

A systematic review of the efficacy of a Contralateral Routing of Signal (CROS) system (AC) and Bone Conduction (BC), in Paediatric patients with Single Sided Deafness

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Introduction

There is very little research into the effectiveness of a CROS system for children with Single Sided Deafness (SSD), which has created some uncertainty about the benefit that it provides for SSD and when the right time is for intervention. There is an opinion that a CROS device may make hearing worse in noisy environments and for young children, this could be detrimental to their hearing. There is no industry guideline that specifies an age that is appropriate for CROS use, leaving room for inconsistent practice and advice. The aim is to identify whether a CROS system provides benefit to paediatric patients with SSD. This includes both AC and BC systems.

Method

- A systematic review of paediatric studies reporting on the benefits of CROS systems, both Air Conduction (AC) and Bone Conduction (BC), for the treatment of Single Sided Deafness (SSD)
- Database search – Google Scholar, PubMed, Web Of Science, Embase)
- Key Words and phrases used – SSD, paediatric, CROS, BC CROS, severe unilateral hearing loss
- Papers screened using the PRISMA 2020 diagram
- 10 papers for data extraction

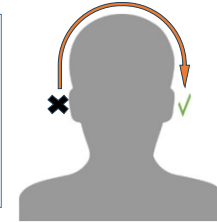


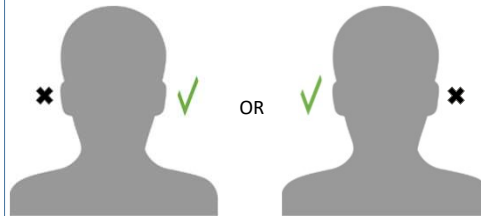
Figure 1: illustrates how a contralateral routing of signal device transfers sound from the "bad" ear to the "good" ear

Objectives

- How does a CROS system or BC device impact speech perception for children with SSD
- To determine whether sound localisation is improved with a CROS (AC) or BC system and if there is any difference between them in terms of sound quality
- Does the use of these devices impact social development, education or behaviour in children with SSD
- Identify if there is an age limit that should be recommended for the use of CROS (AC) or a BC system for children with SSD
- Identify any negative effects of using these systems for children with SSD

Definition of Single Sided Deafness

- Characterised by a severe or total hearing loss in one ear
- Also referred to as a severe unilateral hearing loss
- Normal hearing thresholds in the "good" ear



Inclusion Criteria

- Children (0-18 years) with Single Sided Deafness
- CROS system (AC) or Bone Conduction device, both surgical and non-surgical
- Universal (not country specific)

Exclusion Criteria

- Adults (18+ years)
- BICROS systems
- Asymmetrical losses not defined as SSD
- AC hearing aids
- Cochlear Implants

Discussion

- A CROS (AC) device and BC device will re-route the signal from the "bad" ear to the "good" ear. In noisy environments, this will also transfer the noise signal from the "bad" ear to the "good" ear, introducing additional noise to the hearing ear and potentially negatively affect speech understanding.
- If speech is presented to the "bad" ear, and noise is presented to the "good" ear, then a CROS & BC system provides an improvement in SNR and in speech understanding.
- Post implantation, BC systems outperform CROS (AC) by offering an increase in speech understanding in noise (Chandrasekar et al)
- Improvement in hearing related quality of life was reported through use of these devices.
- Younger children may be negatively affected by the introduction of noise to the "good" ear, as they may not be able to adjust their position to reduce the noise input on the "bad" side. This could be managed by effective parenting/caregiving in noisy situations, or use in quieter places until the child is able to manage themselves
- There is a conflict of advice and information in the studies regarding a minimum age appropriateness for intervention with these solutions, so it is recommended to consider each patient case by case.
- A trial of the devices is imperative to assess suitability and may assist with assessing the appropriate time for intervention.
- There is a need for further research into the effectiveness of these devices in younger children with SSD, specifically under the age of 5 years.
- Studies show that use of these devices improves hearing related quality of life, speech and language or academic and behavioural issues (Patel et al) and should be considered for use for children with SSD.

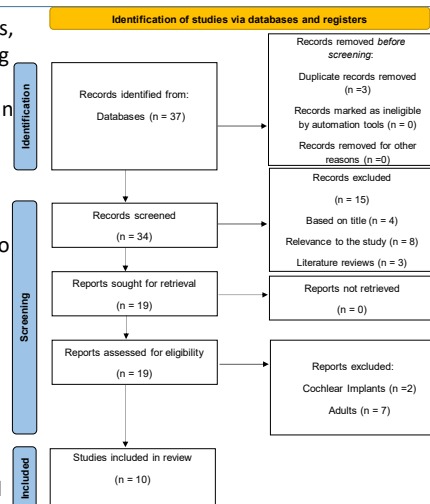


Figure above illustrates the selection of studies for this review according to the PRISMA statement

Positives:

- Lifting of the head shadow effect
- Improved hearing related quality of life

Negatives:

- Potential contra-indication for younger children, regarding speech in noise, if not managed appropriately

Considerations:

- CROS (AC) has two devices to wear compared to one device for BC
- CROS (AC) may occlude the ear canal of the "good" ear
- CROS (AC) limited to 5 years and older, whereas BC (non-surgical) can be worn from birth

Limitations

- Limited research available for paediatrics with SSD
- Of the paediatric studies that include Bone Conduction solutions, most relate to surgical systems and not non-surgical solutions

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