Bone-Anchored Hearing Aids on Speech-in-Noise and Localization Tasks in Children with Unilateral Hearing Loss: A Systematic Review

Evan Fischer and Adrienne Pearson

Division of Speech and Hearing Sciences, The University of North Carolina at Chapel Hill

Background

Many studies have demonstrated that children with unilateral hearing loss may struggle both academically as well as behaviorally. These studies have also found that people with UHL demonstrate greater difficulty in noisy situations than normal hearing peers. There remains limited data on the efficacy of different treatment options for unilateral hearing loss (UHL) in children, however. One such option is a surgically placed bone-anchored hearing aid (BAHA). This is typically only recommended in cases of profound unilateral hearing loss and is currently only approved for use in adults and in children ages 5 and older.

Clinical Question

For children (0-18) with UHL, does intervention with a BAHA lead to improved speech-in-noise and localization outcomes?

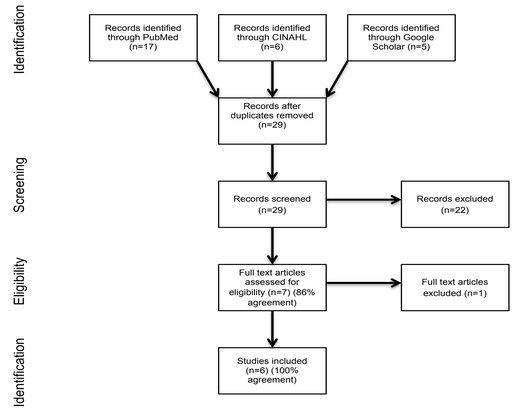
Methods

An electronic systematic review was conducted using the search strategy (BAHA OR bone anchored hearing aid) AND (localization OR “speech in noise”) AND child* AND (UHL or unilateral hearing loss) on two databases, Pubmed and CINAHL, while using Google Scholar as a supplementary database. The publication dates of articles used was restricted up until March 2017.
Each step in the review process was completed independently by two authors and discrepancies resolved by consensus.

Exclusion Criteria

- Bilateral hearing loss
- Cochlear implants or hearing aids
- Non English studies
- Participants over 18
- Expert opinion articles
- Case studies

Flow Chart of Literature Search Strategy



Quality Appraisal

	Article					
Question	1	2	3	4	5	6
1. Were the study methods appropriate for the question?	✓	✓	✓	✓	✓	✓
2. Where the instruments used to measure the outcomes valid and reliable?	✓	✓	✓	?	✓	✓
3. Were all appropriate variables and interventions clearly described	x	x	✓	✓	?	x
4. Were all appropriate outcomes clearly described?	?	?	✓	?	?	✓
5. Was there freedom from conflict of interest?	?	?	?	✓	?	x
6. Were the statistical analysis methods appropriate?	x	x	x	x	✓	x
7. Did the study have a sufficiently large sample size?	x	x	x	x	x	?
8. Were the results statistically significant?	x	x	x	x	x	x
9. Were the results clinically significant?	?	?	?	?	?	?
10. Were any adverse events assessed?	✓	✓	✓	✓	✓	✓
11. Can the results be applied to my population of interest?	✓	✓	✓	✓	✓	✓

1. Christensen et al., 2008 2. Christensen et al., 2010 3. Hassepasse et al., 2015 4. Hol et al., 2013 5. Kunst et al., 2007 6. Nelissen et al., 2016 ✓=yes; x =no; ?=unknown/not addressed

References

References are available upon request
Evan Fischer- evan_fischer@med.unc.edu
Adrienne Pearson- adrienne_pearson@med.unc.edu

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Results

Author	Year	Type of Study	Number of Participants	Intervention	Findings	Quality
Christensen et al	2008	Retrospective	3 (ages 16-18)	BAHA (percutaneous)	Improved HINT scores	4b (Lesser Quality)
Christensen et al	2010	Retrospective	23 (ages 6-19)	BAHA (percutaneous)	Improved HINT scores	4b (Lesser Quality)
Hassepass et al	2015	Case Series	1 (age 15)	Bonebridge (transcutaneous)	Impreved Speech in noise and Speech Perceptions	4b (Lesser Quality)
Hol et al	2013	Case Series	12 (ages 5-12)	BAHA (percutaneous), Sophono (transcutaeous)	Both interventions improved audiologic outcomes; BAHA slightly more improvement	4b (Lesser Quality)
Kunste et al	2007	Prospective	10 (ages 5-14)	BAHA (percutaneous)	Improved Speech Perception in Noise	4b (Lesser Quality)
Nelissen et al	2016	Retrospective	12 (ages 5-11)	BAHA (percutaneous), Sophono (transcutaeous)	Improved sound localization	4b (Lesser Quality)

Author	Hearing or Speech in Noise	Level & Type of Noise	Condition	Localization	Level & Type of Noise	Condition
Christensen et al (2008)	Hearing in Noise (HINT)	0 dB S/N, +10 dB S/N	S_0N_{180}	N/A	N/A	N/A
Christensen et al (2010)	HINT	0 dB S/N, +5 dB S/N, +10 dB S/N	S_0N_0	N/A	N/A	N/A
Hassepass et al (2015)	Sentences in Noise (Oldenburger Sentence Test)	Adaptive speech beginning at 65 dB SPL, noise at 65 dB SPL	S_0N_0; $S_{-45°}$,$N_{-45°}$; $S_{-45°}$,$N_{-45°}$	N/A	N/A	N/A
Hol et al (2013)	SRT and Word Recognition	Word Recognition at 65 dB	Soundfield	N/A	N/A	N/A
Kunste et al (2007)	Words in Noise	65 dB SPL speech-shaped noise	-5 dB S/N	Yes	White noise 500Hz center frequency and 3kHz center frequency; 65 db SPL	5 loudspeakers at 60° intervals (from -120° to +120°)
Nelissen et al (2016)	SRT and Word Recognition	Word Recognition at 65 dB	Soundfield	Minimum Audible Angle Test (Maa)	Broadband noise (0.5-20kHz), between 45-65 dB SPL	Angle between -85° to +85° azimuth

Discussion

Results of these studies examining intervention with a BAHA in children with UHL are promising for future clinical management. Overall, they demonstrate improvement in participant performance in complex listening tasks with a BAHA as compared to the unaided conditions. However, the lack of statistical analysis in many of the studies reviewed does not allow for conclusive results at this time. Also, performance of certain tasks did decrease with the use of a BAHA as compared to the unaided performance in some participants, further hindering ability to make meaningful interpretation of this data. All studies reviewed are quite small and participants were not followed for an extended length of time, something that should be considered for future research in this field.