COMPARISON BETWEEN BEHAVIOURAL-BASED MAPPING AND ESRT-BASED MAPPING IN COCHLEAR IMPLANTEES

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Introduction

Cochlear implants (CIs) are the one of the first examples of a neural prosthesis that can substitute a sensory organ to directly stimulate the auditory nerve. The core functions of a CI are to convert the input sounds into meaningful electrical stimulation patterns, and then to deliver these patterns to the auditory nerve fibers through a number of electrodes. The initial programming data include setting threshold levels (T-levels) and comfortable levels (C-levels). Accurate programming of these levels is required for a good map to access hearing and speech perception with the CI. Contraction of the stapedial muscle can be elicited by an adequate electrical stimulus. Electrically evoked stapedius reflex (ESR) has a threshold and demonstrates amplitude growth till saturation. Using Electrically evoked stapedius reflex threshold (ESRT)-based maps can be an objective method to program both adult and especially pediatric implantees, where behavioural responses are difficult to obtain. The goal of this study will be to compare ESRT-based mapping and behavioural-based mapping and whether if an ESRT-based mapping is a reliable and effective alternative for behavioural-based mapping when the latter cannot be obtained.

Aim of the work

The aim of this study was to compare between behavioural-based maps and eSRT-based maps in cochlear implantees regarding the outcome measures and to study the relation between eSRT levels and “C” and “T” levels in cochlear implantees.

Subjects and Methods

This study was conducted on 34 recipients of unilateral CIs who regularly attend the Audio-Vestibular Medicine unit, Otorhinolaryngology Department, Alexandria Main University Hospital during the study period who had been implanted for at least 6 months with a minimum age of 7 years. Complete history taking, otoscopy and middle ear assessment using tympanometry were done. Behavioural C and T levels were determined for behavioural map. Measurements of ESRT were made in the reflex decay mode of the impedancemetry device Clarinet-Inventis (by Inventis, Italy). Compliance changes were monitored in the contralateral ear using the sound probe. A 226 Hz probe tone was used. Biphasic electric pulses used in programming procedures were presented through the speech processor at levels beginning at the behavioural C-level for the stimulated electrode. The ESRT was taken as the lowest stimulus level that produced a definite, repeatable deflection in the baseline compliance recording of at least 0.05 ml synchronous with the stimulus presentation.

The ESRT-based map was generated by setting MCLs at ESRT levels and threshold levels at 10% of MCL. An aided audiometric test was done to determine the implantee’s hearing thresholds using the CI with AD629 audiometer (by Interacoustics, Denmark). Speech discrimination test of Arabic mono-syllabic phonetically balanced words was done for each implantee with their CI according to age. Both tests were done for each implantee twice, once for each different map used.

Results

Table 1: Comparison of the aided pure tone thresholds in the studied groups:

PTA	All patients (n=34)	Age groups (7-18 years) (n=23) (67.65%)	Age groups (18+ years) (n=11) (32.35%)
PTA Behavioural			
- Min – Max	17.50 – 38.75	17.50 – 38.75	17.50 – 38.75
- Mean ± Std. Deviation	30.74 ± 5.97	30.76 ± 5.93	30.68 ± 6.33
- SEM	1.02	1.24	1.91
- Median	31.88	32.50	31.25
- 25th Percentile – 75th Percentile	27.50 – 35.00	26.25 – 36.25	28.75 – 35.00
PTA ESRT			
- Min – Max	20.00 – 45.00	20.00 – 45.00	21.25 – 42.50
- Mean ± Std. Deviation	32.76 ± 6.15	32.28 ± 6.01	33.75 ± 6.61
- SEM	1.06	1.25	1.99
- Median	33.75	32.50	36.25
25th Percentile – 75th Percentile	28.75 – 37.50	27.50 – 36.25	28.75 – 37.50
Test of Significance *p-value*	$t_{(df=33)}$=3.322 *p*=.002*	$t_{(df=22)}$=1.881 *p*=.073 NS	$t_{(df=10)}$=3.938 *p*=.003*

n: Number of patients, Min-Max: Minimum – Maximum ,SEM: Standard Error of Mean, df=degree of freedom, t: Paired Samples Test ,*Statistically significant (p<.05)

Table 1 showing that there was no statistically significantly difference between aided pure tone thresholds in ESRT-based maps compared to behavioual-based maps in the 7-18 years age group, while aided pure tone thresholds in ESRT-based maps were statistically significantly worse compared to behavioual-based maps in the 18+ years age group.

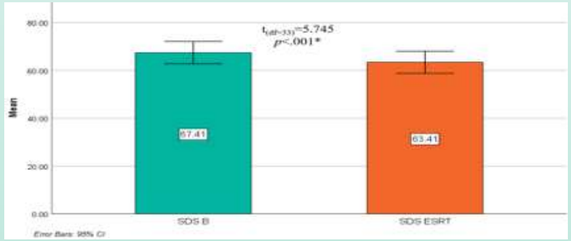

Figure 1: Comparison of the speech discrimination scores (SDS) between behavioural-based maps and ESRT-based maps:

Figure 1 showing that behvaiourally-based SDS were statistically significantly better compared to ESRT-based SDS in both age groups (p<.001).

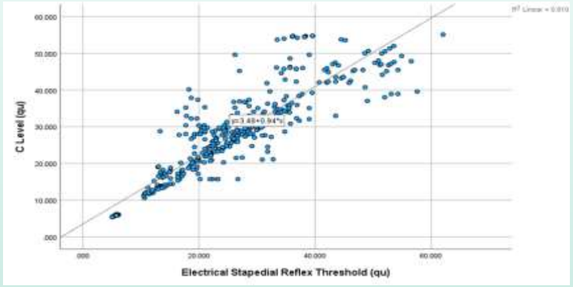

Figure 2: Correlation between ESRTs and C-levels:

Figure 2 showing that there was a very high statistically significant positive correlation between Electrical Stapedial Reflex Thresholds and behavioural C-levels (r=0.900, p<.001).

Conclusion

According to the established results, the following was concluded:
There is a significant positive correlation between ESRT levels and C-Levels in cochlear implantees which makes ESRT values a statistically significant predictor for behavioural C-levels.
The equation for prediction is: (C-level = 3.479 + 0.936 x (Electrical Stapedial Reflex Threshold) ± Residual Error).
Behavioural-based maps produced better results likely due to the familiarity and individuality of the map parameters compared to the ESRT-based maps.
Although ESRT-based maps produced worse aided and speech discrimination outcomes than behaviourally-based maps, it still could be used as an objective initial alternative method for mapping in challenging cases.