Monitoring auditory maturation and adequacy of audio processor programs of pediatric CI users using aided cortical assessment.

Julie Kosaner¹, Ozgur Yigit ², Muammer Gultekin ¹, Svetlana Bayguzina¹; ¹Meders Speech and Hearing Clinic, Istanbul, Turkey, ²Istanbul Training and Res. Hosp., Istanbul, Turkey. 14th International Conference on CI and other implantable Technologies, May 11-14, 2016, Toronto, Canada
Disclosure

- J. Kosaner: An employee of MED-EL GmbH
Introduction

- To realize benefits of early cochlear implantation (CI) audio processor (AP) programs need to be optimized and validated in a timely fashion
- To be able to optimize AP programs a measure of device benefit is required
- Aided cortical assessment (ACA) can be used to objectively measure device benefit and monitor auditory maturation
Objectives

- To monitor auditory maturation of pediatric CI users, fit using the objective eSRT fitting method, using ACA
- To compare cortical responses of new CI users with those of hearing peers
Method

- 20 children with normal hearing (NH group), mean age 34m, had ACA done 1 time
- 45 pre-lingually deafened, unilateral, MED-EL, CI users (CI group) mean age 25m had ACA done repeatedly over first 6 m of CI use.
- 7 ACA test intervals (1 week, 1, 2, 3, 4, 5 and 6 m)
  Mean number of ACA’s done per CI user - 4.48 (range 3-7)
  Number of CI users tested at each interval ranged from 17 - 34
- CI users were fit using eSRT fitting method, typically, 4 times in 6 m
- All NH and CI children were aged under 4 years
Method: data collected using....

- Automated, single channel, sound field cortical response equipment
- P1 responses elicited using speech tokens /m/, /g/ and /t/ representing low, mid, high frequency sound
- Presented at 55 dB SPL to evaluate access to soft conversational speech

<table>
<thead>
<tr>
<th>Speech token</th>
<th>Length ms</th>
<th>Dominant frequencyHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>30</td>
<td>250</td>
</tr>
<tr>
<td>g</td>
<td>21</td>
<td>1250</td>
</tr>
<tr>
<td>t</td>
<td>30</td>
<td>3250</td>
</tr>
</tbody>
</table>
Method: P1 responses scored to clarify reporting

No P1 = 0 points

P1 long latency = 1 point

P1 reference range latency = 2 points

Total possible score at each ACA = 6

(Golding, Pearce, Seymour, Cooper, King, Ching, Dillon, 2007).
(Kosaner et al 2014)
Method:

- P1 response rate was compared across NH and CI group
- Mean ACA score and mean latencies of P1’s to /m/, /g/ and /t/ stimuli compared across test intervals for CI group and compared with mean values for the NH group
- ANOVA, Tukey HSD and Spearman’s rho correlation used to analyse P1 response rates and latencies of P1 responses
Results:

- NH group had a P1 response rate of 100%
- CI group had a P1 response rate of 75% (all test intervals)
- From 1\textsuperscript{st} to 7\textsuperscript{th} test interval mean P1 response rate to /m/, /g/ and /t/ increased from 16% to 62%, 45% to 88%, 45% to 97%, respectively
- Positive increase in P1 percentage over time was significant for /m/, /g/ and /t/ (\(r=.385\) to \(r=.560\); all \(p<0.001\))
- P1 response rates to /m/ remained significantly different to response rates for NH group at all test intervals (\(p<0.001\) to \(p=0.001\))
- From 3\textsuperscript{rd} month onwards, P1 response rates to /g/ and /t/ were not significantly different to rates for NH group (\(p=0.191\) to \(p=0.436\))
Figure 1: Mean (±SD) P1 response rate (as %) to speech tokens /m/, /g/ and /t/ for the NH group and across test intervals for the CI group are shown.
Results: P1 latency

- Mean latencies of P1 responses to speech tokens /m/, /g/ and /t/ presented at 55 dB SPL for the NH group were 120ms, 115ms and 115ms, respectively.

- Excluding 1st week data mean latencies of P1 to /m, /g and /t/ presented at 55 dB SPL for CI group across tested intervals were 155ms, 122ms and 130ms, respectively.

<table>
<thead>
<tr>
<th>Speech token at 55 DB SPL</th>
<th>Latency to /m/ ms.</th>
<th>Latency to /g/ ms.</th>
<th>Latency to /t/ ms.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH</td>
<td>120</td>
<td>115</td>
<td>115</td>
</tr>
<tr>
<td>CI 2ND – 7TH test interval</td>
<td>155</td>
<td>122</td>
<td>130</td>
</tr>
</tbody>
</table>
Results: P1 latency

- Correlation analyses confirmed a significant decrease in P1 latencies over the tested intervals for /m/, /g/ and /t/ \((r=-.565 \text{ to } r=-.781; \text{ all } p<0.001)\).  
- Mean P1 latency for /m/ for CI group was not significantly different from mean P1 latency for NH group from 5th month onwards.  
- Mean P1 latency for /g/ and /t/ for CI group was not significantly different from mean P1 latency for NH group from 3rd month onwards.
Figure 2: Mean (±SD) P1 latencies to speech tokens /m/, /g/ and /t/ for the NH group and across test intervals for the CI group are shown.

* Significant difference to NH group
Results: ACA score

- All in NH group scored 6
- Mean score CI group over all intervals- 4 (± SD: 1.781)
- 76% CI users scored 6 within 6 months
- 89% CI users scored 5 / 6 within 6 months (ACA = 5 typically reflects P1 latency to /m/ out of reference latency range)
- 51% scored 5 / 6 within 3 months – good performers
- Only 7% (3 users) scored 3 or less with 4m CI use
- Subsequently, only 1 user still scores <3 with 16m CI use
- Significant improvement in ACA score till 3m (all p<0.001)
Figure 3: Mean (±SD) ACA scores for CI group across intervals and NH group at their single test interval.

* Significant comparison to NH children
Conclusion

Typically, CI users implanted <4y, with eSRT set MCL’s, develop cortical responses similar to hearing peers over a period of 3 to 6 months (in line with other research 1,2,3,4,5).

Results verify that a CI gives access to quiet sound and allows for auditory maturation.

Study provides clinicians with information on ‘expected’ cortical responses for objectively fit pediatric CI users.

‘Expected’ cortical responses boost confidence in device efficacy.

Less than optimum cortical responses can prompt early solutions.