In Children with Profound Bilateral Hearing Impairment, is Sound Localization for Bilateral Cochlear Implant Users Better Than for Those Who Do Not Receive a Second Implant?

Tracy Saunders, M.Cl.Sc. (Aud) Candidate
University of Western Ontario: School of Communication Sciences and Disorders

This critical review examines the sound localization abilities of children with profound bilateral hearing impairment using two cochlear implants and compares these abilities to children who are using only one. Study designs are all case-control studies. Overall, research supports the inclusion of a second cochlear implant to optimize sound localization abilities. It is not yet certain how age at implantation, order of implantation (i.e. simultaneous vs. sequential), and time since implantation (i.e. 2 months vs. 2 years) individually influence sound localization abilities.

Introduction

In recent years, hearing researchers have exerted great effort to determine whether two cochlear implants (CIs) are better than one. At the onset of this investigation, it is likely that researchers looked to the myriad of hearing aid studies which have also compared bilateral to unilateral use. Even though CIs and hearing aids use vastly different technologies, it is reasonable to assume both investigations might assume a similar research approach. The early bilateral hearing aid studies focused their measurements on improved hearing in noise, sound quality, and sound localization. Not surprisingly, bilateral CI research followed suit and has studied these same parameters. This critical review will examine the third aforementioned parameter, sound localization, in children who are bilateral CI users.

the source of a sound. In the most basic part of this process, humans use interaural level differences (ILDs)

This review will begin with the study which included the oldest children first, and then proceed to the younger groups next.

Case Control Study One

Litovsky et al. (2006) evaluated a group of 13 children, aged 3 to 16 years, with bilateral CIs at various intervals after receiving their second implant. The cause of deafness varied for the children and all were implanted sequentially. Time between first and second implant ranged anywhere from 1 to 12 years. commencement, 2 to 14 months had passed since the second CI was activated.

Sound localization ability was measured using a minimum audible angle procedure. Testing was conducted in a sound-treated booth, in which subjects sat at a table facing an array of 15 speakers, arranged in a semicircular arc with a radius of 1.5m, and positioned at 10° intervals
(-70° to +70°).

For each test block, two loudspeakers were selected at equal right and left angles and remained fixed for 20

were required to answer whether a spondaic word was presented from the right or left side (2-alternative forced choice). Stimulus levels averaged 60dB SPL and roved ± 4dB. After blocks in which the child scored (15/20), the angle was decreased and otherwise, the angle was increased. This follows a multi interval 1-up/1-down adaptive procedure. The amount of angular increase or decrease was determined following the Parameter Estimation by Sequential Testing (PEST) procedure.

MAA thresholds for each listening mode and every subject were defined as the smallest angle at which performance reached 70.9%. Children were tested under two conditions: (1) with both their CIs turned on and (2) with only their first CI turned on. (First refers to the order in which the implant was received.)

Results suggested that MAA thresholds were significantly lower in children when they received bilateral as compared with unilateral stimulation. In the bilateral mode, the MAA thresholds of the children ranged from 5° to 40°. The unilateral condition elicited thresholds ranging from 15° to 60°.

A limitation of this study lies in the formation of the unilateral group, whereby children who were bilateral cochlear implant users were asked to remove one of their implants.

The bilateral group ranged in age from 26.5 to 34.5 months and had a minimum of five months experience

In conclusion, pediatric CI studies have shown that sound localization abilities are improved by using bilateral instead of unilateral stimulation. These findings accompany a growing body of knowledge which exists in support