

THE EFFECT OF FULL AND PARTIAL MAPPING ON SOUND LOCALIZATION AND CONSONANT RECOGNITION ABILITIES IN CI USERS

Mona Ibrahim Mourad, Mirhan Khamis Eldeeb, Amira Mohammed Zaki Al-MAhy,* Arwa Ahmed Abdelmottaleb Ali

Department of Otorhinolaryngology, Audiology Unit, Faculty of Medicine, Alexandria University, Head of Audiology Unit, El-Talaba Sporting Hospital*

INTRODUCTION

Sound localization is an auditory skill that allows identification of an acoustic signal in space. It's dependent on two mechanisms; a peripheral mechanism that includes signal comparison between right and left ears of a normal hearing person and a central processing mechanism in the brain stem pathways.

Hearing loss impairs both peripheral and central mechanisms. However, people with unilateral hearing loss have some ability to localize sound, a finding that reinforces the importance of monaural spectral cues for this purpose. Monaural ability to localize sound might be especially important for patients with unilateral cochlear implants, who base their 'acoustic picture' on limited acoustic data.

Speech is a complex acoustic signal that is rich in both spectral and temporal features. The listener makes use of whatever spectral or temporal cues are available to help decode the incoming speech signal. Multiple redundant acoustic cues can contribute to the perception of a single phonemic contrast.

CI processing preserves the slowly varying temporal envelope information in the speech signal (i.e., cues related to amplitude changes over time) but provides only a coarse representation of the spectral envelope.

AIM OF THE WORK

The aim of the work was to evaluate sound localization skills and speech discrimination using high frequency weighted speech list in CI users for full electrode activation and partial electrode activation.

SUBJECTS AND METHODS

Forty cochlear implant users were enrolled in this study ranging in age from 7 to 18 years pre or perilingual children with at least 2 years experience with the implant use and satisfactory aided response. Exclusion criteria included postlingual deafness. All patients were tested for sound localization with 5 loudspeakers arranged along a circular path, covering an arc of 180° from (+90° to -90°) and spaced at 45° in the horizontal plane. Speech recognition was tested via a high frequency speech list of CVC sense words.

The tests were done using the patients' default map and other two maps created at test time; one permitted the high frequency electrodes only to be active and the other map permitted hearing with only the low frequency electrodes. The cut off center frequency ranged from 1191-1638 Hz.

RESULTS

Table 1: Comparison between patient performance on modified Arabic consonants discrimination list in different studied maps in total sample (n = 40)

Percent of error of consonant class	Full map	Low pass map	High pass map
Stops			
Min. – Max.	5.88 – 73.53	26.47 – 97.06	26.47 – 100.0
Mean ± SD.	34.78 ± 18.29	68.01 ± 16.41	84.12 ± 14.60
Median (IQR)	32.35 (19.1 – 51.5)	70.59 (57.4 – 77.9)	85.29 (82.4 – 91.2)
Sig. bet. cond.	$p_1 < 0.001^*, p_2 < 0.001^*, p_3 < 0.001^*$		
Fricatives			
Min. – Max.	10.81 – 91.89	32.43 – 97.30	32.43 – 97.30
Mean ± SD.	36.22 ± 20.87	74.53 ± 13.94	79.86 ± 15.45
Median (IQR)	32.43 (20.3 – 47.3)	78.38 (66.2 – 83.8)	83.78 (71.6 – 91.9)
Sig. bet. cond.	$p_1 < 0.001^*, p_2 < 0.001^*, p_3 = 0.131$		
Laterals			
Min. – Max.	6.67 – 93.33	26.67 – 100.0	26.67 – 100.0
Mean ± SD.	37.50 ± 23.76	74.0 ± 17.79	79.50 ± 18.76
Median (IQR)	30.0 (20.0 – 53.3)	80.0 (60.0 – 86.7)	83.33 (73.3 – 93.3)
Sig. bet. cond.	$p_1 < 0.001^*, p_2 < 0.001^*, p_3 = 0.146$		
Nasals			
Min. – Max.	7.14 – 85.71	28.57 – 100.0	35.71 – 100.0
Mean ± SD.	41.43 ± 23.34	75.18 ± 16.96	86.96 ± 14.64
Median (IQR)	35.71 (25.0 – 57.1)	78.57 (64.3 – 85.7)	92.86(82.1 – 100.0)
Sig. bet. cond.	$p_1 < 0.001^*, p_2 < 0.001^*, p_3 = 0.009^*$		

IQR: Inter quartile range

SD: Standard deviation

p: p value for comparing between the studied conditions

p_1 : p value for comparing between **Default condition** and **Low pass condition**

p_2 : p value for comparing between **Default condition** and **High pass condition**

p_3 : p value for comparing between **Low pass condition** and **High pass condition**

*: Statistically significant at $p \leq 0.05$

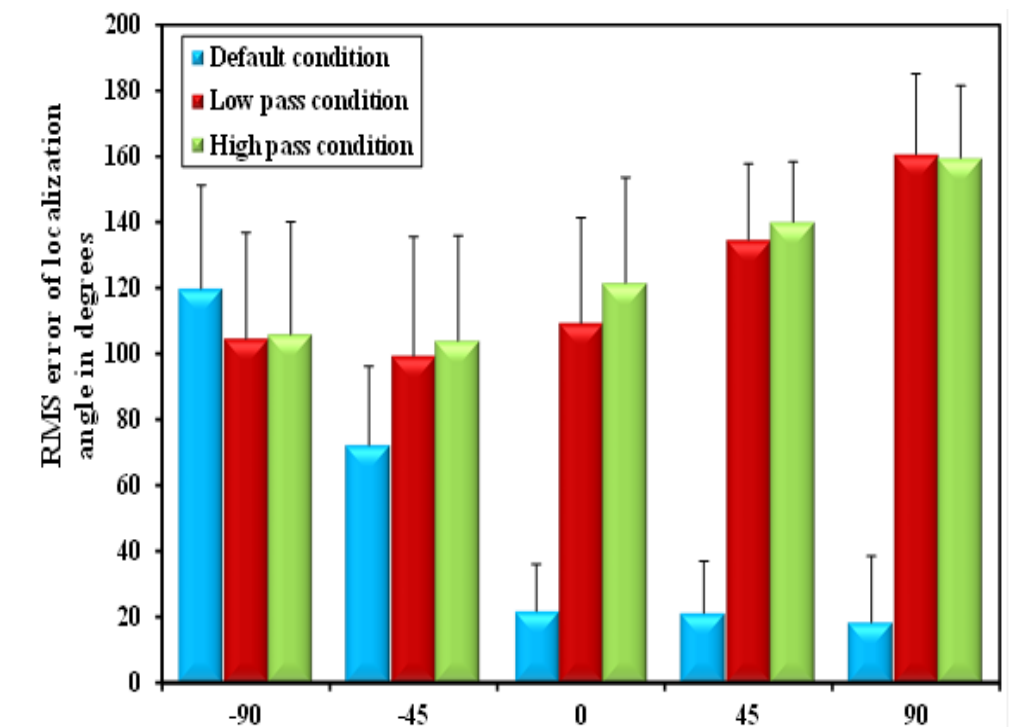


Figure: Comparison between the different studied conditions according to RMS error localization angle in degrees in total sample (n = 40)

CONCLUSION

- In general low pass map consonant recognition accuracy was always better in all consonant classes than for the high pass map. And this can be explained by the fact that temporal cues are as important in perception of consonants as in perception of vowels. post meningitis hearing loss, short electrodes or incomplete insertion of electrodes due to any cause are more likely to affect consonant perception due compressing a large spectrum of frequencies within a narrow range and the resultant frequency-place mismatch.
- Horizontal sound localization in congenitally deaf children can be restored even with monaural hearing by the CI device.