

## Pedaudiology

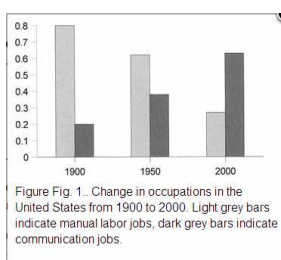


PD Dr. Steffi Johanna  
Brockmeier

## Contents

- introduction
- diagnostics of hearing impairment
  - case history
  - auditory testing
- treatment of hearing impairment
- beyond the cochlea

## Introduction: Development of Communication Dependent Jobs



## Introduction

### Hearing Impairment and Academic Success

Late identification and amplification of children with hearing loss lead to reduced academic success at school level. This is already true for children with mild hearing loss.

Reed (2008) Journal of Deaf Studies and Deaf Education

Hearing impaired subjects are often employed in less well paid jobs and are rarely found in highly qualified positions.

Hogan (2009) International Journal of Audiology  
US Department of Health and Human Services 1994

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## Introduction

### Diagnostics for Hearing Loss

The earlier the better...

... at 3 months different reactions are observed to speech stimuli in the mother tongue as opposed to foreign languages.

... canonic babbling from approximately 6 months onwards is language specific.

... missing amplification results in impairment in the emotional, intellectual, linguistic and social development.

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## Diagnostics of Hearing Loss

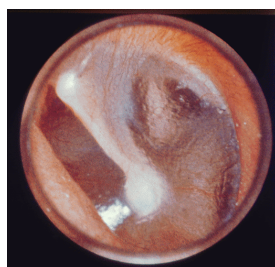
case history

- hearing
- general health
- development (speech/motor)

ENT examination

audiological testing

- subjective tests
- objective tests



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## Diagnostics in Hearing Loss

### Case History

- reactions to auditory stimuli  
    evt. Little Ears Questionnaire (Medel)
- risk factors
- speech development
- Motor skills (gross and fine motor function)

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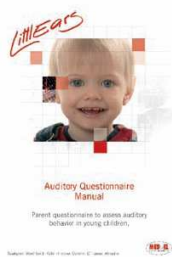
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## Diagnostics – Case History

### Development of Auditory Behaviour



from 0 – 24 months  
development of auditory behaviour  
normalized data

35 questions yes/no answers  
In many languages

Comparison number of yes/no to  
normal control group

Lit: Coninx F et al (2009) Int J Ped ORL  
73, 1761

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## Case History

### Risk Factors for Permanent Hearing Loss

- preterm birth (< 32 gw)
- perinatal hypoxia
- weight at birth < 1500g
- Apgar 5 minutes < 4
- ventilation in neonatal period
- transfusion for jaundice
- infections pre/postnatal (Toxoplasmose, Rubella, CMV)
- meningitis, encephalitis
- ototoxic drugs
- abuse of medication, drugs, alcohol
- inpatient treatment for head trauma
- family history of hearing loss
- dysmorphic features

**BUT: Above only account for 50% of hearing loss**

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Core symptom  
impaired speech development



Mama sagt Anna nur,  
wenn Anna Mama hört.

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## Diagnostics Milestones of Speech Development

- 7. week	crying
6. week - 6. month	cooing/babbling stage non linguistic/pure motor vocalisation with vowels and consonants
6. month - 9. month	canonic babbling language specific- baba, lala
9. month - 12. month	intentional use of speech
12 month	one word utterances
18 months	two word utterances, questions
3 years	three word utterances
4 - 5 years	complex sentences lexicon > 1000 words

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## Diagnostics Normal Speech Development

lexicon: reference point age appropriate books  
overgeneralization -> refinement

articulation:  
development from front to back  
at age 5 all language specific sounds have to be  
present and should be used correctly

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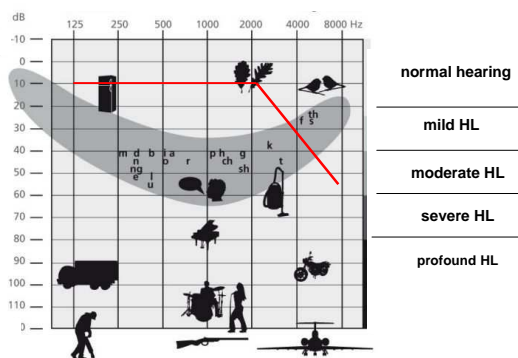
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## Diagnostics – Case History

### Speech Development and Hearing Loss

	first word	two word utterances
normal hearing	9,8 months	17,8 months
mild hearing loss	12,8 months	22,5 months
moderate hearing loss	20,7 months	36,2 months
Severe/profound hearing loss	29,6 months	69,6 months

### Field of Hearing with Speech Sounds



## Diagnostics

### Auditory Assessment

**objective tests:**

- impedance: tympanometry, stapedial reflex
- electric Response Audiometry: Bera, ASSR,...
- otoacoustic emissions: SOAE, TOAE, DPOAE

**subjective tests:**

active cooperation necessary

- pure tone audiometry
- speech perception with/without noise

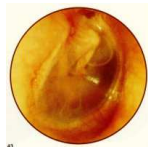
age dependent measures

### Diagnostics: Auditory Assessment - Objective Tests Impedance

- tympanometry
- stapedial reflex

use

- middle ear diagnostics
- screening of auditory nerve



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### Diagnostics Auditory Assessment – Objective Tests Otoacoustic Emissionens (OAES)

spontaneous OAES

evoked

- transient evoked OAES (TOAES)
- distortionsproduct emissionen (DPOAES)

limited frequency and loudness  
specifity



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### Diagnostics Auditory Assessment – Objective Tests Transient Otoacoustic Emissions (TOAES)

confirmation of subjective results

Screening for hearing loss – universal neonatal hearing  
screening

Neonatal hearing screening makes sense because

- sensorineural hearing loss is the most common inborn defect
- even moderate hearing loss leads to relevant deficits
- we have good means of assessment available
- therapy is available

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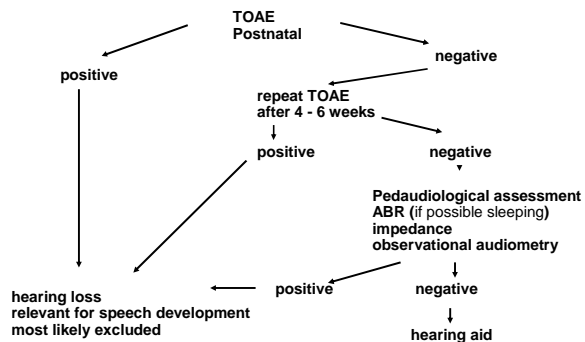
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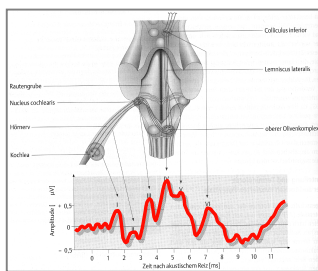
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## Neonatal Hearing Screening



## Diagnostics Auditory Assessment – Objective Tests Click-ABR / Notch – Noise – ABR



EEG-based measures

Click ABR:

limited

frequency specificity

1 – 4 kHz

loudness specific

Notch-Noise-ABR/ASSR:

loudness specific

frequency specific

low frequencies 0.5 –

1 kHz

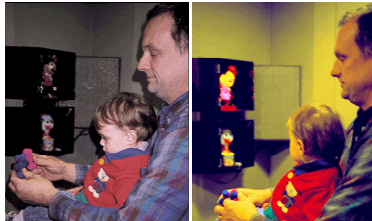
## Diagnostics Auditory Assessment– subjective tests Pure Tone Audiometry - Adaptation for Children



free field  
observational audiometry

## Diagnostics Auditory Assessment– subjective tests

### Pure Tone Audiometry - Adaptation for Children



visual reinforcement  
Audiometry (VRA)

play audiometry  
(no picture)

## Diagnostics Auditory Assessment– subjective tests

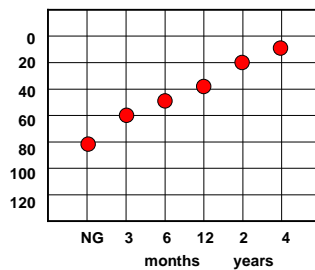
### Pure Tone Audiometry - Adaptation for Children

frequency specific  
volume specific

age adapted mode:  
Observational up to 1 yr  
Pure tone audiometry with  
conditioning  
from 1 year of age

Problem:  
volume needed for reaction  
is

- age dependent
- cooperation dependent



## Diagnostics Auditory Assessment– subjective tests

### Speech Perception Tests

age specific vocabulary  
with and without noise  
close set/pictures from age 2  
open set/oral answers from age 4

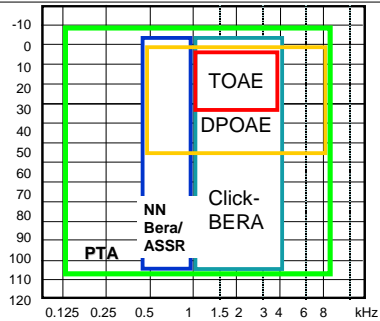
problem: speech development  
language

mostly used for hearing aid assessment





## Summary Auditory Assessment Objective + Subjective Auditory Assessment



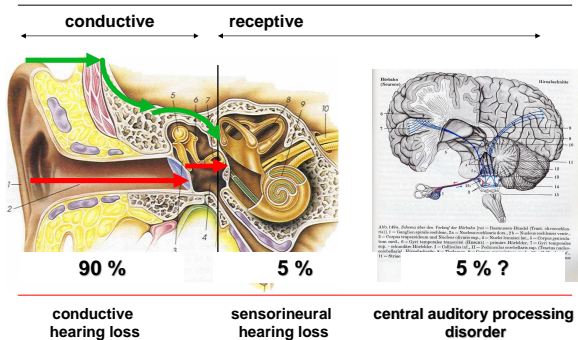
..therefore

Only a combination of  
**objective + subjective assessment**  
**+ developmental data**  
allow optimal treatment decisions



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## Different Types of Hearing Loss



## Therapy of Sensorineural Hearing Loss in Children

like in adults but if necessary and possible  
always bilateral

conventional hearing aids always BTE  
bone conduction hearing aids  
implantable hearing aids  
cochlear implant  
FM-Systems

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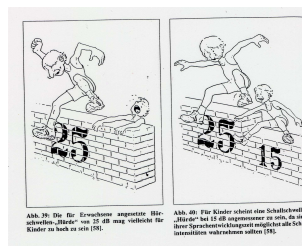
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## Therapy of mild hearing loss

Hearing impairment :  
20 – 40 dB

Symptoms:  
delay of speech development  
impaired understanding in noise

Therapy:  
Hearing aid




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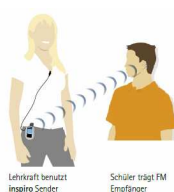
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## Therapy of Sensorineural Hearing Loss in Children

FM Systems




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## Therapy of hearing loss in children

### Unilateral hearing loss

**Hearing impairment :**  
normal thresholds one ear  
any grade of hearing loss other ear

**Symptoms:**  
impaired understanding in noise  
impaired directional hearing

**Therapy:**  
hearing aid evt. Cross aid  
Baha  
FM

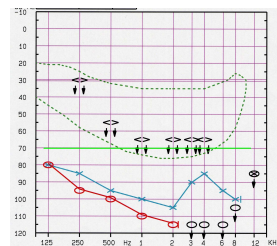
## Therapy of Hearing Loss in Children

### Cochlear Implant

**Indication**  
threshold > 70 - 90 dB  
poor speech development

after optimal  
hearing aid trial of 6 months  
support of family/audiopedagogues

if no speech development  
implantation if possible around  
age 1



## Therapy of Hearing Loss

### Bilateral External Ear Canal Atresia

**After Birth**  
• ABR  
mostly normal inner ear  
60 dB conductive hearing loss

bone conducting hearing aids

**6 – 9 months**  
repeat ABR if dubious

**Approx 5 – 6 yrs**  
CT  
Baha, implantable hearing aid,  
plastic surgery



Courtesy C. Schwob

## Therapy of Hearing Loss Unilateral External Ear Canal Atresia

### After birth

- OAES normal contralateral  
=> counselling  
talking to open side

### monitoring of speech development

### Further treatment dependent on problems

- BAHA/implantable hearing aid
- plastic surgery



## Therapy of Hearing loss Chronic Otitis media with effusion

### Therapy

#### Conservative

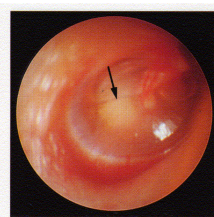
Steroids

Otovent

If persistent tubes

time scale

dependent on speech development



a Serotympanon (akute seröse Otitis media) mit Spiegelbildung (Pfeil) und Retraction des Trommelfells

## Beyond the Cochlea: Auditory Neuropathy Mixtures of Pathologies

### Symptoms:

- Speech perception and development impaired
- Symptoms extremely variable and fluctuating

### Results of audiological testing

- Otoacoustic emissions present
- ABR pathological

### Therapy:

- hearing aids
- cochlear implant

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## Summary

### Therapy of Pediatric Hearing Loss

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in principle like adults

BUT

TAKE OF SPEECH DEVELOPMENT  
INTO ACCOUNT

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## Beyond the Cochlea

### And there are some different kids....

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**History** : difficulties at school, dyslexia  
problems auditory memory, hearing in noise,  
discrimination of sounds, directional hearing  
**Results ENT**: normal peripheral hearing

*Suspected*  
*Central Auditory Processing Disorder*  
*(CAPD)*

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## Beyond the Cochlea

### Central Auditory Processing

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... processes in the auditory pathways from brainstem upwards

auditive memory	
auditive selection	selection of information from background noise
binaural summation	fusion of different parts of one word presented to both ears
auditive localisation	recognition of direction of sound
auditive separation	evaluation of different information from both ears at the same time
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# Beyond the Cochlea

## Central Auditory Processing Disorders

### Prior to assessment for CAPD exclusion of

- sensorineural hearing loss
- intelligence deficiency
- attention deficit disorder

### Diagnostics:

- all processes have to be tested
- not for all processes test available
- often no age dependent norm group
- no common standard




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## Incidence of Pathological Testing in CAPD

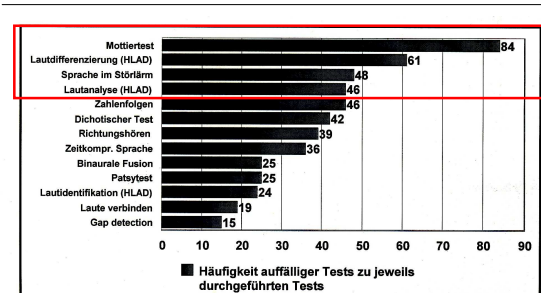


Abbildung 2: prozentuale Häufigkeit auffälliger Tests bei 79 Kindern mit modalitätsspezifischer AVWS

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Thank you for your attention




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