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- Numerosas contribuciones sobre la técnica y resultados de la implantación coclear pediátrica
Implantes cocleares bilaterales simultáneos y secuenciales a corto plazo en niños pequeños

Simultaneous and short sequencional bilateral cochlear implants in infants
Fully Awakening the Developing Auditory System: Bilateral Cochlear Implantation In Children

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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
TAC scores as a function of age of implantation

Time after implantation in months

< 6 yrs. at implantation

> 6 yrs. at implantation

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McConkey Robbins 2004 + HSC unpublished

[Graph showing IT-MAIS score (%) vs. Age (months)]

Cochlear Implant

Electrophysiology of the Auditory System for Pediatricians

- Frontal cortex and associations areas
- Primary auditory cortex
- Medial geniculate body
- Inferior colliculus
- Lateral leminiscus
- Superior olivary complex
- Cochlear nucleus
- Organ of Corti
- Acoustic nerve

With respect to vertex

Brainstem response
Early cortical response
Late cortical response

Interwave Latency Changes

ECAP  EABR

eN1  eIII  eV
EABR Over Time
(age 22 months at implant)
EABR Wave eV Latency Changes

Latency (ms)

Time (days)

-60 0 60 120 180 240 300 360 420

Cortical Responses to Cochlear Implantation

Apical Electrode

Type 1

Type 2

Type 3

Basal Electrode

Typical waveform

Atypical waveforms

Typical of Cortical Wave

Age at Implantation (years)

0 to 3 4 to 6 7 to 10

n= 5 9 9

Type 1 Type 2 Type 3

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

![Annual Cochlear Implants by Age Graph](image)

Date: Feb. 22, 2008

Detection, Diagnostic and Early Treatment of Orthopedic Defects in Infancy, Madrid
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%)
    - ¼ hard – ¾ 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)

Pie chart showing:
- Unknown 40%
- Connexin 26 30%
- Cochlear Anomaly 13%
- Meningitis 17%

Impact of Implantation

- Implanted: 71%
- Unimplanted: 29%

P = 0.16

- Implanted: 60%
- Unimplanted: 40%

P = 0.19

Vestibular Summary

- incidence
  - 35 to 40%

- insignificant effect of implantation

- post meningitics are clinically fine
Implant ON vs. OFF

Mean Scale Score (max=30)

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Controls
Norms

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
Child A: Simultaneous
Prolonged Responses in Newly Implanted Ears

- Device activation
- 3 months bilateral use
- 9 months bilateral use

Wave eV, Electrode 20

Latency relative to Right (ms)

- long delay
- short delay
- simultaneous


Outcomes of the first 13 children

Wave eV Latency

- Left (newly implanted) ear
- Right (experienced) ear

Duration of Bilateral Implant Use (yr)
What's happening binaurally?

Right Stimulation

Left Stimulation

Left + Right Added

Binaural Interaction

Binaural Stimulation

Prolonged Binaural Difference Wave

- Device activation
- 3 months bilateral use
- 9 months bilateral use

Latency relative to Right (ms)

- Long delay: 10, 12, 3
- Short delay: 8, 9
- Simultaneous: 8, 11, 6

References:
Bilateral Surgery

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

Bilateral Surgery in Infants

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

* bilateral sequential
  straight electrode – common cavity deformity
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!

Bilateral simultaneous straight electrode IP-1 deformity
Conclusions - II

- the developing auditory system is plastic
  - within “critical periods”

- simultaneous or short sequential cochlear implantation are optimal
  - for establishing binaural fusion