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- Pionero en la implantación coclear pediátrica bilateral simultánea y secuencial a corto plazo
- Director del programa de implantes cocleares pediátricos, The Hospital for Sick Children
- Numerosas contribuciones sobre la técnica y resultados de la implantación coclear pediátrica

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Implantes cocleares bilaterales simultáneos
y secuenciales a corto plazo en niños pequeños

*Simultaneous and short secuencial bilateral
cochlear implants in infants*

Fully Awakening the Developing Auditory System: Bilateral Cochlear Implantation In Children

SickKids[®]

THE HOSPITAL FOR
SICK CHILDREN

COCHLEAR
IMPLANT
PROGRAM

Blake C. Papsin



Deteccion, Diagnostico Y Tratamiento Precoz de la Sordera en la Infancia, Madrid – Feb. 22, 2008

Cochlear Implant Research Team

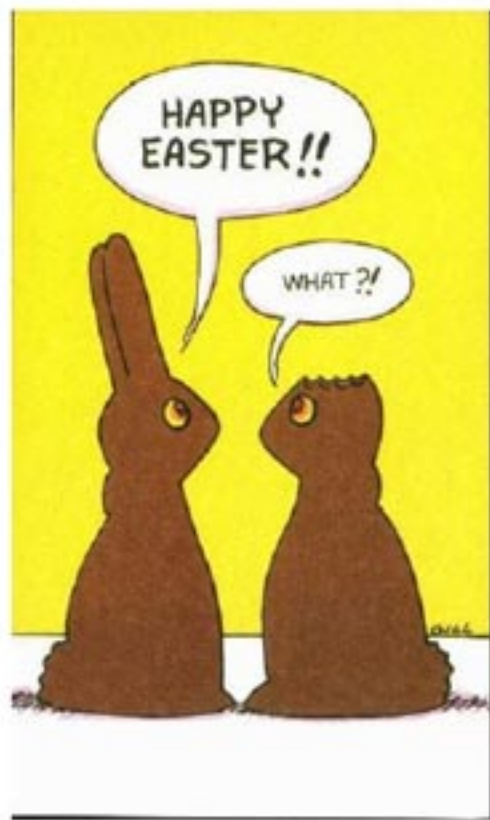
- Susan Blaser
- Paulo Campisi
- Ruth Chia
- Mark Crawford
- Sharon Cushing
- Taryn Davids
- Mary Lynn Fenness
- Karen Gordon
- Nancy Greenwald-Hood
- Bob Harrison
- Adrian James
- Stephanie Jewell
- Clara Kluge
- Phillip Lai
- Laurie MacDonald
- Talar Misakyan
- Vicky Papaioannou
- Evan Propst
- Claire Salloum
- Gina Sohn
- Tracey Stockley
- Sho Tanaka
- Cory Torgerson
- Sandra Trehub
- Jerome Valero
- Daniel Wong



Introduction

- **pediatric deafness**
 - physiological context
 - critical periods
 - hearing screening

- **awakening the auditory system**
 - safe surgery
 - binaural hearing
 - binaural fusion



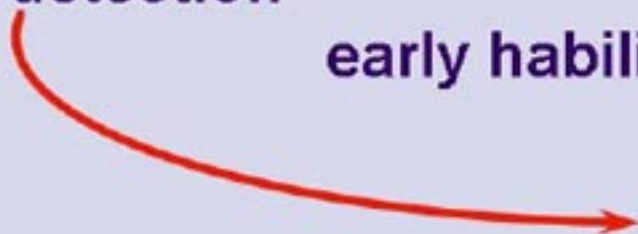
The Physiologic Context

- 2-4 children/1000 have sensorineural hearing loss
- average age of detection was 18-30 months

early detection

early habilitation

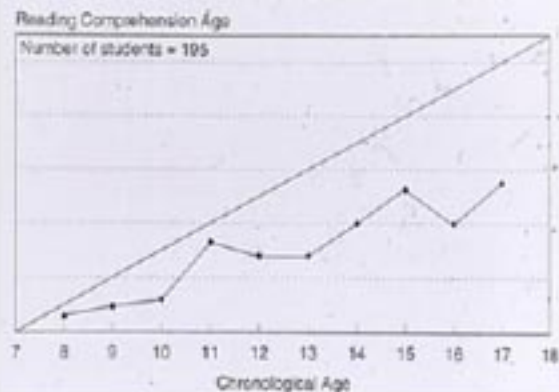
better outcome



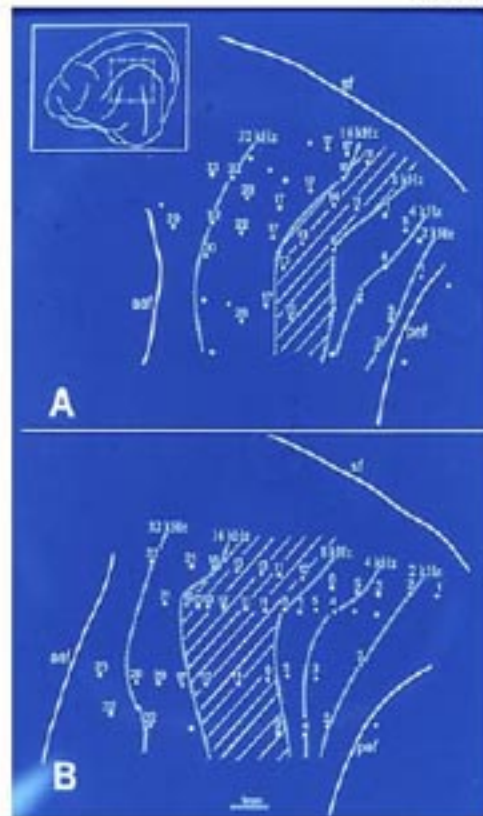
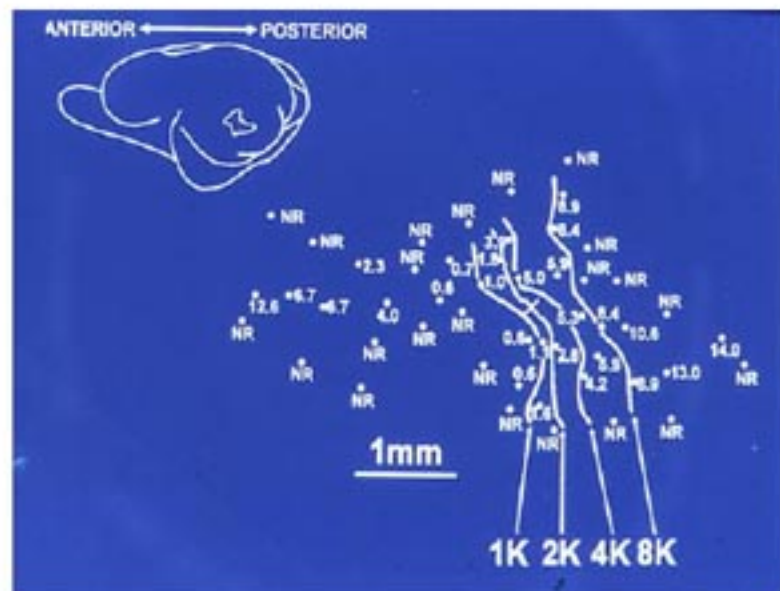
Pediatric Deafness

- poorer school performance
- difficulty obtaining oralism
- limits (?):
 - education
 - employment
 - socialization

Reading Comprehension of Profoundly Hearing Impaired Students in Victoria (Prelinguistically Deafened)

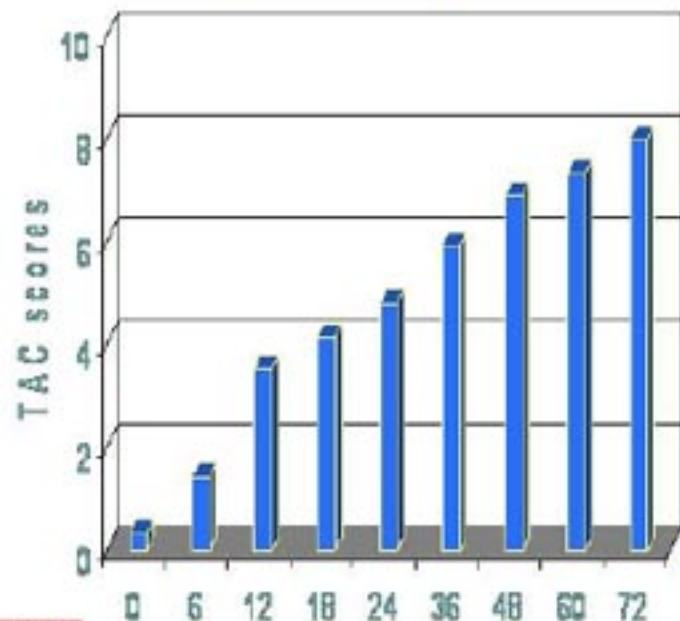


“Critical Periods”

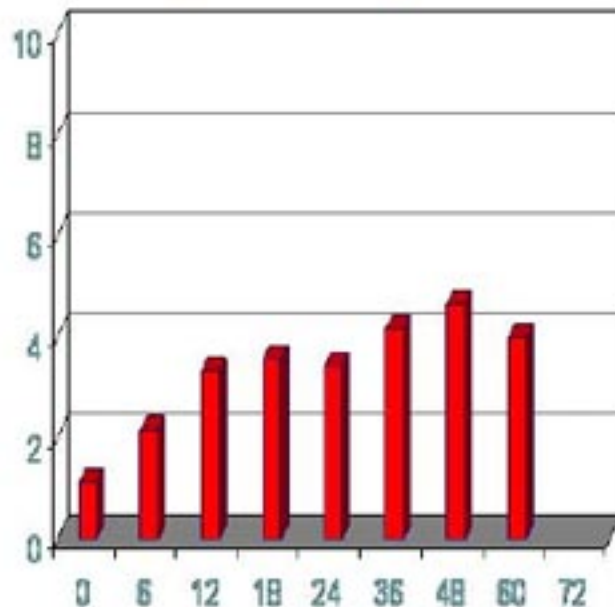


TAC scores as a function of age of implantation

< 6 yrs. at implantation

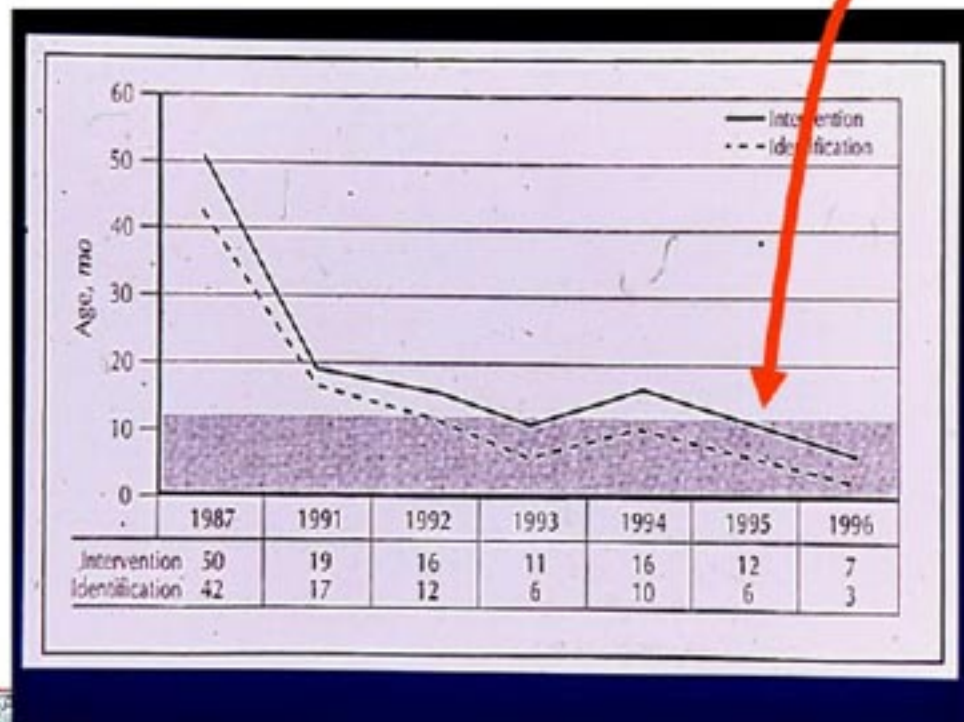


> 6 yrs. at implantation

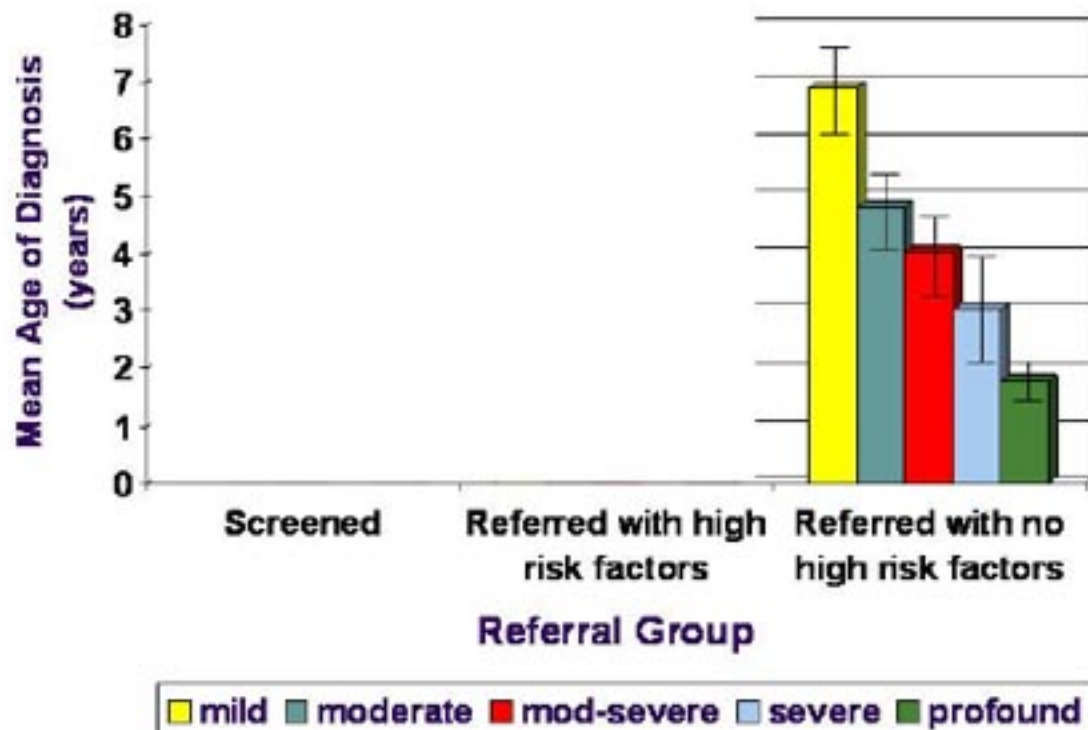


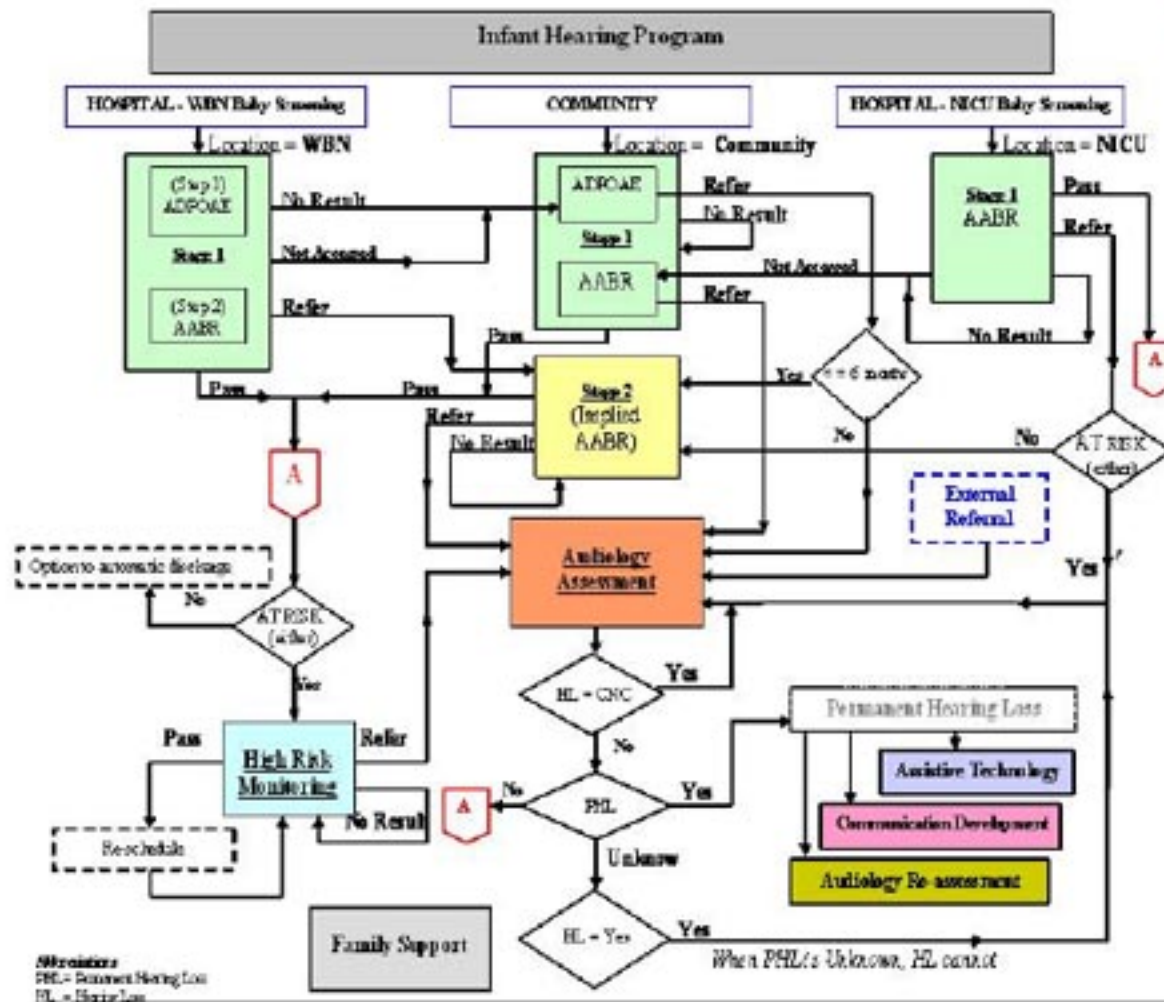
Time after implantation in months

Early Detection of Hearing Loss



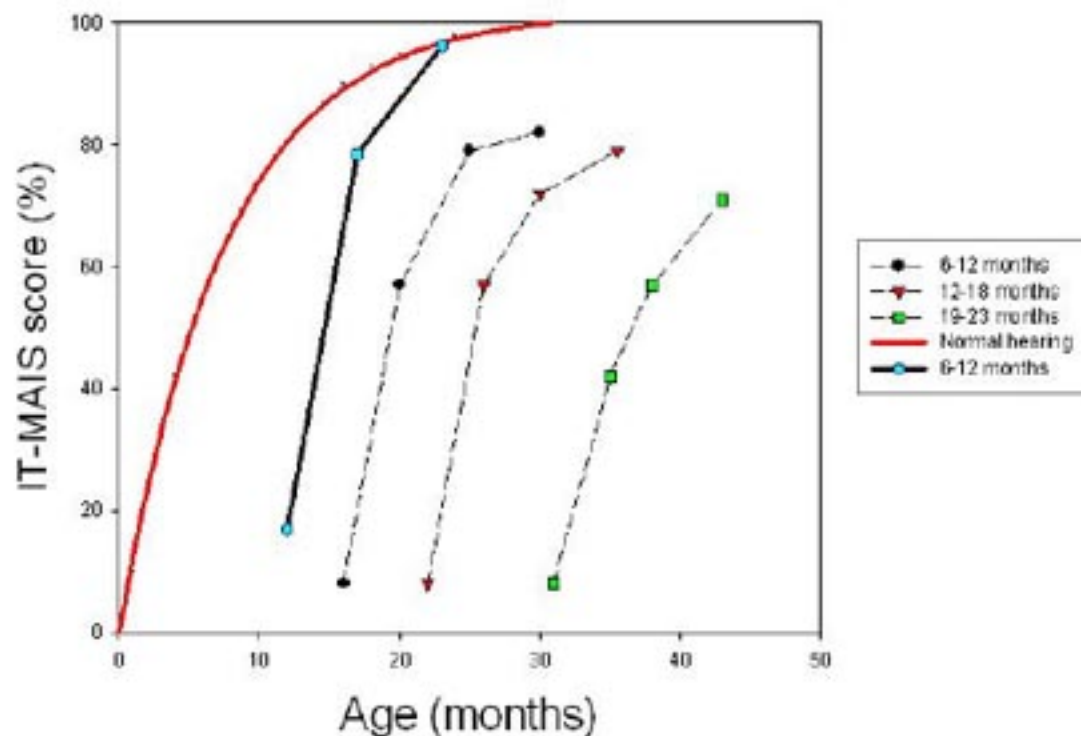
Age at diagnosis, by severity & route to diagnosis (N=613 with HAs)



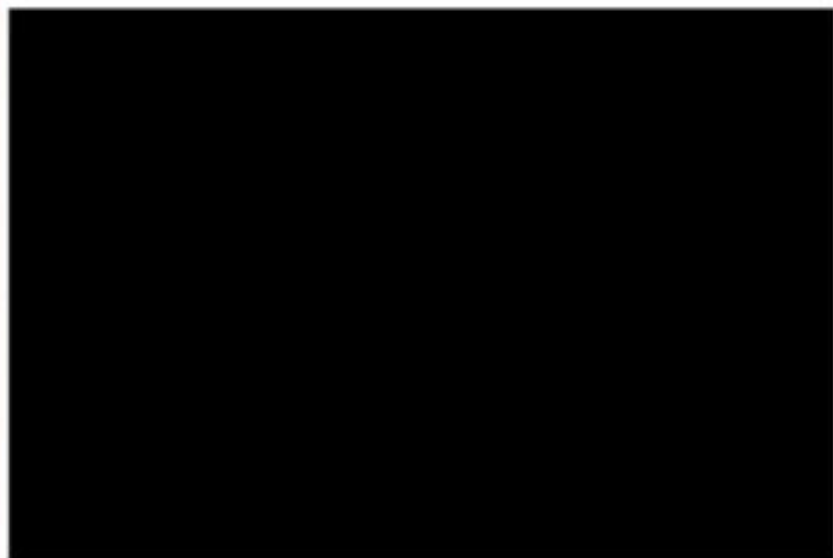
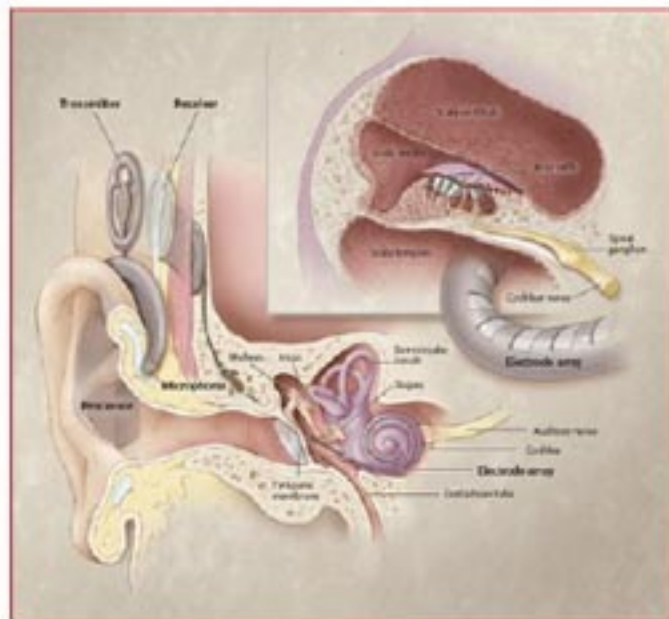


Capitalizing on Plasticity

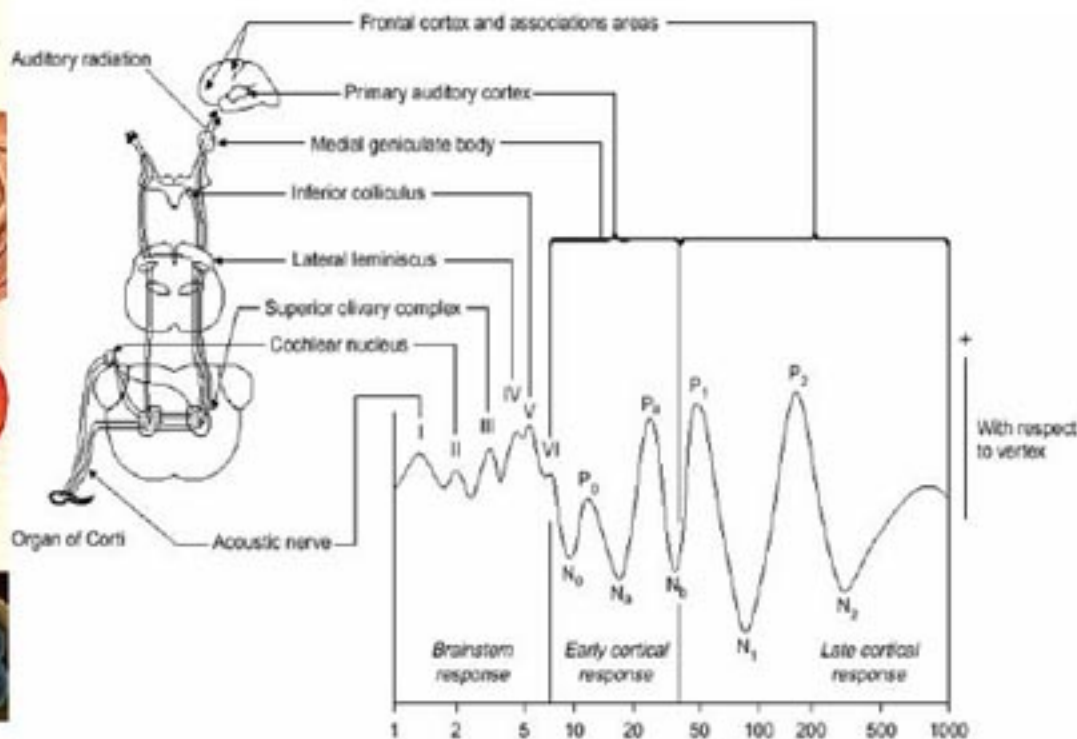
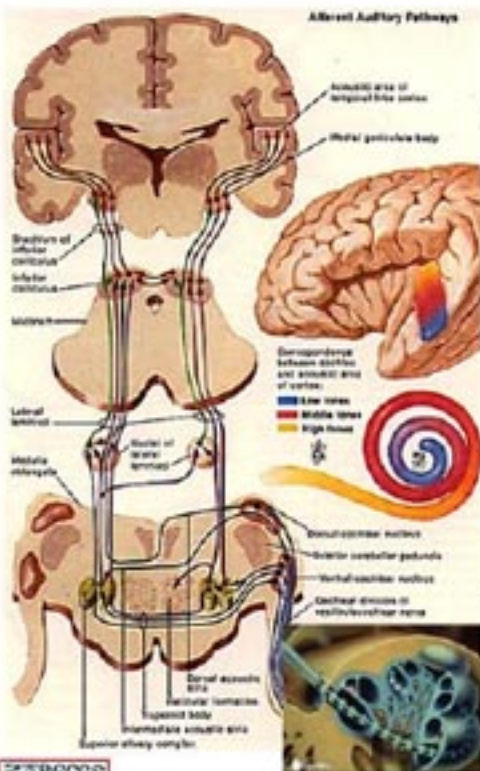
McConkey Robbins 2004 + HSC unpublished

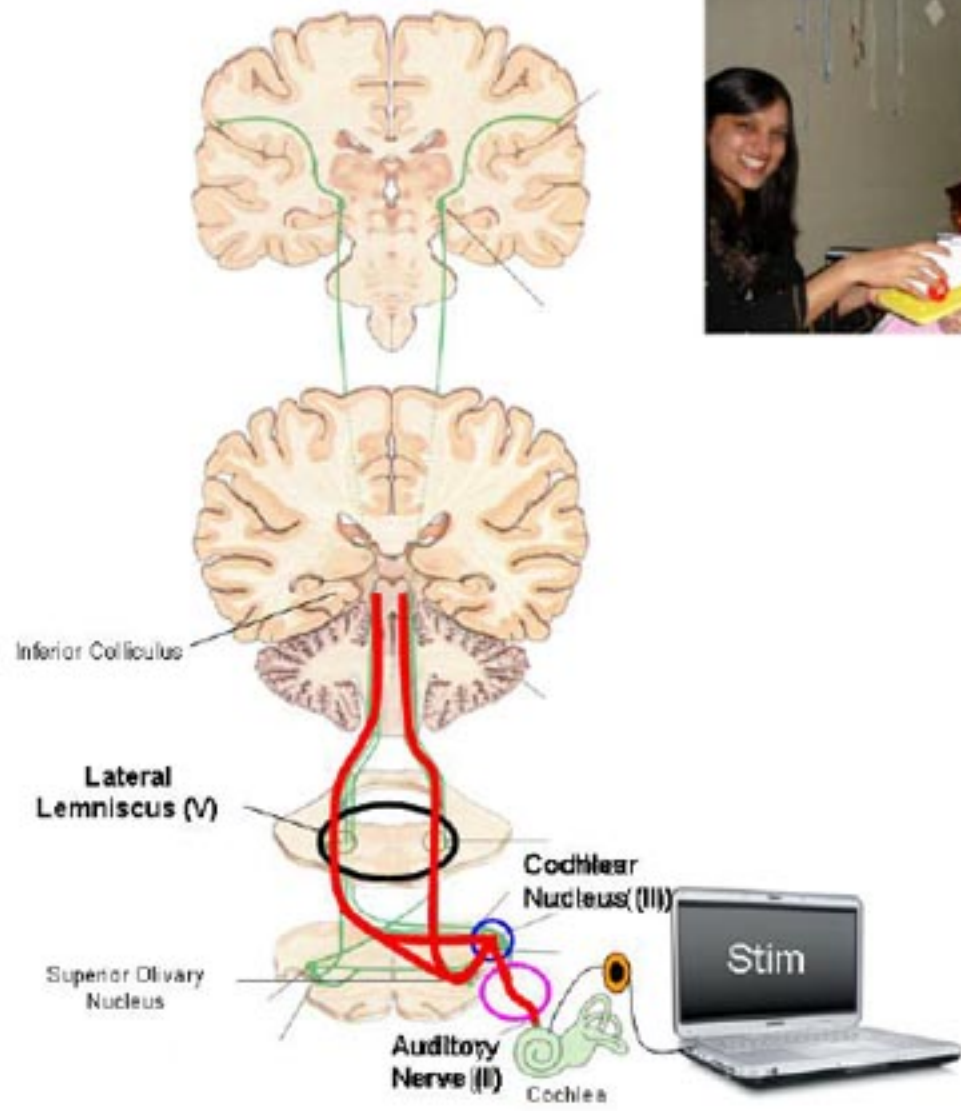


Cochlear Implant

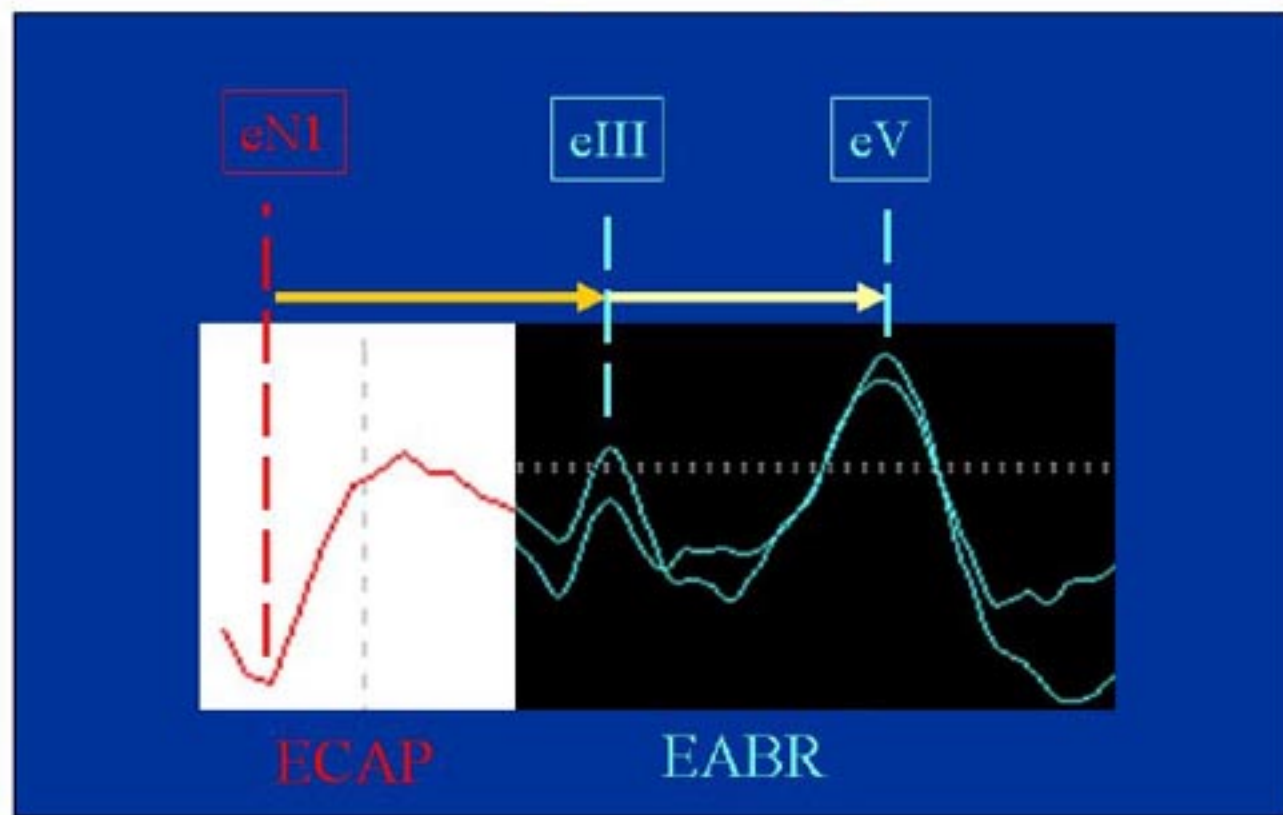


Electrophysiology of the Auditory System for Pediatricians



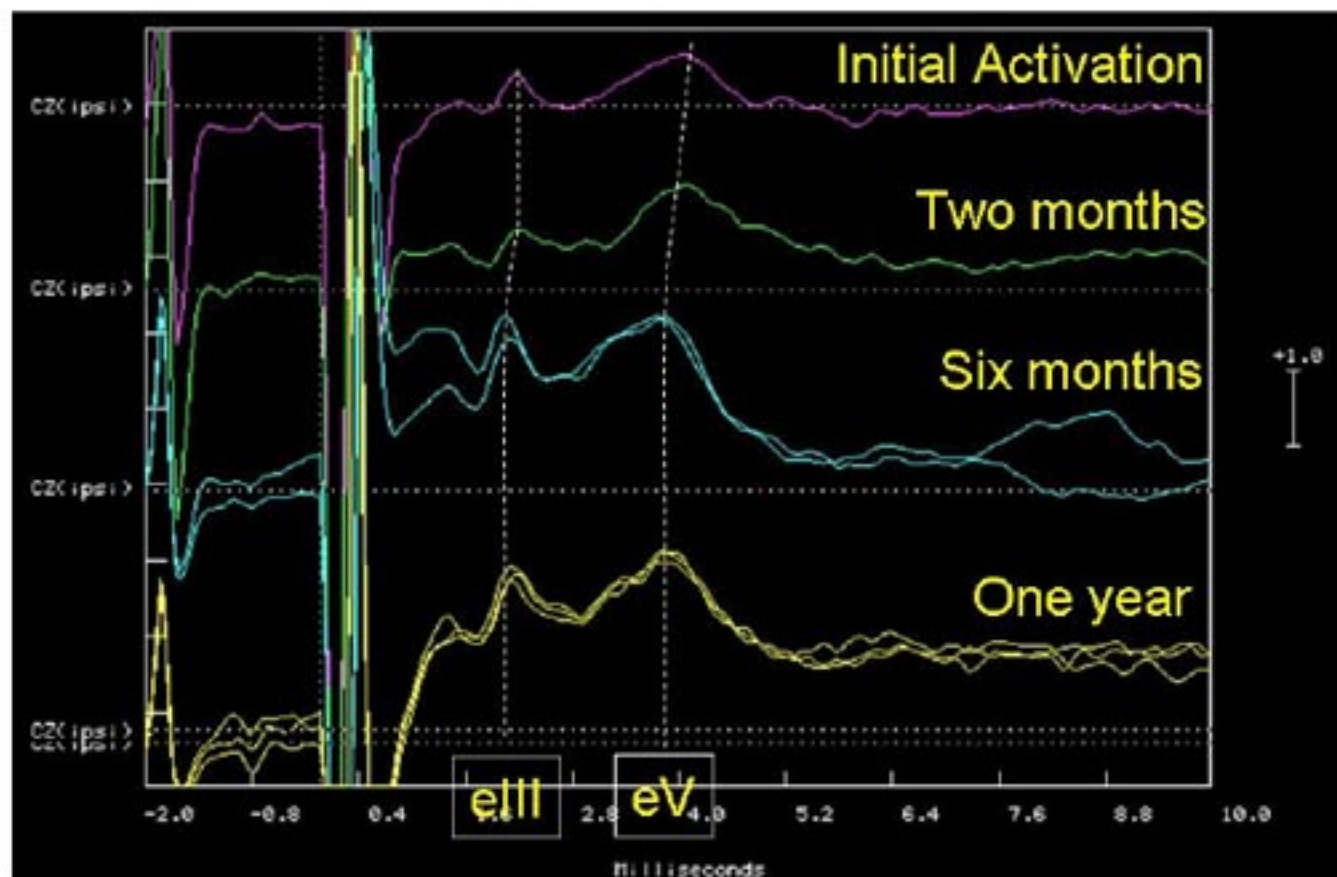


Interwave Latency Changes

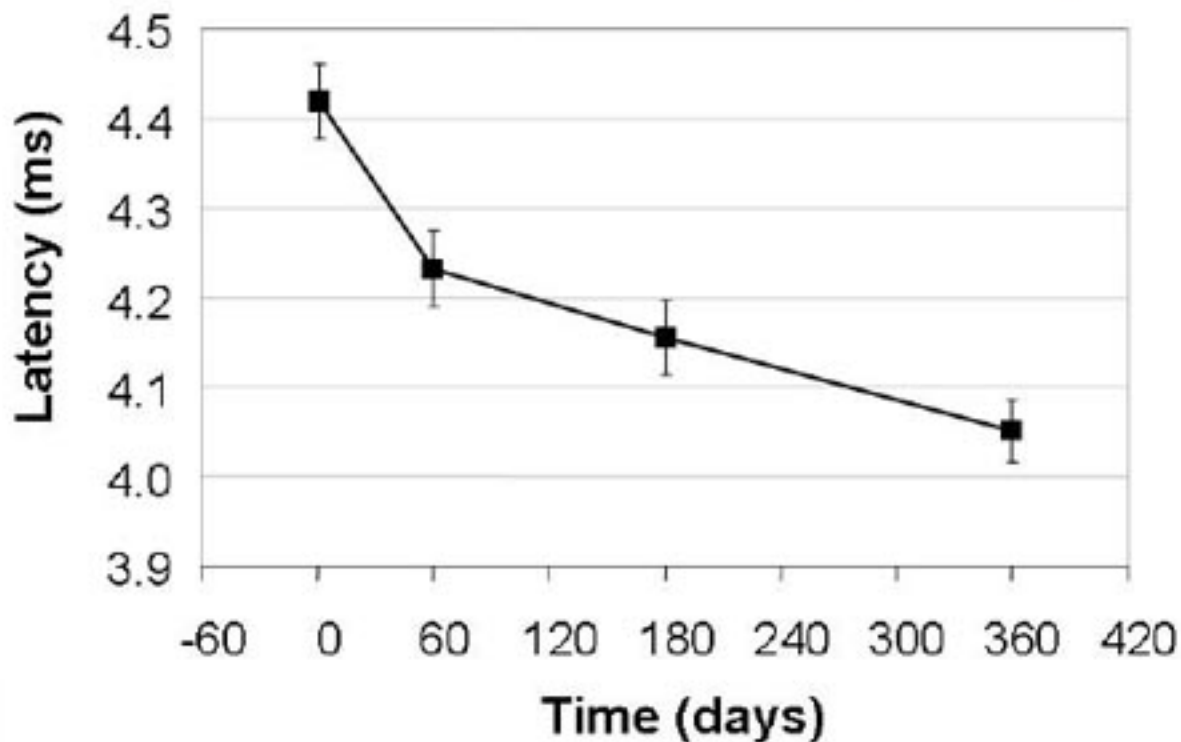


EABR Over Time

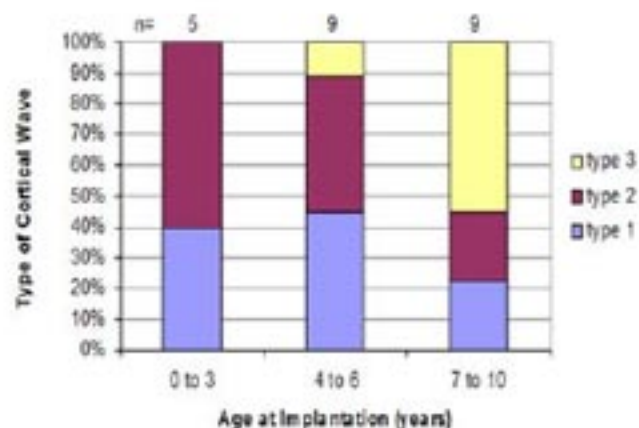
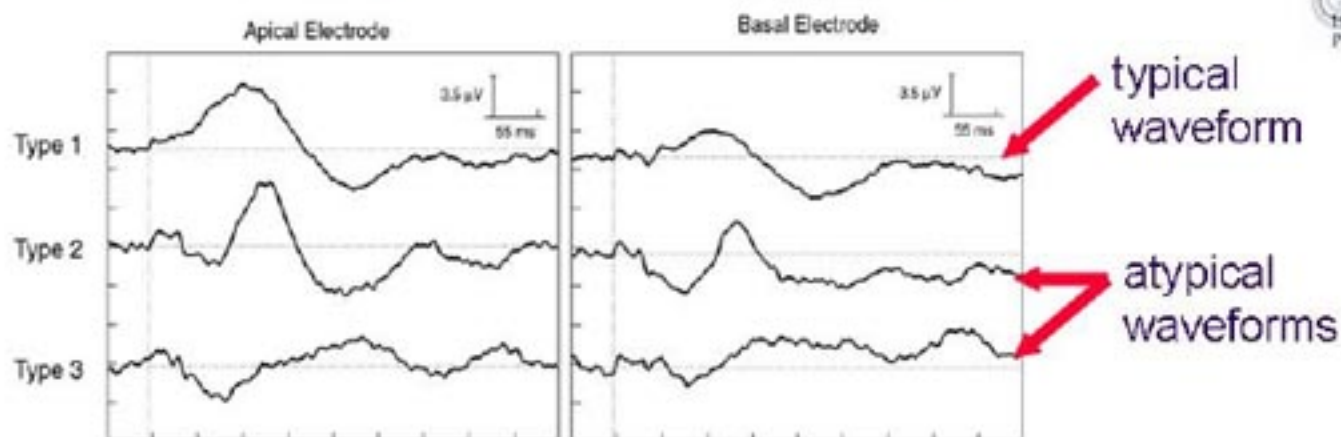
(age 22 months at implant)



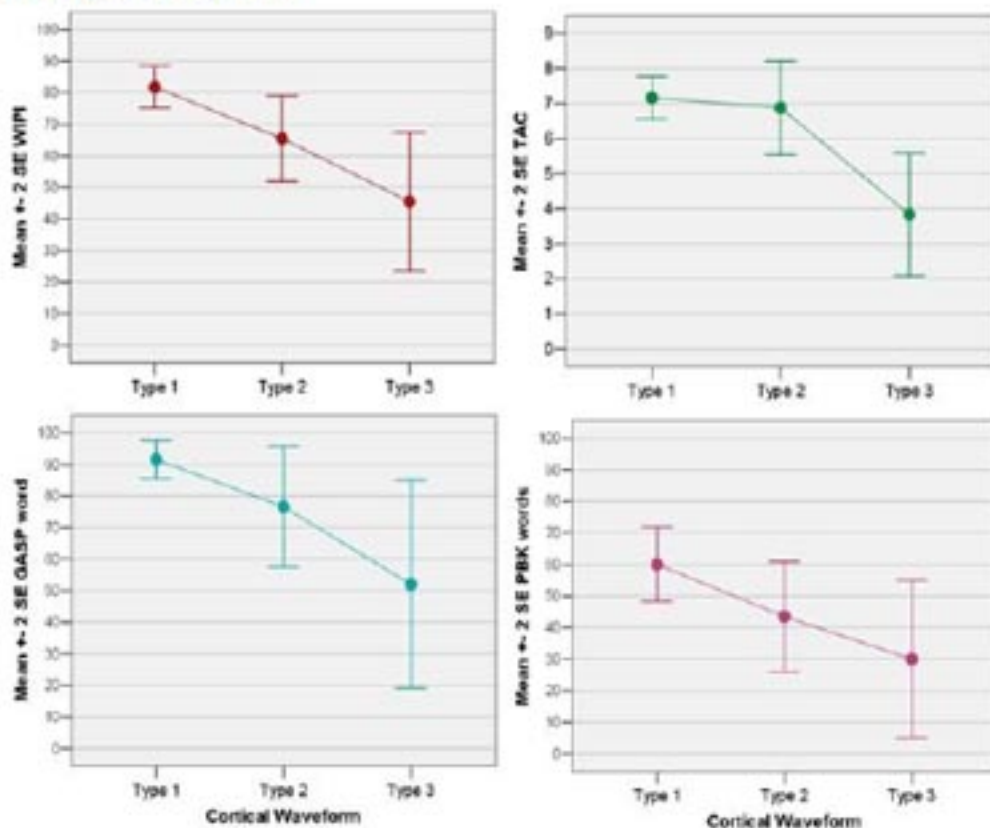
EABR Wave eV Latency Changes



Cortical Responses to Cochlear Implantation



Atypical Cortical Responses and Outcome After Cochlear Implantation



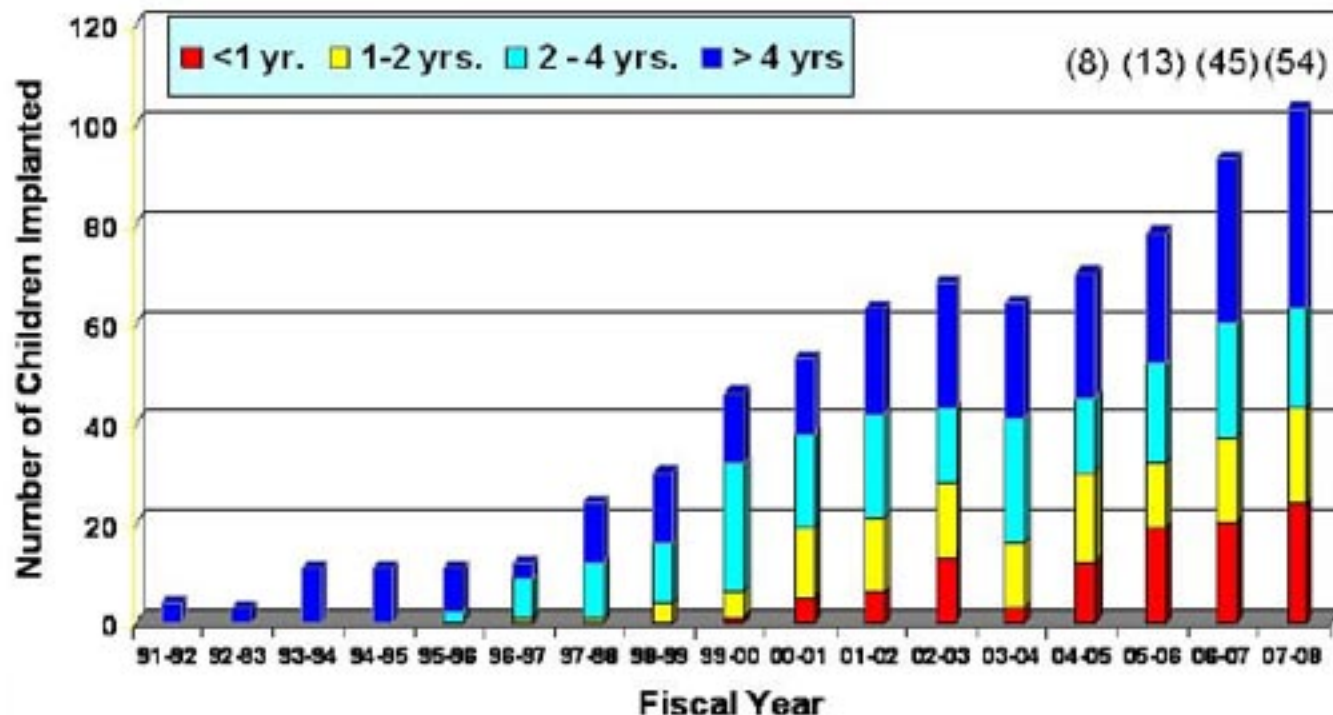
Capitalizing on Auditory Plasticity

– Early implantation

- early implantation
- pediatric considerations
 - evaluative process
 - post-op therapy
 - anesthesia
 - surgery



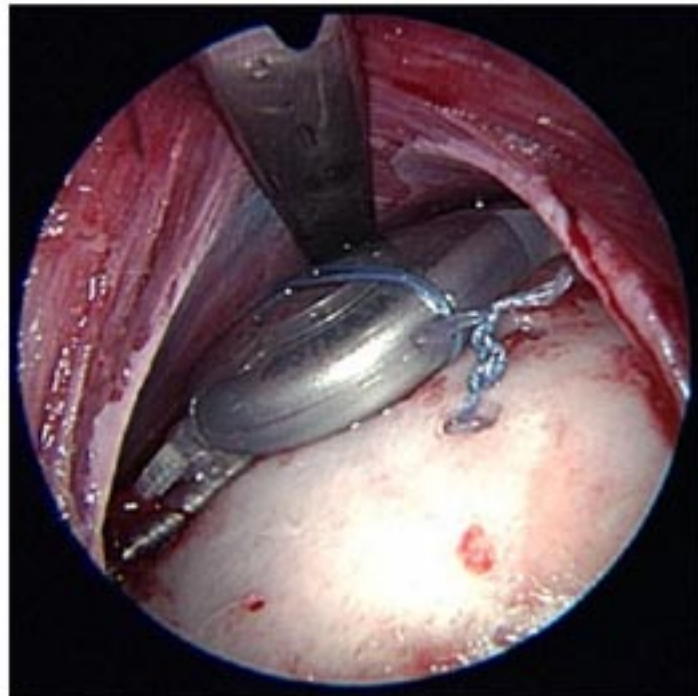
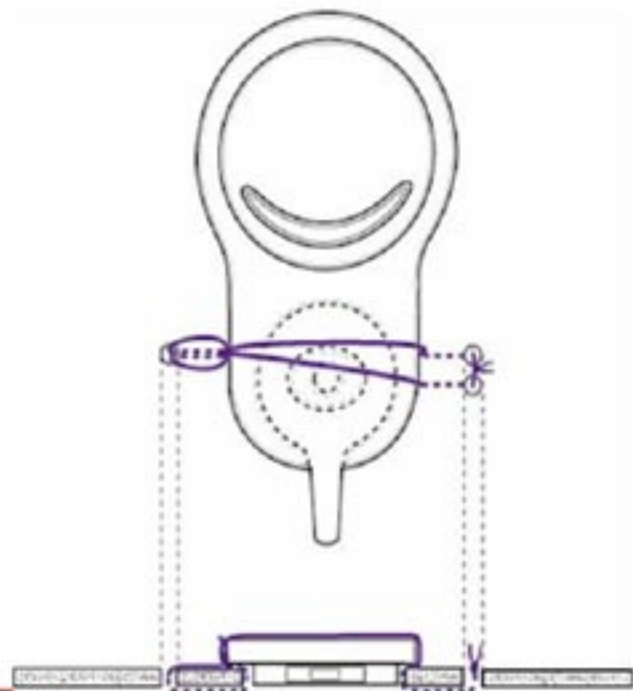
Annual Cochlear Implants by Age



Small Incision



Tie-down Technique



Infant Surgical Technique

- short surgical procedure (1.5 hrs)
 - success in cochleovestibular anomalies
- >600 implants (3476 yrs)
 - soft tissue complication (1.9%)
 - uncommon device failure (3.1%)
 - 1/4 hard – 3/4 soft!!
 - no post operative meningitis



Conclusions - I

- the developing auditory system is plastic
 - within “critical periods”
- early detection and implantation are optimal
 - for acquisition of speech and language



Is the Auditory System Fully Awakened?

- inability to localize sound
- difficulties understanding speech in noise



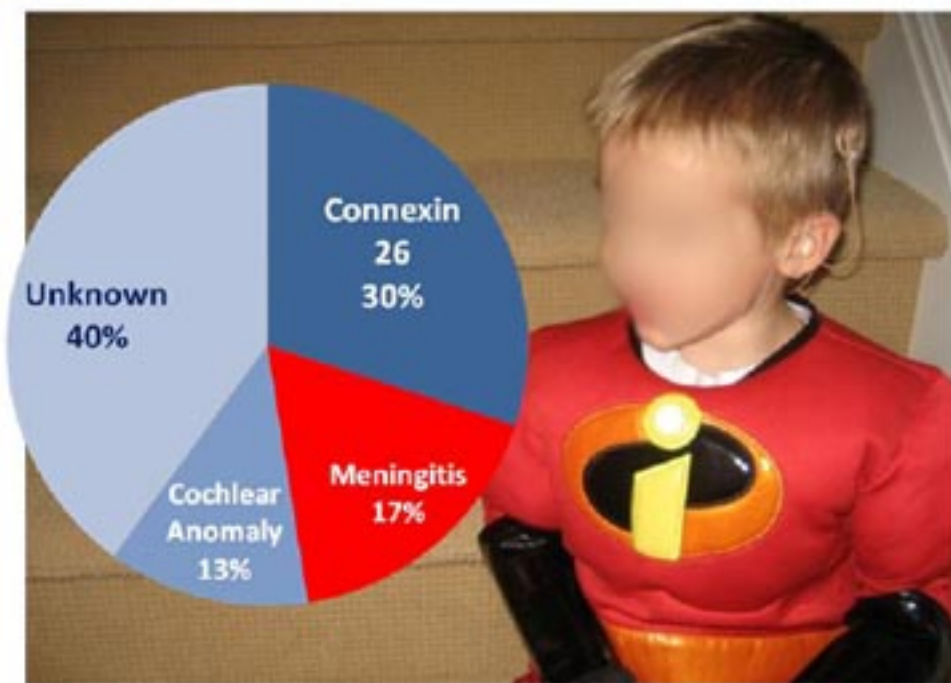
Bilateral Cochlear Implantation: Are Objections Legitimate?

- sanctity of the other ear
 - vs. critical period for binaural development
- limited cost-effectiveness
 - only a factor until device costs decrease
- surgical safety
 - no evidentiary support

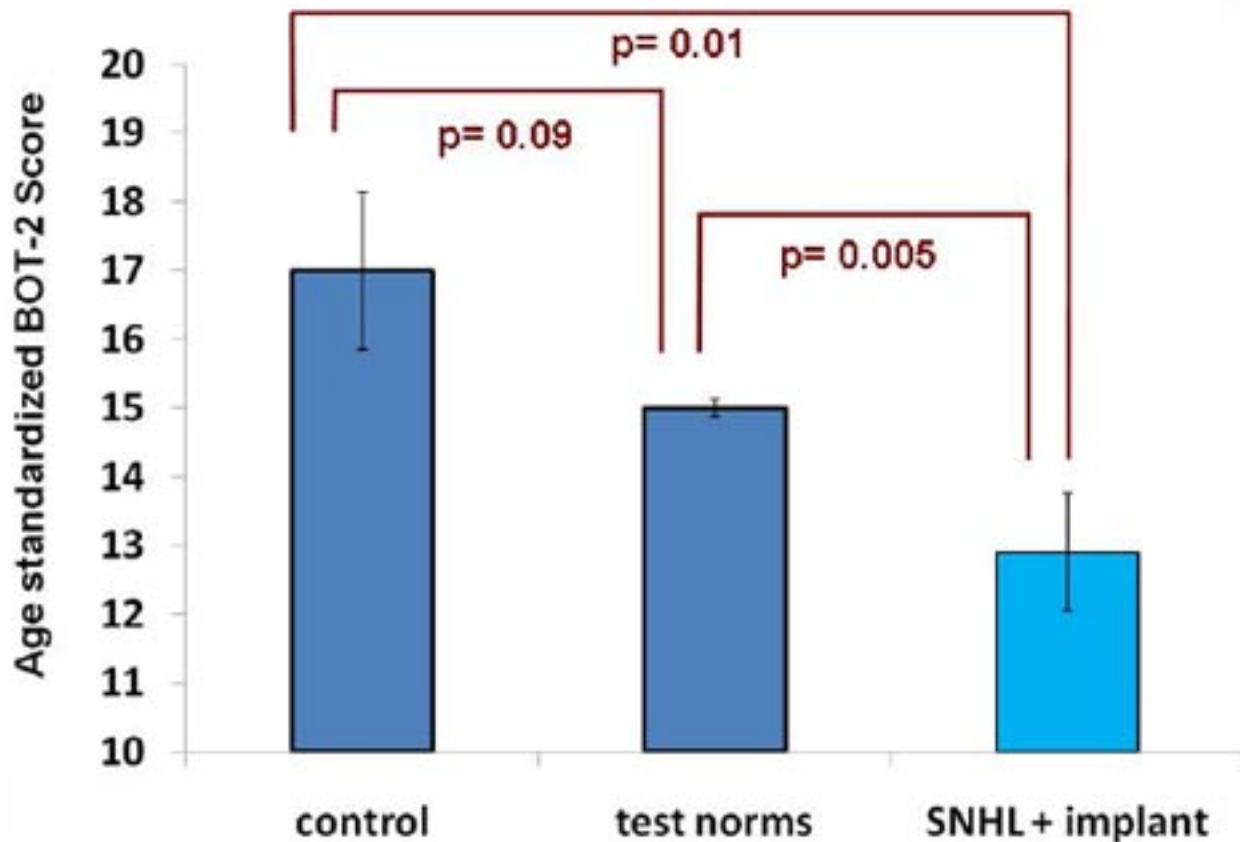


Vestibular Safety

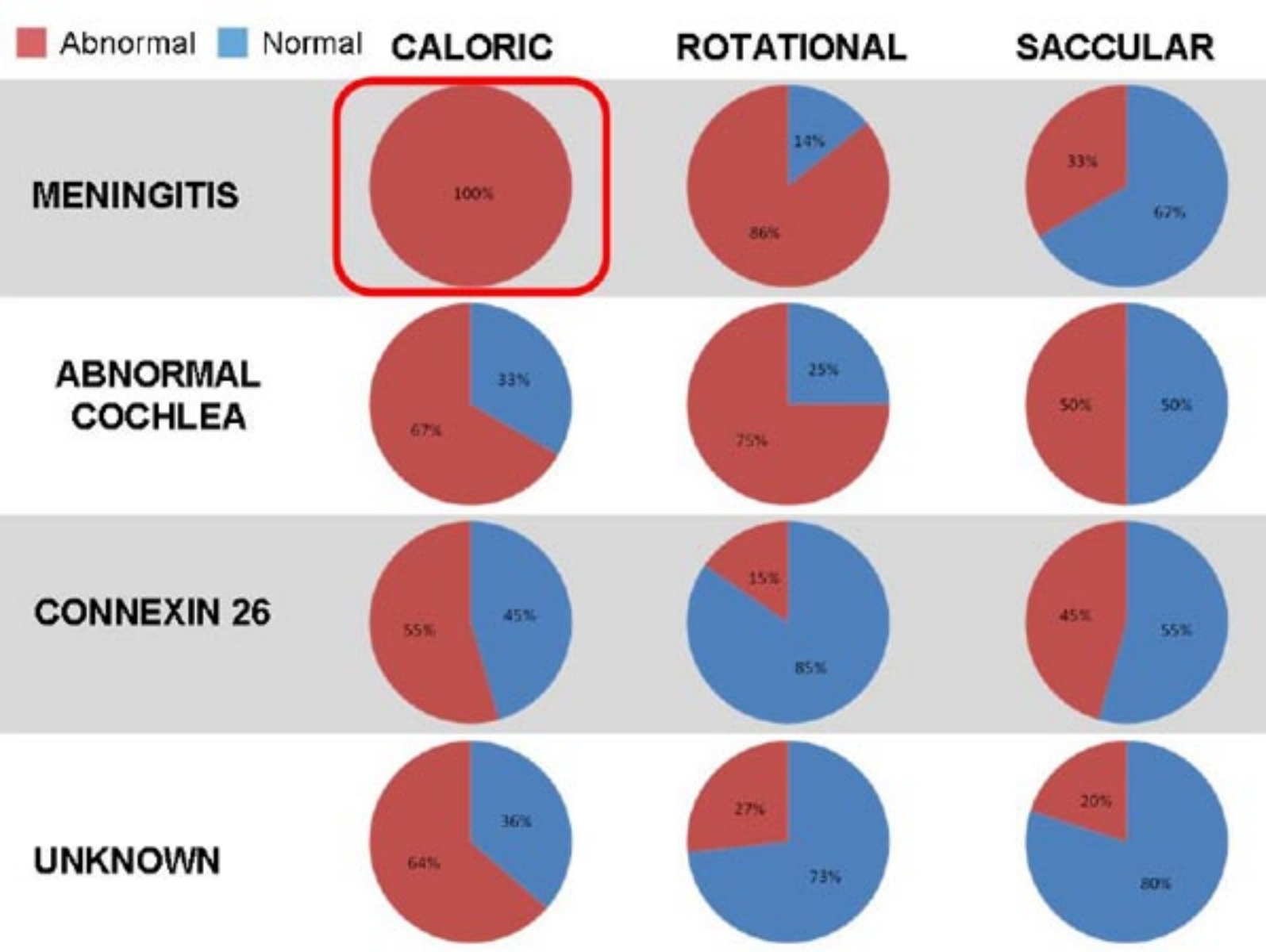
- 40 children – Unilateral CI
- Mean age: 9 yrs (3 to 17.8)



Static and Dynamic Balance

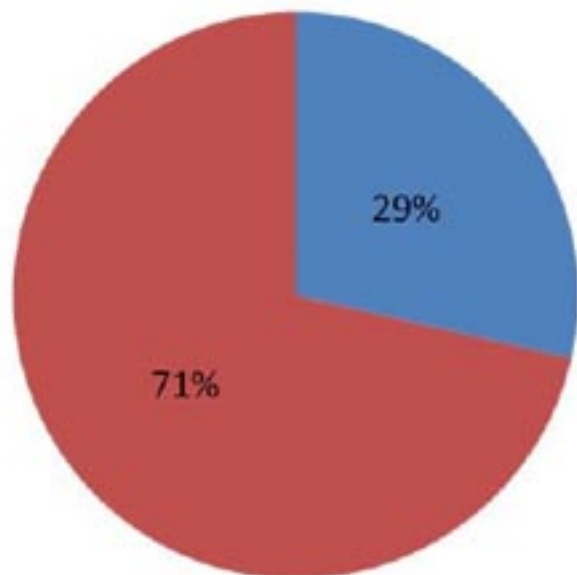




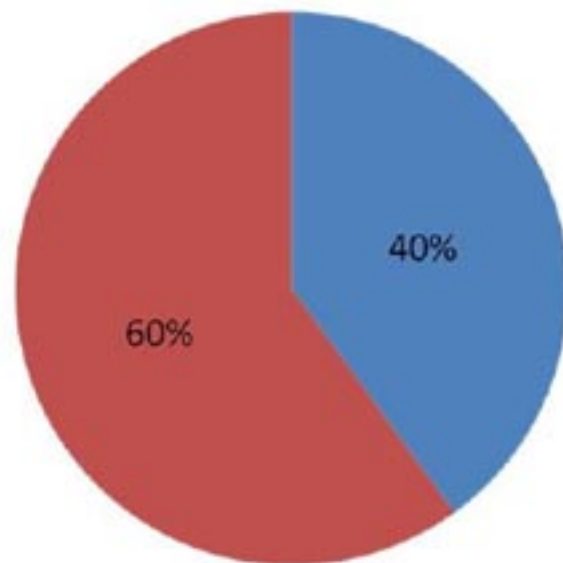


Impact of Implantation

■ Implanted ■ Unimplanted



P=0.16



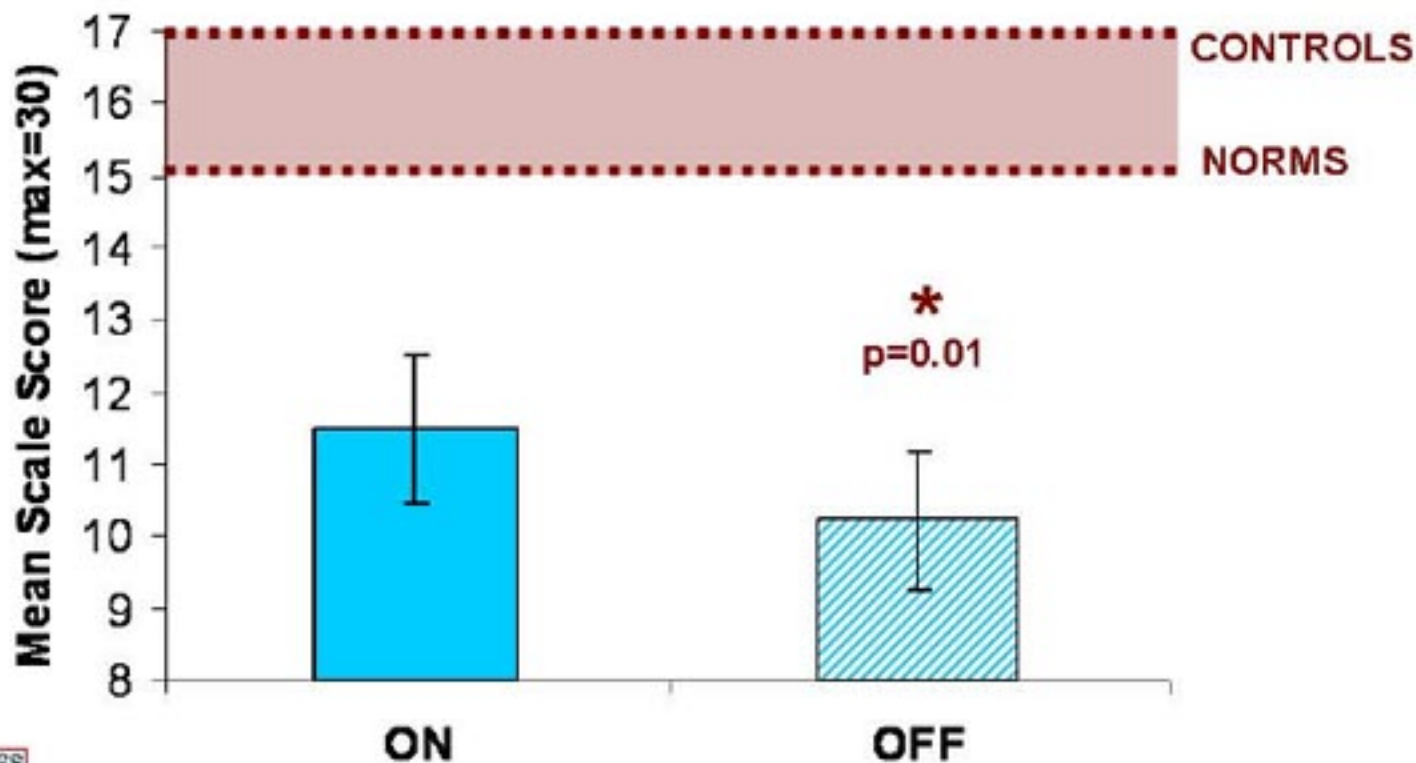
P=0.19

Vestibular Summary

- incidence
 - 35 to 40%
- insignificant effect of implantation
- post meningitits are clinically fine

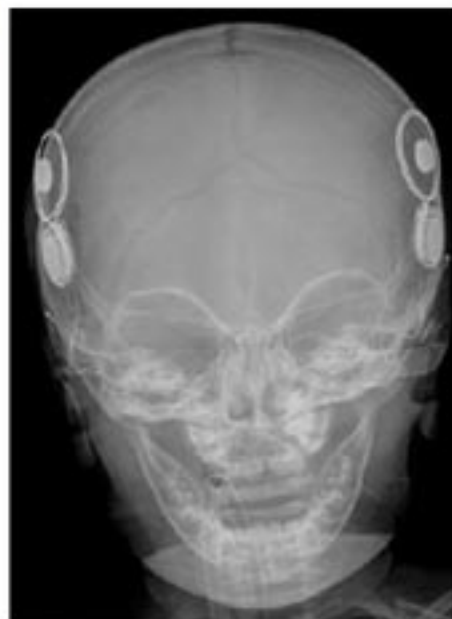


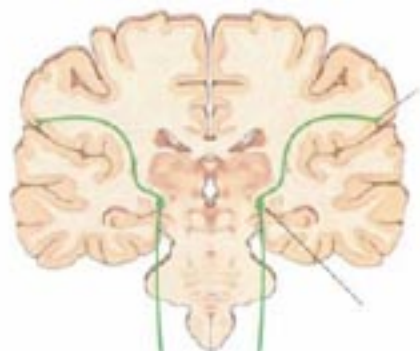
Implant ON vs. OFF



Prospective Study of Bilateral Implantation

- homogenous group < 2 yrs at implant
 - sequentially implanted > 2 yrs apart
 - sequentially implanted > 6 -12 months apart
 - simultaneously implanted at 1 year of age





Inferior Colliculus

Lateral Lemniscus (V)

Cochlear Nucleus (II)

Superior Olivary Nucleus

Auditory Nerve (I)

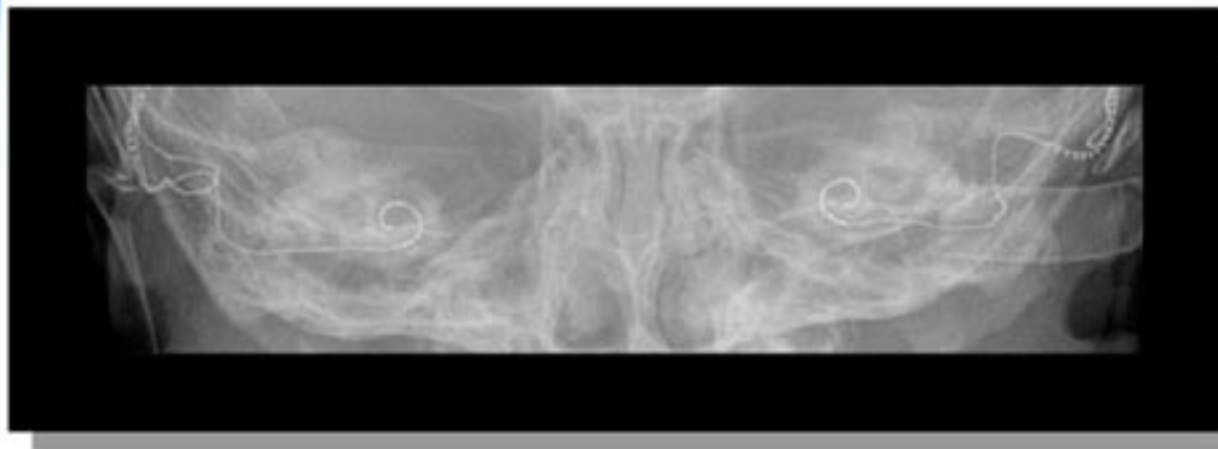
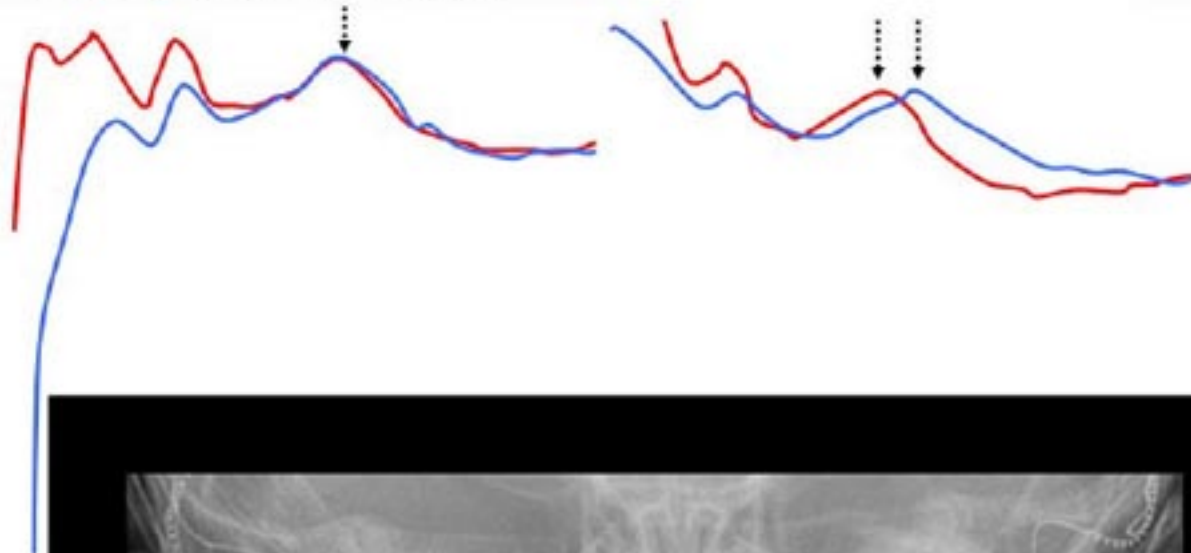
Cochlea



Stim



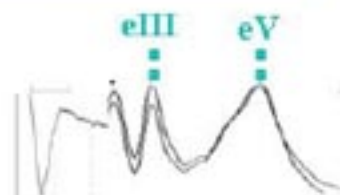
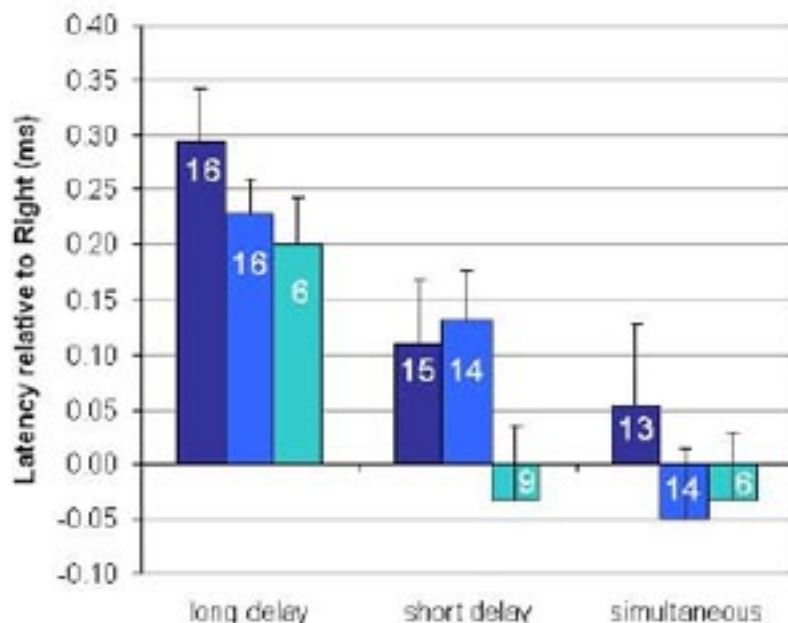
Child A: Simultaneous



Prolonged Responses in Newly Implanted Ears

■ Device activation ■ 3 months bilateral use ■ 9 months bilateral use

Wave eV, Electrode 20

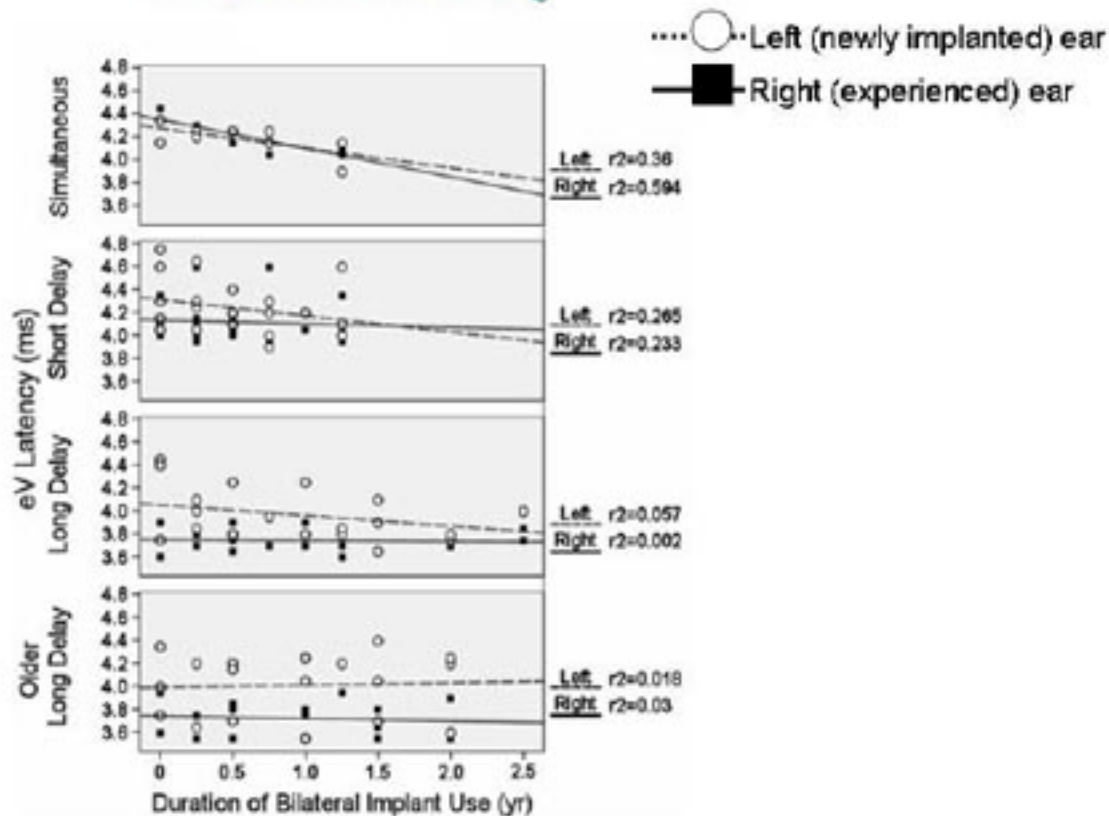


Gordon, et al., *Otology & NeuroOtology*, 2007

Deteccion, Diagnostico Y Tratamiento Precoz de la Sordera en la Infancia, Madrid – Feb. 22, 2008

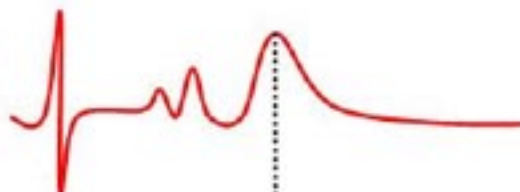
Outcomes of the first 13 children

Wave eV Latency

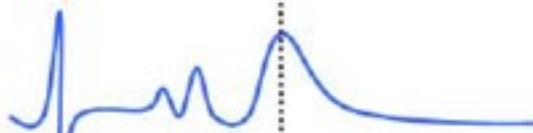


What's happening binaurally?

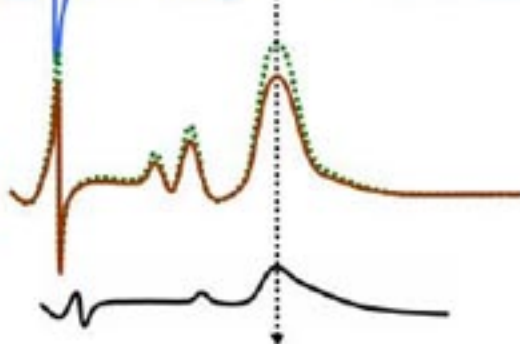
Right Stimulation



Left Stimulation

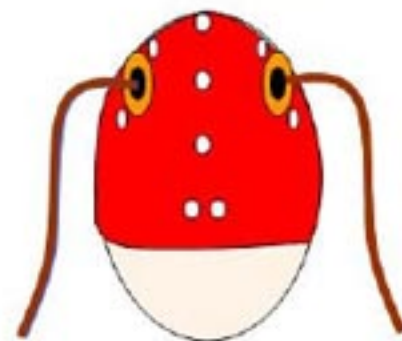


Left + Right Added



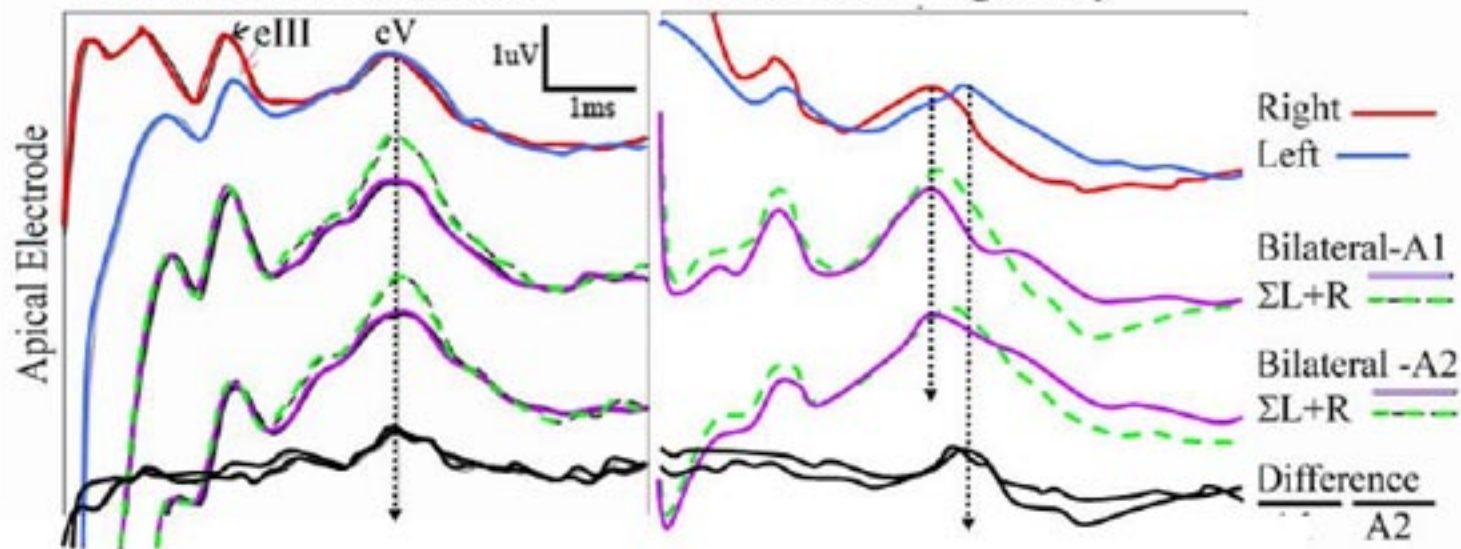
Binaural Stimulation

Binaural Interaction



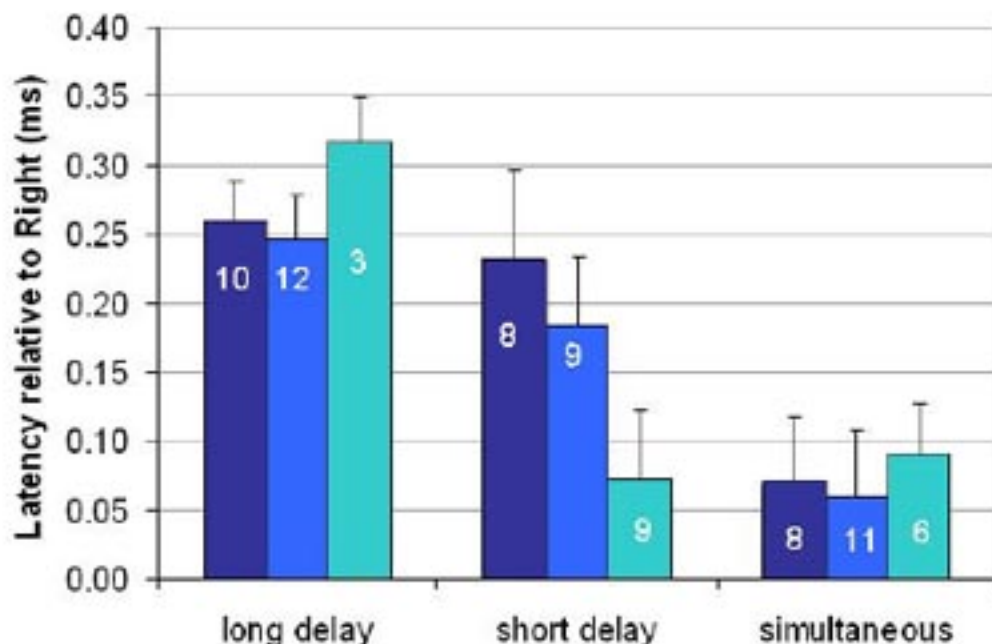
Child A: Simultaneous

Child B: Long delay



Prolonged Binaural Difference Wave

Device activation
 3 months bilateral use
 9 months bilateral use



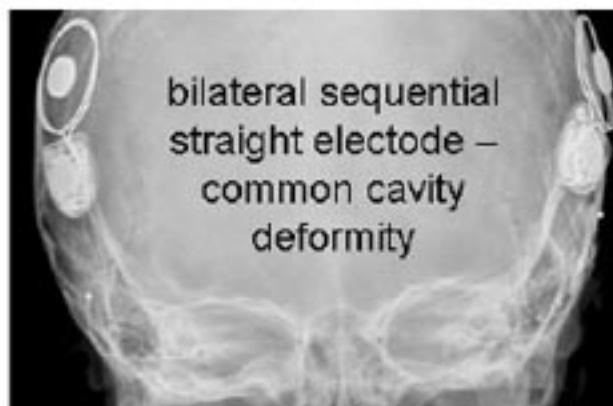
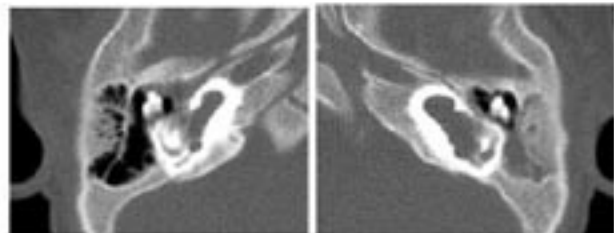
Bilateral Surgery

- bilateral prep
- speed with care
 - blood loss
 - anaesthesia
- technique unchanged



Bilateral Surgery in Infants

- started with sequential* then simultaneous
 - normal anatomy
 - decreased age
 - mild anomalies
 - gross anomalies
 - developmental delay



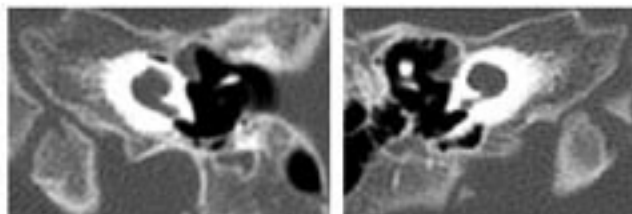
Who Wants Two?

- 1 year, 91 implants, 75 children
- exclusions
 - 23 sequential
 - 4 revision
 - 4 out of catchment



Who Wants Two? (II)

- 44 eligible for bilateral simultaneous
 - 16 (37%) bilateral
 - 28 (63%) unilateral
 - 8 borderline hearing
 - 8 multiple handicap/
developmental delay
 - 1 cochleovestibular anomaly
 - 5 parents refused!



Conclusions - II

- the developing auditory system is plastic
 - within “critical periods”
- simultaneous or short sequential cochlear implantation are optimal
 - for establishing binaural fusion



