation; Comparison between Children and Adults Using Auditory-Visual Mode

N	Age	Mean Latency (ms)	SD	Mean Latency (ms)	SD	Mean Latency (ms)	SD	Mean Latency (ms)	SD
		P1		N1		P2		N2	
20	Adults	60.0	11.7	93.3	14.5	163.9	12.9	219.8	19.9

20	Children	72.6	11.5	110.1	9.2	170.9	13.2	219.7	13.3

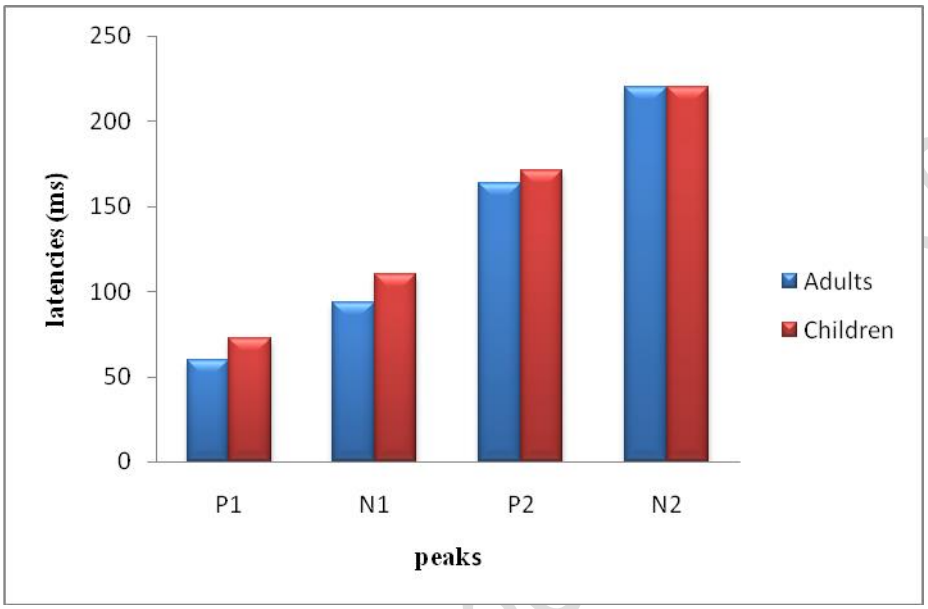

Figure: 3 shows mean latency values for adults and children at 80 dBnHL, using 500 Hz tone bursts along with visual mode of presentation.

Conclusion

In order to facilitate for the purpose for the presented study, a total of 40 subjects (20 males and 20 females) were selected. These subjects were divided into two groups Group A and Group B, having individuals in the age range of 5-15 years (children) and 18-25 years (adults) respectively. Subjects in each group underwent otoscopic examination, tympanometry, reflexometry and puretone audiometry. ALLR was recorded using GSI Audera, by presenting a 500 Hz tone burst to both the groups at the intensity of 80 and 70 dBnHL, to right and left ear. The same procedure was carried out at 1000 Hz. For auditory visual mode, a 500 Hz tone burst was presented along with the theatrical animated cartoon presented through a laptop placed in front of the subject at an angle of 0^0 azimuth angle at an intensity of 80 and 70 dBnHL, to the right and the left ear. Only those response were noted which had repeatable morphology. The

same procedure was carried out at 1000 Hz.The latency values of P1, N1, P2 and N2 were marked, taking into account the maximum amplitude points. The latency values obtained for both the auditory and auditory-visual mode for each of the frequency at the respective intensities were then compared.Statistical analysis was done using descriptive analysis, independent't' test and paired't' test. It can be done on a large sample size.It can be administered on clinical populations such as CAPD, ADHD and LD etc.More detailed study on how the maturation of cortical potentials occurred could be studied by taking children from 2 months of age and above, and dividing the pediatric age groups into smaller ranges and studying the maturational changes.

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