



# P1 latency in cochlear implant candidates

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**Is there a  
"critical period"  
for  
auditory development?**

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## Auditory deprivation in animals

- Loss of SG cells
- Loss of cell in anteroventral & ventral CN
- $\Delta$ s in neural projections between BS nuclei
- Decreased cortical synaptic activity
- $\downarrow$  # of 1° dendrites in cortical pyramidal cells
- Take over of cortical area by visual

Finney: Nature neuroscience 2001, Hartmann: Hearing research 1997, Kral: Cerebral Cortex 2000

## DWC & rats

- Kral:
  - $\uparrow$  length of stim =  $\uparrow$  cortical tissue iff it occurs before 6 m of age
  - Synaptic current flow normal iff before 6 m
- Hsu:
  - $\uparrow$ FOS immuno-active cells in deaf rats if implanted @ 21 days than 120

Kral et al: Cerebral Cortex 2002; Hsu et al: J Comput Neurobiol 2001

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**Is there a  
"critical period"  
for  
auditory development?**

**There is for animals!**

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**If there is a critical period in humans,  
then cortical responses to auditory stimuli  
should develop better within this period  
than outside it**

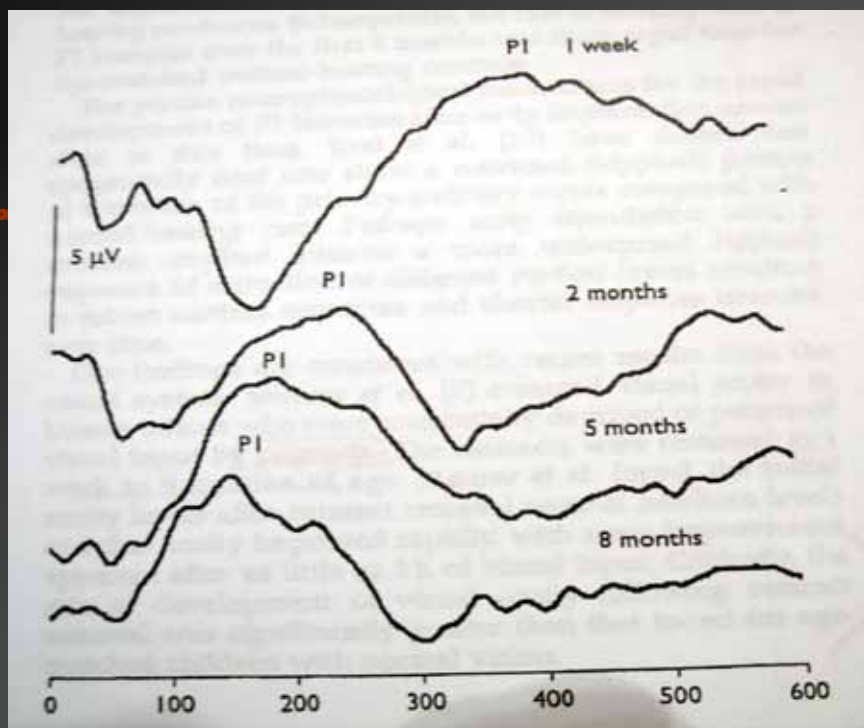
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# P1

- An evoked auditory response arising from the thalamus &/or auditory cortex.
- In normal hearing adults occurs about 100 msec after the stimulus
- Latency is much longer at birth and shortens in response to auditory stimulation
- Clinically evoked with vocal stimulus: /ba/

Sharma et al: Neuroreport 2002; Ponton et al: Ear & Hearing 1996

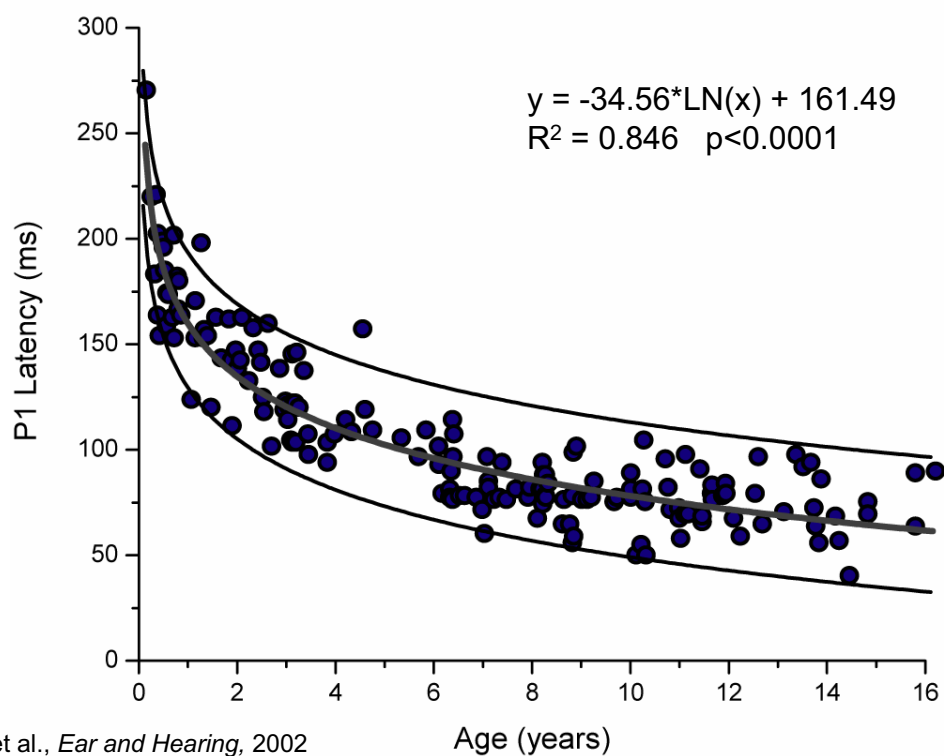
# P1



- 1) Latency shortens in response to auditory stimulus
- 2) Early pronounced negativity (pre-natal) disappears slowly as latency shortens

Sharma et al: Neuroreport 2002

### Normal Hearing Children (N=190)

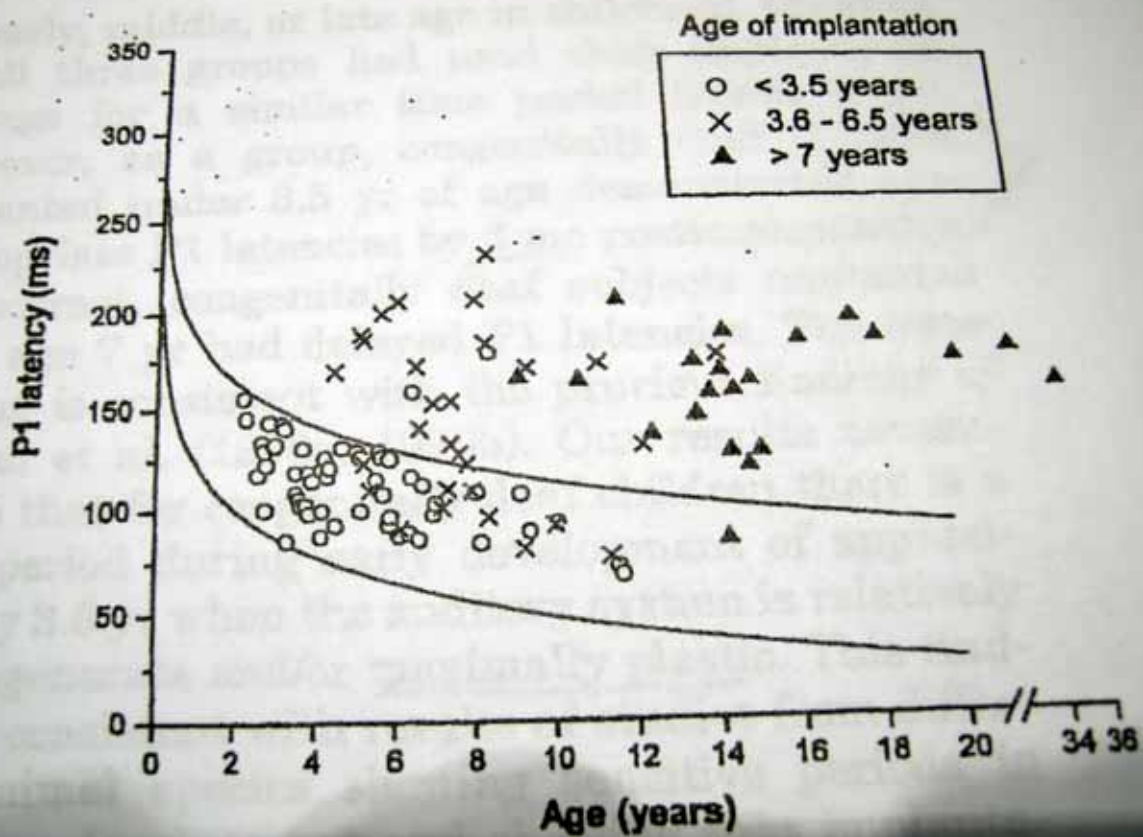


Sharma et al., *Ear and Hearing*, 2002  
Sharma and Dorman, AOR, 2006

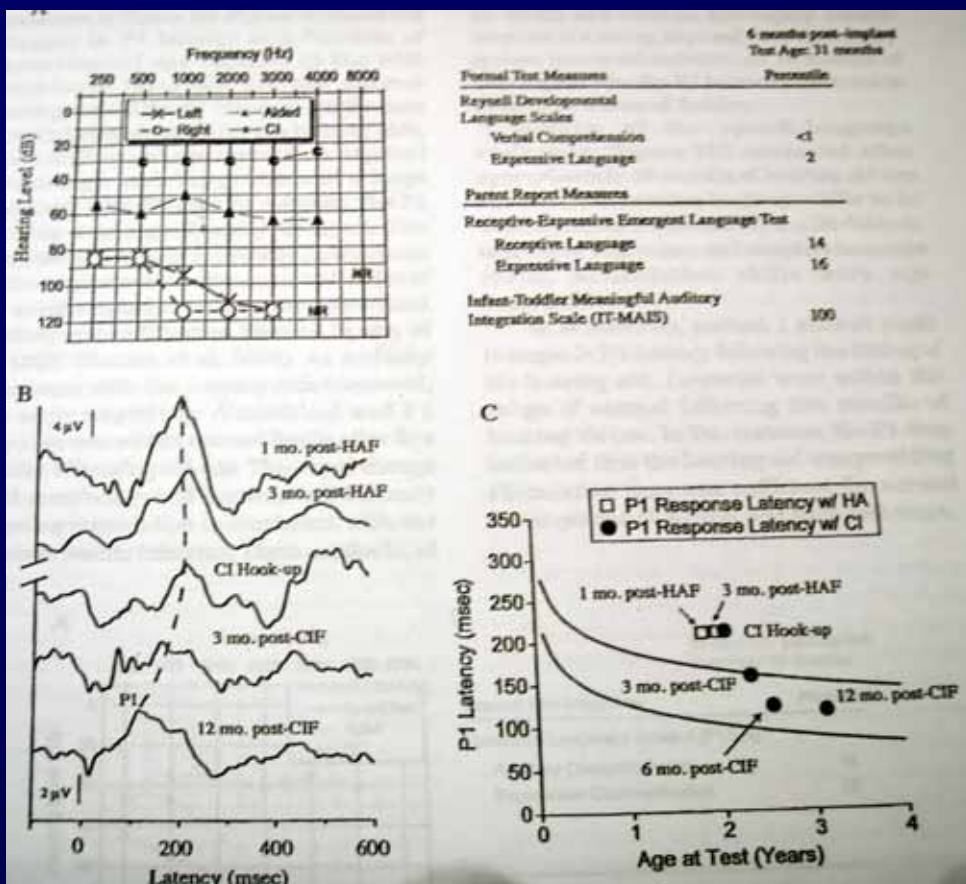
*Slide courtesy of Anu Sharma, PhD*

## Sharma

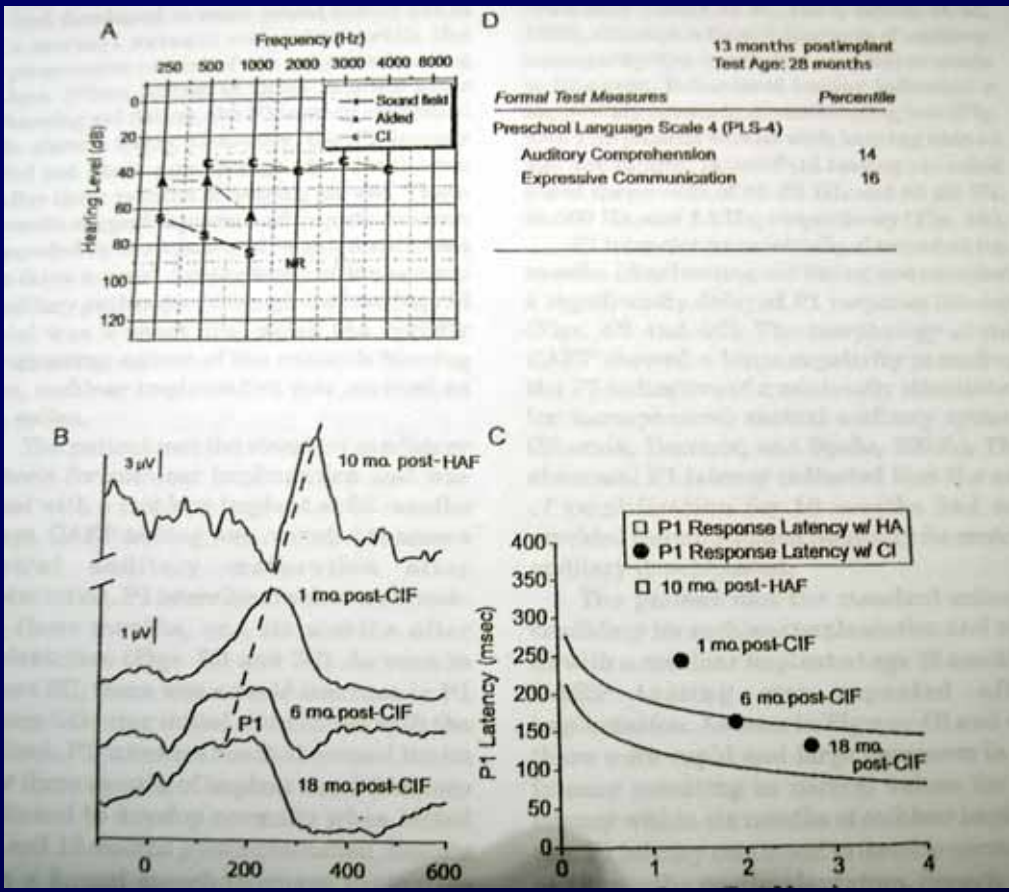
- 136 normal vs 107 CI kids
- CI kids divided into 3 groups;
  - < 3.5 yrs
  - 3.5 - 7.0 yrs
  - > 7.0 yrs



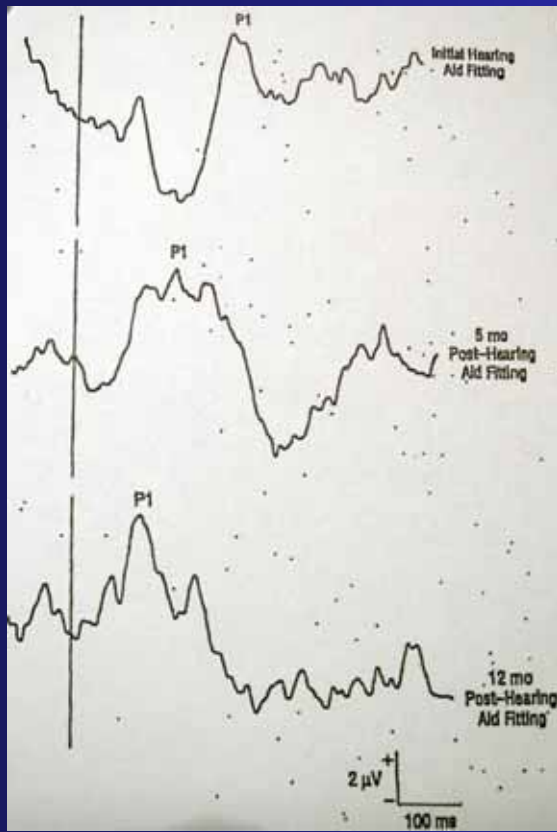
Sharma et al: Ear & Hearing 2002



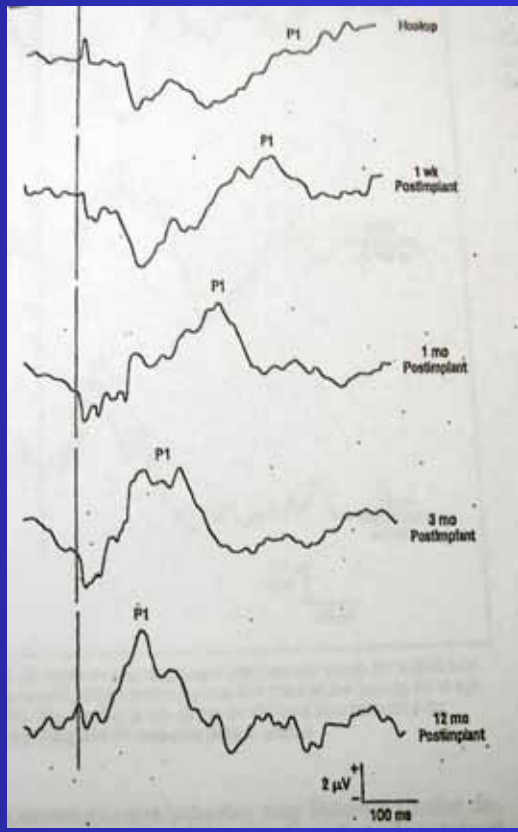
Sharma et al: J Am Acad Audiol 2005



Sharma et al: J Am Acad Audiol 2005



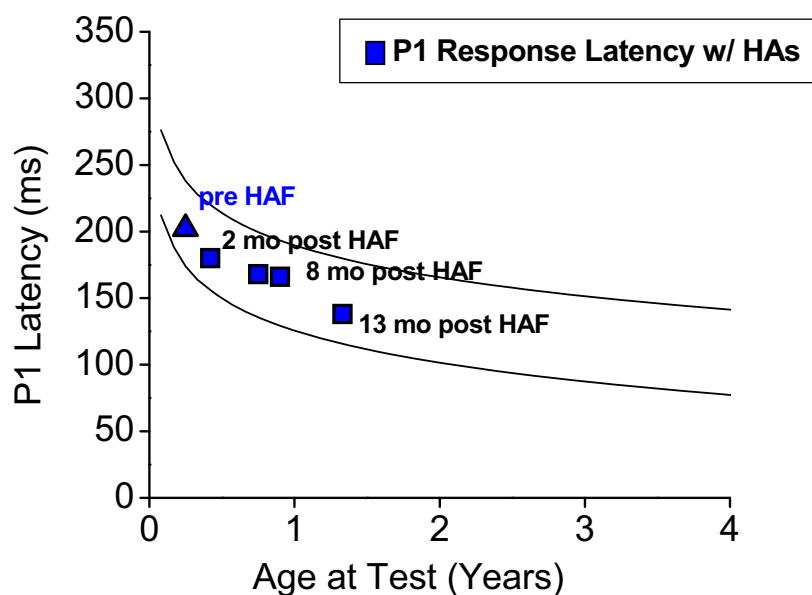
Hearing aid



Cochlear implant

# Case A

- 3 year old, female
- Congenital, moderate to severe, bilateral hearing loss (Unaided PTA= 67dB HL)
- Hearing aids fit at age 3 months
- P1 cortical auditory evoked response measures performed at various intervals post activation to assess central auditory system development



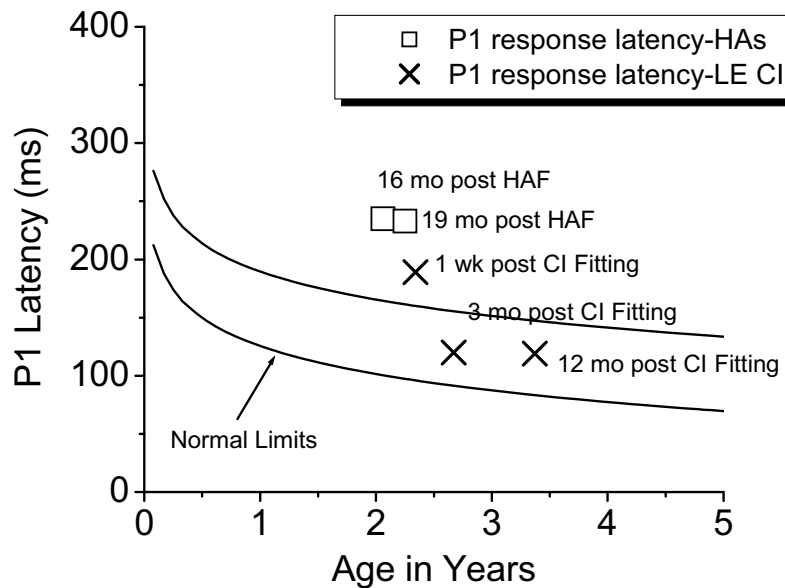


## Case A

- P1 response within the expected latency range for a normal hearing child of a similar age
- Suggests adequate auditory input to the central auditory pathway following HA fitting
- Not a CI candidate

## Case B

- 6 yr old, male
- Congenital, bilateral severe to profound hearing loss (Unaided PTA= 100 dBHL)
- Hearing aids fit at age 6 months (Aided PTA= 75 dBHL)
- Left ear MedEI cochlear implant initial stimulation at age 28 months
- P1 cortical auditory evoked response measures performed at various intervals post activation to assess central auditory system development



## Case B

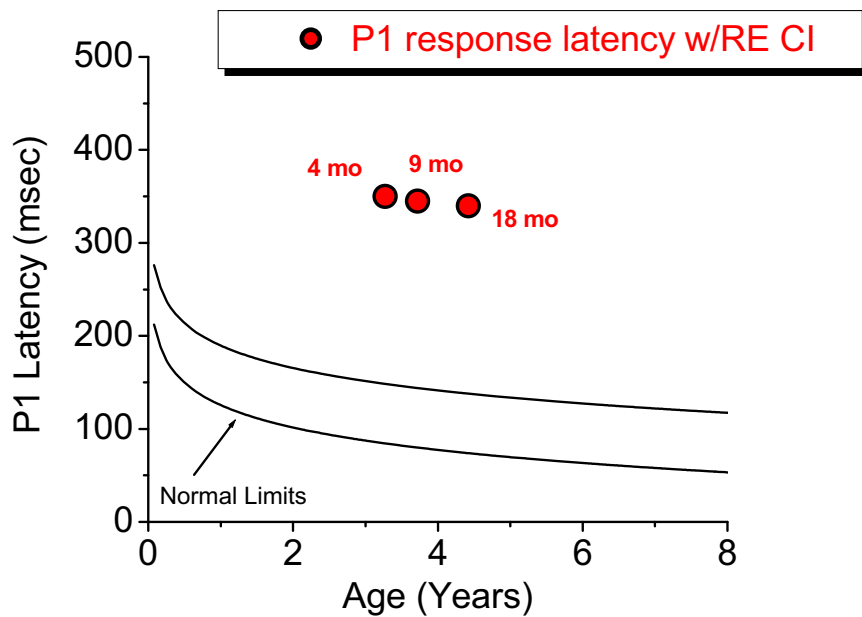
- Two-Year Post CI Activation:
  - Early Speech Perception Test
    - Category 4 (Consistent Word Identification) of the CID speech perception categories
  - Glendonald Auditory Screening Procedure (GASP)
    - 92% words correct
  - Multisyllabic Lexical Neighborhood Test (MLNT)
    - 42% words correct

## Case C

- 5.5 year old, male
- Bilateral, profound sensorineural hearing loss estimated via ABR at age 7 months
- Etiology: Connexin 26 mutations
- Fit with a right ear Advanced Bionics HiRes 90K cochlear implant at age 3 years, 1 month

## Case C

- Post-activation, managing audiologist documented inconsistent behavioral responses to sound despite consistent device use and multiple MAPping changes
- Child not making expected progress post-implant
- P1 cortical auditory evoked response measures performed at various intervals post activation to assess central auditory system development



## Case C

- Family pursued implantation for opposite ear (left ear) and discontinued use of right implant device
- Left ear Nucleus Freedom device activated at age 4 years, 10 months
- More consistent sound awareness reported by managing audiologist
- P1 cortical response measures performed to track central auditory system development

