



A Systematic Review of Early Cochlear Implantation Outcomes (Under 12 Months)

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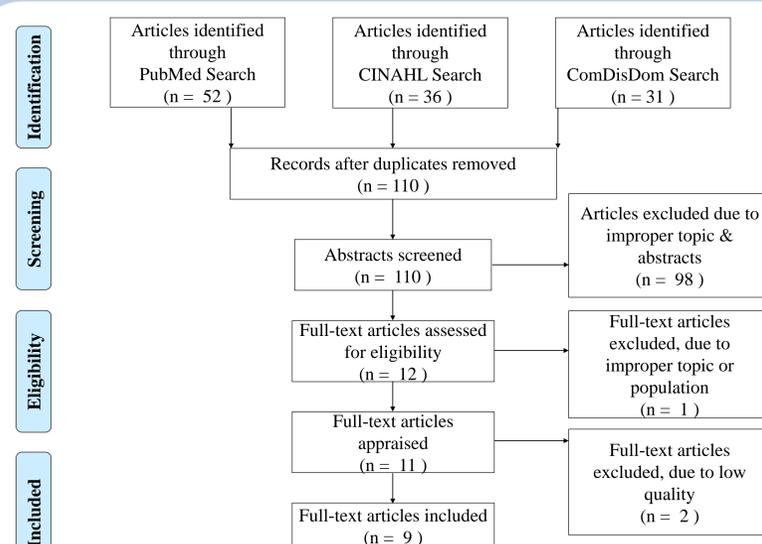
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Background

- Due to the standardization of universal newborn hearing screenings in the United States and several other countries, children with severe to profound sensorineural hearing loss are being identified earlier, leading to more immediate intervention³.
- The Joint Committee on Infant Hearing's 2007 position statement stated the goals for pediatric hearing loss intervention as: identification by one month of age, diagnosis by three months of age, and intervention by six months of age⁶.
- Currently, children with severe to profound hearing loss undergo a several month hearing aid trial to determine benefit prior to proceeding with cochlear implantation.
- Current FDA guidelines allow pediatric cochlear implantation at 12 months and beyond⁹.
- As technology continues to improve and surgical techniques become more advanced there has been a push to alter FDA guidelines to allow implantation prior to 1 year of age⁹.
- Potential benefits of early implantation include normal language development due to the increased neural plasticity of infants¹.
- Potential risks of implantation prior to 1 year include an inability to identify potential comorbidities that could affect cochlear implant success and surgical risks¹.
- This systematic review aims to look at the current research assessing the outcomes of children implanted before 12 months of age compared to those implanted after 12 months and their age-matched normal hearing peers

Methods



A literature search was conducted in three databases to identify articles assessing the outcomes of children implanted before 12 months with the following inclusion and exclusion criteria: children with no comorbidities, articles published within the last fifteen years, and an age at implantation range for the comparison groups of 12 months to 18 years, with a preference for research with children implanted under 10 years of age. For each step above, 20% of the articles were checked for inter-rater reliability. Each reviewer was blinded to which articles were being evaluated for reliability, and were also blinded to the second reviewer's decision to include or exclude.

Results

The inter-rater reliability was calculated for each step of the systematic review process. For the abstract review, the reviewers achieved 92.3% reliability on average. For the full-text review and quality appraisals, 100% reliability was achieved across all reviewers. Data extraction was completed on the remaining articles that fit the inclusion and exclusion criteria for this review ($n = 9$). A description of the studies and their results are described in the table below.

Author	Study Type	Age at Implantation	Comparison Group(s)	Method/Measure	Interval(s) Tested	Findings
Schauwers et al. (2004)	Case Report	5 & 15 mo.	NH	Speech audiometry, linguistic development, and educational setting	Monthly from birth to 4 years old	Subject developed speech and language skills within 95% confidence interval of NH peers and achieved a mainstream educational placement
Colletti et al. (2005)	Cohort	< 12 mo.	NH and those implanted > 12 mo.	Compound Action Potential (CAP) and Babbling Assessment	1, 3, 6, 12, and 24 months post-implantation	Those implanted at < 12 mo. old had normalization of audiophonologic parameters comparable to NH peers
Tait et al. (2007)	Case Control	< 12 mo.	NH	Vocal turn-taking, vocal autonomy, and non-looking vocal turns (auditory awareness) from 20-minute recordings assessed by Tait Video Analysis	Preop and 6 and 12 mo. postop	The children implanted before 12 mo. of age performed similarly in vocal and auditory communication behaviors
May-Mederake & Shehata (2012)	Case Series	< 12 mo.	NH	LittLEARS, SETK (sentence comprehension)	Variable; 3-5 years of follow-up total	All achieved age-appropriate auditory skills by 20 mo. (LittLEARS); sentence comprehension within normal range by 5 years old (SETK)
Leigh et al. (2013)	Case Series	6 – 12 mo.	13 – 24 mo.	Speech perception (CNC), speech production (DEAP, and language development (RI-TSL, PPVT)	Preop and 1, 2, 3, and 5 years postop	Those implanted at < 12 mo. old demonstrated better speech production and language skills than those implanted from 13-24 mo. old, and reached age-appropriate communication skills kindergarten
Brujinzeel et al. (2015)	Systematic Review	< 12 mo.	Those implanted > 12 mo.	Speech perception/production (CNC, PB-K, IT-MAIS) and auditory performance (CAP)	Variable	Those implanted at <2 years old showed benefit on speech perception/production, and <12 month showed benefit on speech production and auditory performance
Fagan, M. (2015)	Cohort	8.9 – 14.4 mo.	NH	Direct observation, parent interview/report	4 and 12 months post-implantation	Less delayed than those implanted at 2.5 years, but still behind NH peers in vocab production
Dettman et al. (2016)	Case Series	6-12, 13-18, 19-24, 24-42, & 43-60 mo.	NH and across study groups	Speech perception (CNC, BKB), language development (PLS), and speech production (DEAP)	Either at school entry or at primary/early secondary time point	Optimized speech perception when implanted < 24 mo., optimized speech production when implanted < 12 mo., comparable language acquisition to NH peers when implanted < 12 mo.
McKinney, S. (2017)	Systematic Review	< 12 mo.	NH and those implanted > 12 mo.	IT-MAIS, LittLEARS, PLS-4, PPVT, DEAP, CAP, and surgical outcomes	Variable	Those implanted at < 18 mo. had better speech perception scores, those implanted at < 12 mo. of age had higher cognitive ratings and language outcomes comparable to their NH peers, and surgical outcomes suggest that implantation is safe and efficacious at < 12 mo.

Conclusions

Research at this time suggests that cochlear implantation for children under 12 months of age is a safe and efficacious procedure⁹. Overall, the studies included in this review suggest that earlier cochlear implantation yields benefits in speech perception, language acquisition outcomes, and other aspects of development including educational placement and cortical plasticity when compared to children implanted beyond 12 months of age. Furthermore, several studies found that the development of speech and language in children implanted before 12 months of age was comparable to their age-matched normal hearing peers. While this research is promising, the majority of these studies were case series, case reports, and cohort designs. Moving forward, research with larger sample sizes should be conducted on this topic in order to fully examine the possible benefits and implications of implanting children before 12 months of age.

References available upon request.