

Critical Review: Comparison of contralateral routing of signal (CROS) hearing aids with bone-anchored implantable hearing devices (BAHAs) in adults with single-sided deafness

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The purpose of this critical review is to compare the subjective and objective rehabilitative benefit of contralateral routing of signal (CROS) hearing aids with bone-anchored implantable hearing devices (BAHAs) in adults with single-sided deafness. Study designs include: single group with repeated measures (5), meta-analysis (1), and systematic review (1). Overall, the current literature provides suggestive evidence to support greater subjective and objective benefit of BAHAs over CROS hearing aids, though there is a need for future research to address methodological shortcomings and device limitations. Clinicians are therefore advised to proceed with caution when forming intervention recommendations for BAHAs in adults with single-sided deafness.

Introduction

In individuals with acquired single-sided deafness (SSD), a myriad of unique and specific listening challenges and hearing disabilities are faced (Bishop & Eby, 2009).

patient satisfaction of CROS and BAHA devices in adults with SSD. No limits were set on the type of subjective or objective measurements or on the demographics of the research participants (age, gender, race, or socioeconomic status).

Data Collection

A review of the literature yielded seven articles consistent with the selection criteria: single group with repeated measures (5), meta-analysis (1), and systematic review (1). All of these studies provide a grade III level of evidence (Dollaghan, 2007).

Results

Single group with repeated measures #1: Niparko, Cox, and Lustig (2003) compared the effects of a semi-implantable bone conductor with conventional CROS amplification in order to assess rehabilitative benefit in adults with unilateral deafness. This study looked at ten patients with a pure tone average (PTA) >90 dB HL for the affected ear and normal hearing (PTA <25 dB HL) in the opposite ear. Subjects had experienced SSD after: acoustic neuroma excision, sudden idiopathic sensorineural hearing loss (SNHL), and sudden SNHL associated with chronic suppurative otitis media (OM)

subjects varied for this test, though no reason was provided for this discre07kansty186(.) TJETBT1 0 0 1191.424 699.46 Tm[()] TJET EMC /P <</MCID10/Lang (en-US)>> BDC BT

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that IOI-HA norms are based on bilateral adult in-the-ear hearing aid fittings, and as such outcome comparisons are suspect. SSDQ results also indicate increased satisfaction, benefit, aesthetics, and ease of use with the BAHA over the CROS aid, with the majority of participants reporting an increased quality of life and benefit when listening to music and television and when in large groups. All subjects were found to still use the BAHA daily, though reports of usage times varied considerably.

Results of this analysis must be interpreted with caution,

Hol et al. therefore concluded that patients were still satisfied with the BAHA at a 1 year follow-up, as demonstrated by the stability of scores and measures of subjective benefit. Similar to their previous study in 2004, methodological and study design flaws exist: in addition to a lack of crossover design, blinding, device fitting details and a small number of participants, a confound exists in that reasons for the lack of responses to the follow-up assessments ranged from poor health to non-BAHA use and compliance, though no specifics were given as to how many participants were non-compliant or their reasons for BAHA dissatisfaction. As such, while the level of evidence is suggestive of long-term BAHA satisfaction and benefit in adults with SSD results must be interpreted cautiously when formulating rehabilitation interventions.

Meta-Analysis: Baguley, Bird, Humphriss, and Prevost (2006) evaluated the peer-reviewed published evidence for the application of contralateral BAHAs in acquired unilateral sensorineural hearing loss in adults. A MedLine search (1960-2005) was performed using the

four prospective controlled trials were identified. Observational and non-peer reviewed studies were also identified and included in the review. The four studies included in the meta-analysis were chosen to maximize participant numbers and to minimize subject overlap. Mean and SD values between the unaided, CROS, and BAHA periods were extracted from the papers; as SDs were not available for one study, the pooled SDs of the other three were used as a proxy. Using the DerSimonian and Laird method to perform random-effects meta-analysis pooled mean values and a 95% confidence interval (CI) were obtained. Heterogeneity between the three studies was also assessed using the chi-squared test.

A pooled mean difference for the four APHAB domains was calculated. Results indicate a BAHA advantage compared to both CROS and unaided conditions; a similar advantage was also found for speech discrimination in noise. Also consistent across the four studies was the finding of no significant difference in auditory localization ability across the three conditions.

sudden idiopathic SNHL. Average deafness duration was 23 years. A headband BAHA was used, allowing the researchers to randomly order the devices being trialed (CROS, BAHA, and CIC not to be discussed in this paper), thus addressing one of the main methodological criticisms with previous research. Participants were allowed an eight week acclimatization period per device prior to outcome measurement on sound localization, speech perception in noise, and hearing aid benefit using the SAINT, HINT, and APHAB; additional measures including the SSDQ and the Speech, Spatial, and Qualities questionnaire (SSQ) were also used.

Sound localization performance was found to be at chance level for all test conditions (unaided, CROS, and BAHA). In contrast with previous research, for speech perception in noise findings indicate that the CROS system is most beneficial in situations where noise was presented to the front and the speech signal to the poorer ear when compared to the unaided and BAHA conditions. No explanation for this finding was offered.

Also contrary to previous research findings, scores on the APHAB revealed the greatest amount of improvement in the ease of communication domain with the BAHA, though overall the conventional CROS system had the best scores on the 4 domains of the APHAB. Mean scores on the SSQ indicate the most benefit in spatial hearing, speech perception and quality of sounds in the unaided condition, with less benefit from the BAHA and CROS. Results of the SSDQ indicate that the majority of the participants (n=6) found the BAHA more beneficial for hearing but that the CROS system had slightly better sound quality. However, no mention of significance was made. Following completion of the trial 3 participants opted for the BAHA and 1 for the CROS system; the other 6 declined either device, though no explanations for why participants opted for one device over the other were given.

adults with SSD. To date research comparing the two devices generally shares the same fundamental shortcomings, as such making it difficult to view either as a valid standard of care (Bishop and Eby, 2009). There is also a need for further investigation to distinguish between the characteristics of those adults