Unilateral Hearing Loss in Children: A Review of Current Literature
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Welcome

- Introduction
- Webinar Format
- Slides
Today’s Deaf and Hard of Hearing Students

Newborn Hearing Screening – children who are identified early, and receive intervention with appropriate hearing technology can achieve communication outcomes similar to hearing peers (Yoshinaga-Itano, 2003).

Better Hearing Technology – innovations in digital hearing aids and cochlear implants mean more access to auditory information and more opportunities to develop age appropriate spoken language (Cole & Flexer, 2007).

Evidence-based practice (Moodie, 2014)

Best available clinical/research evidence

Decision-Making

Professional’s expertise

Client characteristics + needs

Organizational Context

Broader Healthcare System

Adapted from: www.ebbp.org
The needs of children with unilateral hearing loss command less attention, awareness and advocacy than the needs of children with bilateral hearing loss.

There are fewer workshops or mentoring activities designed for their needs.

They are less likely to undergo a medical and radiological workup for the cause of the hearing loss.

Less likely to know peers who are like them.
Definition

Unilateral Hearing Loss (UHL) affects only one ear. It can be from mild to profound and can be conductive, mixed or sensorineural.

It is typically characterized by:

- Difficulties locating the source of sounds (localization)

- Understanding speech in a noisy background

- Word understanding in the poor ear varies from individual to individual.
**Challenges with Diagnosis and Intervention**  
(McKay and Iyer, 2005)

- Unilateral hearing loss children may be identified late, if loss was not present during infant hearing screen.

- Children with mild hearing loss were significantly more likely to get amplification than those with unilateral hearing loss.

- **Most frequent option to parents when unilateral hearing loss was identified was to give advice and to put on review.**
Unilateral Hearing Loss – Challenges For Hearing Professionals

- Little consensus among hearing professionals and physicians on management of children with unilateral hearing loss.

- Convincing parents about the benefits of early amplification can be difficult.

- Limited body of research on aiding young children with unilateral hearing loss.
Incidence
(Mckay and Iyer, 2005)

• Incidence is placed at about 1 in 3700 newborns.

• Incidence increases with age due to noise exposure, sudden sensorineural hearing loss, trauma and ototoxic drugs.

• Seems to be an equal split between right ear vs left ear.
Causes of Unilateral Loss
(Nance, 2007)

- Hereditary and/or present at birth

- Trauma at birth

- Illnesses (meningitis, mumps) head trauma, chronic ear infections.
Causes of Congenital Unilateral Loss
(Nance, 2007)

- Malformations of the ear (ie. atresia, microtia)
- Large Vestibular Aqueduct (LVA)
- Cytomegalovirus (CMV) (most common infection to cause HL and neurological damage)
- Unknown
Progression from Unilateral Hearing loss to Bilateral hearing loss (McKay, 2002)

High Risk Group

- Hereditary progressive SN Hearing loss
- CMV (Cytomegalovirus)
- Enlarged Vestibular Aqueduct

Most other cases of Unilateral Hearing Loss – hearing in the good ear remains stable.
CT Scan Findings in Children with Unilateral Hearing Loss

- 18 children underwent CT scan
- 8 had abnormal findings that included:
  - Enlarged vestibular aqueduct
  - Mondini deformity
  - Cochlear hypoplasia
  - Abnormal semi-circular canals

(Licameli, Robson & Kenna, 2005; Children’s Hospital Boston)
Unilateral Hearing Loss
Right Ear versus Left Ear
Right vs. Left Ear Impairment
(Niedzielski, et al, 2006)

- Completed a study where they evaluated 64 children with unilateral hearing loss.

- Average age was 11 years, and children were evaluated with IQ tests.

- Children with right side hearing loss scored much lower on the verbal test compared to those with left-side hearing loss.

- Children with right side hearing loss had a reduced number of concepts, lower skills for learning verbal material and smaller abilities to use acquired knowledge in everyday situations (Ford, 2014).
What about those with left side hearing loss?

Children with left-sided hearing loss scored more poorly on the non-verbal tests:

- Demonstrated reduced abilities for analyzing, synthesizing, visual memory, spatial imagination and visual-motor coordination.
The Multiple Impacts of Unilateral Hearing Loss

- Speech/Language
- Psychological
- Social
- Cognitive
Signal-to-noise ratio (Ford, 2014)

Children with typical hearing require a greater SNR than adults to discriminate speech (Lieu, 2004).

- Auditory cortex not fully developed
- better language base

Children with UHL require a greater SNR than children with typical hearing (Ruscetta, et al, 2005).

Consider the following listening environments:

- A child’s classroom.
- A child at recess
- A child at a restaurant, hockey game, or birthday party
Academic, Social, and Behavioral Outcomes (Tharpe, 2007)

- 22-35% of unilateral and mild losses failing one grade in school.
- 12-41% receiving educational assistance

Why?
Could be related to decreased energy. Children with hearing loss exert more listening energy and have a slower processing time than their hearing peers.

- Neurological deficits related to CMV
- Poor school performance could lead to low self esteem and high stress.
- Less likely to qualify for service at school!
Speech and Language Development (Tharpe, 2007)

- Unilateral Hearing Loss – 33% of preschool age children had MLU (mean length utterance) that was below age expectations.

- Literature suggests 25% of these kids have language delays.

- Are we routinely recommending a speech and language assessment when these kids are identified? Are we monitoring their development?
Bess, et al., 1998

Reviewed the records of 1228 children in grades 3, 6 and 9.

- 5.4% of those children had minimal hearing loss
- 30% of the 3rd graders with minimal hearing loss had repeated a grade
- By 9th grade, 50% had repeated a grade
Psychosocial Impact (Ford, 2014)

- Borton, Mauze & Lieu, 2010
- Children 6-17 years and their parents
- Health Related Quality of Life survey
- Survey had a control group of NH and those with bilateral loss
- Focus groups for those with UHL
Psychosocial Impact (Ford, 2014)

- Found that children with UHL had significantly more variance in the social functioning score than children with normal hearing or those with bilateral loss.

- Both parents and children with UHL rated social functioning lower than children with normal hearing or bilateral loss.
Psychosocial Impact (Ford, 2014)

Focus groups found:

- Children didn’t notice differences as much as their parents did.
- Parents suggested that difficulties got worse as their children aged and got into sports, etc.
- Parents felt that teachers were not educated about UHL and their children suffered as a result.
- Assistive technology was seen as a barrier to being “normal”.
Solutions for Children with Unilateral Hearing Loss
Selection of Amplification
What are our options?

◆ Behind-the-Ear Hearing Aid – for those children who have an ear that has able hearing, hearing aid should be FM compatible

◆ FM.

◆ CROS Hearing Aid

◆ Bone Anchored Hearing Aid on soft band/headband (i.e. BAHA or Ponto)

◆ Cochlear Implant – whaaaaaaattt?
EVIDENCE-BASED STATEMENT

“Recently, the American Academy of Audiology (AAA) updated their pediatric amplification clinical practice guidelines and indicated that children with aidable unilateral hearing loss should be considered candidates for amplification” (Taken from IHP, 2014).
Amplification Intervention for Children with Unilateral Hearing Loss

Degree of Unilateral Hearing Loss

- Severe to Profound
  - FM trial first line intervention
  - Educate about hearing aid use as second line
  - Monitor impact of intervention with functional listening tools

- Mild to Moderately Severe
  - HA trial first line intervention
  - And/or FM system (classroom vs coupled with HA)

3b (Updike 1994; Kenworthy 1990)

4a (Kiese-Himmel 2002)

5 (Local Consensus)

4b (McKay 2005)

FM - frequency modulation system; HA - hearing aid

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Candidacy for Amplification
(Cincinnati Children’s Hospital)

Some Suggested Guidelines

◆ Degree of hearing loss from mild to moderate-severe.

◆ Fair to good word discrimination ability in the affected ear with hearing aid.

◆ Parents and/or child is motivated to use amplification.

◆ Earlier fitting seems to translates into better fitting.
Amplification (Mckay, 2002)

- Infants – benefits of early intervention prior to six months of age is well documented. We need to ensure we have accurate middle ear evaluation and bone conduction results. Rule out conductive component!

- Auditory Deprivation – the effect may be minimized with early intervention and translates to better acceptance of amplification. This could be important if the loss is progressive.

- Social/Emotional Issues – less of an issue for children fit at a young age.
Selection, Fitting and Assessment of Hearing Technology

- Select device that is designed for children.
- Use of prescriptive formulas and age generated targets to set gain of hearing technology.

- Use of outcome measures (sound field speech testing in noise – comparing aided versus unaided).

- Use of teacher, parent and student questionnaires.

- Annual review.
Does a Hearing Aid Improve the Quality of Life of Children with Unilateral Hearing Loss?

- Mckay, 2002) 28 children fit with hearing aids, ages 2-17 years.

- Unilateral Hearing loss ranged from mild to moderately-severe.

- Parents reported on:
  - child’s attention span
  - Ability to follow direction
  - Frustration level since being fit with hearing aid
  - Child’s ability to understand TV speech and conversations with hearing aid
  - Child’s response when called from another room
  - Hearing in group situations
  - Ability to hear in the car
  - Child’s confidence
  - How child likes hearing aid
  - Decision to get hearing aid.
Survey Results

◆ Majority of parents commented child was doing the same, improved or greatly improved in all areas with hearing aid.

◆ Majority of kids liked their hearing aid, but may not have liked the way it looked. They recognized the benefit and chose to wear it.

◆ Other studies suggest low compliance among children who are identified late. Cosmetics and pipes clogged?
FM for Unilateral Hearing Loss

- Regardless on decision of amplification, use of FM in the school environment will help children with unilateral hearing loss, particularly in the settings or situations where background noise is present (Tharpe, Ricketts, Sladen, 2004).

- *Selection of PFM or SF FM - based on individual profile and age of the child.*

- Provides good S/N and listening for one speaker, using the FM microphone.
CROS Hearing Aid

Unaidable Ear

Hearing Ear

Microphone for unaidable ear

Receiver for hearing ear
Bone Anchored Hearing Aid
Skull vibration transmits to both cochleas
Ponto BAHA Options for Children with Unilateral Hearing Loss

- Soft band in 6 colors
- Easily adjustable to fit all head sizes
- Headband often used by older children
Cochlear Implants and Unilateral Hearing Loss

- There are a growing number of studies exploring and evaluating the effect of cochlear implantation for rehabilitation of the deficits associated with unilateral hearing loss.

- Current studies to date have few patients, most of which are adults and children with **acquired hearing loss**, but most report improvement in sound localization, speech understanding in quiet and noise, and reduction in tinnitus.
Cochlear Implants and Unilateral Hearing Loss

- In many of these cases, results achieved with cochlear implantation in adults with unilateral hearing loss are far superior to those with bone anchored devices or CROS hearing aids.

- No approval for use of cochlear implants for unilateral hearing loss by Health Canada or by Food and Drug Administration.
Focus of the meeting was investigating the utility of using CI for unilateral hearing loss, particularly those children who do not respond well with amplification.

Adult studies far out number those with children.

Some are suggesting to implant children with SSD as soon as possible to manage speech and language development and reduce education delays, auditory fatigue and attention.

“Outcomes of Children and Adolescents with Unilateral Hearing Loss (Giardina et al 2014).”
Is there a critical period for intervention with amplification for those children with aid-able hearing? (Kral, et al., 2013)

- Seems to be most important for those children with **congenital unilateral hearing loss**, and that intervention occur before two years of age.

- Reduces auditory deprivation and the amount of auditory cortex reorganization.

- With, no intervention - the unaffected (better) ear will be preferentially represented in the auditory cortex.
Identifying Difficulties  
Functional Auditory Assessments

• Children’s Home Inventory for Listening Difficulties (CHILD)

• Screening Inventory for Targeting Education Risk (SIFTER).

• PEACH

• Can help the hearing care professional gather information to develop management plans for children with unilateral hearing loss.
in the Home and in the Classroom

- Safety – teach child to use visual cues to protect themselves in hazardous situations.

- Protect the good ear! Use of earplugs and education on the detrimental effects of loud noise.

- Have child sit with better ear towards classmates and allow access for visual cues.
Summary

- Children with unilateral hearing loss should have the same medical evaluation and speech and language assessment as a bilateral hearing loss. They need close monitoring of the better ear to check for progression.

- We need to communicate/counsel to parents and other school professionals the impact unilateral hearing loss can have on the child’s development.

- Children who meet candidacy, may benefit from a trial with amplification. Early intervention is key! Hearing care professionals may consider beginning with the least invasive solutions to understand potential benefit and family/child motivation.
Summary

◆ FM seems to benefit children with unilateral hearing loss, managing barriers to good listening and reducing auditory fatigue.

◆ Technology alone does not eliminate academic challenges, particularly those with late intervention.

◆ Children with unilateral hearing loss can benefit from the same mentoring/peer connections as those with bilateral hearing loss.
Every child deserves the best!
Thank you
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Acknowledgements/References

Information presented today was taken from the following articles, researchers and conference presentations:


◆ Mckay, Sarah. To Aid or Not to Aid: Children with Unilateral Hearing Loss. Audiology Online. 2002.
References and Acknowledgements


References and Acknowledgements


◆ Ford, Joey, Children’s Mercy Hospital, Kansas City, MO.

◆ American Academy of Audiology Pediatric Amplification Guidelines

◆ Ontario Infant Hearing Program