Early diagnosis and intervention – the key to a successful implantation

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Why early implantation

– Speech and language skills develop more readily when a child hears spoken language early in life

– From birth through early childhood stages, children’s neural pathways develop in a manner that is shaped by their sensory experience

– The shorter the period of deprivation of sound, the better the results from cochlear implantation

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Best Access to Sound

- To assure early diagnosis
- To facilitate early intervention and habilitation
- To make the best use of the residual hearing of the child
- To allow appropriate amplification as early as possible

Newborn Hearing Screening
Early implantation

Studies

- In the absence of normal stimulation there is a sensitive period of about 3.5 years during which the human central auditory system remains maximally plastic.

- Plasticity remains in some, but not all children until approximately age 7. After age 7, plasticity is greatly reduced.

- These data may be relevant to the issue of when best to place a cochlear implant in a congenitally deaf child.

Sharma, A; et al (2002), Ear & Hearing, 23 (6) : 532-539

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Early implantation

Studies

- …For children who have become deaf before learning to speak, success is more likely if they are implanted at a young age.¹

- These children receive auditory information at a time when their brain is especially ready to learn language. In many cases, when children with a profound hearing impairment are implanted early enough, their hearing and speech can develop in a manner similar to that of their hearing peers. In these cases, spoken language appears to emerge almost naturally.²,³


Assessment of early auditory and verbal development of infants

- Research shows a significant benefit in early implantation in infants and toddlers.
  (Eg. ref.: Boons et al., 2012; Colletti et al., 2011 and 2012; May-Mederake, 2012 and 2013; Schramm et al., 2010)
- Early diagnosis & treatment of congenital hearing loss
  • Newborn Hearing Screening
  • Refined CI technology
  • Improved surgical methods
- Reliable diagnostic instruments to assess early auditory and speech and language development

Best benefit in Rehabilitation

A Range of Outcomes Post Implant
Paediatric

- Spoken language same as hearing peers
- Spoken language same as hearing age
- Increased ability in spoken language
- Receptive language understanding
- Aid to speech reading and literacy
- Environmental sound awareness
- No change
What are the factors affecting outcomes?

- **Intrinsic factors**
  - Within the recipient
  - Outside our influence??

- **Extrinsic factors**
  - Outside the recipient
  - Within our influence??

What are the factors affecting outcomes?

Paediatric

- **Intrinsic factors**
  - Age at provision of optimal amplification
  - Pre/post lingual deafness; pre-implant hearing level
  - Medical findings
  - Aetiology
  - Non-verbal intelligence
  - Additional disabilities
  - Communicative intent
Best benefit in Rehabilitation

What are the factors affecting outcomes? Paediatric

- Extrinsic factors
  - Compliance with amplification
  - Access to spoken language
  - Child’s behaviour, focus and attention
  - Family dynamics, including commitment to rehabilitation
  - Multiple languages in the home (spoken or signed)

Multidisciplinary Evaluation

- Evaluation protocols differ among clinics
- Cover following areas:
  - Objective measures
  - Clinician-elicited measures
  - Subjective measures
  - Parent-report measures:
    - Questionnaires
    - Diaries
    - Parental interview

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Parent report measures are reliable

LittlEARS™ Test Battery
Evaluation of Auditory Responses to Speech

1. Auditory Questionnaire
2. My Diary
3. Early Speech Production Questionnaire

LittlEARS Auditory Questionnaire (LEAQ)
Coninx et al., 2003

- Assesses auditory behaviour of children up to 24 months in the preverbal developmental stage within the home environment
- 35 yes or no questions for parents
- Validated multilingual test
- Based on normative data of children with normal hearing
Based on international, normative critical data of 3309 children with normal hearing (Coninx et al., 2009)

Statistical analysis included:
- Item analysis
- Scale analysis
- Regression analysis
- Correlation with age
- Reliability
- Homogeneity

**Individual scores of 10 children implanted before 12 months of age**

![Graph showing individual scores of 10 children](image1)

- **Expected value**
- **Minimal value**
- **95% confidence interval**

![Graph showing hearing age vs total score](image2)

- **Norm curve - expected value**
- **Norm curve - minimum value**
Children with CI

Comparison of chronological age according to hearing age
CI children reach the 24-month level of normal hearing children after 16 months of hearing age
Subset group results - Children with CI

Does the developmental progress differ between very early and later implanted children?

Children implanted under 12 months start at a lower level and proceed more slowly in the first 8 months, then speed up.

My LittEARS Diary (Veekmans et al., 2005)

- Assesses the auditory speech and language development of infants with hearing impairment
- For the first 6 months after fitting with a CI or hearing aid
- For parents to document observations, for experts as a guideline for therapy
- 5 parts: My Diary, Parent Book, First Words List, Therapist Book, Overview Sheets
My LittlEARS Diary

- Descriptive assessment of early auditory, speech-language development in infants with hearing impairment
- Enables therapists to use the observations as a guideline in therapy
- First Words Lists conduct perceptive and expressive vocabulary

LittlEARS Early Speech Production Questionnaire (LEES PQ) Schramm et al., 2009

- Parent questionnaire with 22 yes or no questions
- Assesses and documents speech behaviour up to 18 months after fitting
- Based on a longitudinal study of infants with normal hearing and infants with CI

* 2011 March, B. Schramm, J. Brachmaier, A. Keilmann
Early speech production dimensions

**Reflexive behaviour**
- Crying (when hungry or uncomfortable)
- Movement of eyes and head
- Towards sound source
- Cooing

**Babbling**
- Vocalisations contain vowels and consonants
- Single or double syllables
- Repetitive syllables
- Imitating sounds

**Vocalisation stages**
- Pre-vocalizing
- Crying when annoyed
- Laughing
- Quietening to sound
- Tuneful Vocalizing
- Vowel sounds

**Baby jargon**

**Vocabulary**

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Parents and caregivers

- Parental observation and documentation are well accepted methods and often used to document early development
  - Parent observations can provide important information about child’s development in a different (non-clinical) situations
Parent Report Measures

- Spending most of the time with the child
- Every day / home environment situations – incidental knowledge
- Sensitive to communicative skills used by the child
- Knowledge of child’s habits
- Child is not developmentally ready to participate in clinician-elicited measures
- For children with special needs
- Children using various manually supported communication modes

Aims of parental assessment tools

- For parents
  - Record important developmental milestones in their child’s life
  - Guide parents’ through their child’s development and help them recognise their child’s progress

- For therapists
  - Information source about parents’ observations
  - Estimate child’s developmental progress
  - Help identify appropriate therapy goals and identify potential problems

- For research
  - To gather semi-structured information on early auditory, speech and language development in children with hearing impairment
  - Focus on reliable and valid parental observation
  - Documentation for international research purposes