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SAC Position Paper on **Cochlear Implants in Children**

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A position paper represents the direction SAC has taken on a particular topic or provides guidelines for particular areas of practice. These positions are time-bound, representing the thinking at a particular point in time.

Position

Speech-Language & Audiology Canada supports early bilateral cochlear implantation in children in order to optimize access to auditory cues and spoken language.

Background

A cochlear implant is an electronic medical device that provides children with severe to profound hearing loss access to sounds that they cannot hear with hearing aids alone. The device consists of a speech processor (worn externally) that picks up sound and converts it to a digital signal that is transmitted to a surgically implanted receiver stimulator and electrode array. The internal receiver stimulator converts the signal to electrical impulses that travel along the electrode array implanted into the cochlea. The body then takes over as the auditory nerve sends this stimulation to the brain where it can be perceived as sound.

Advances in technology and surgical procedures now allow a broader range of individuals with hearing loss to benefit from implantation. Factors to consider during cochlear implant candidacy assessment include:

- Degree and configuration of hearing loss
- Age and/or language level
- Access to speech signals (especially to high frequency speech sounds with hearing aids, using frequency lowering technology, as appropriate)
- Radiology results (MRI and/or CT scans to examine ossification, presence of auditory nerve, cochlear abnormalities and anatomic landmarks)
- Other health conditions
- Family support and expectations
- Auditory experience
- Access to (re)habilitation programs

Candidates for implantation may also include individuals who have auditory neuropathy spectrum disorder (ANSD), profound unilateral hearing loss (UNHL) and precipitous high frequency hearing losses (Polonenko, Papsin & Gordon, 2017; Gantz et al., 2010; Machado, Ramos, Arthur, Guimaraes & Sartorato, 2016). The trend is to extend candidacy considerations to children with more residual hearing to provide an opportunity for better access to sounds than available through conventional amplification. Children with complex developmental conditions may also benefit from implantation (Eze, Ofo, Jiang & O'Connor, 2013; Zaidman-Zait, Curle, Jamieson, Chia & Koziel, 2017).

Members of the cochlear implant team perform candidacy assessment, surgery, processor fitting, (re)habilitation and follow-up services. The interprofessional team includes: audiologists, speech-language pathologists, communication health assistants, otolaryngologists, auditory-verbal therapists, psychologists, radiologists, social workers, geneticists and educators of the deaf and hard of hearing. The cochlear implant team works closely with the parents and professionals who will be providing ongoing support and (re)habilitation to the child.

Bilateral cochlear implantation is the standard of care in children who are candidates for implantation in both ears (Cullington et al., 2017a; Cullington et al, 2017b; Papsin and Gordon, 2008). This is consistent with Early Hearing Detection and Intervention (EHDI) principles and the provision of binaural amplification for children (Gordon, Wong & Papsin, 2013). In some cases, such as asymmetric hearing loss, unilateral implantation may be indicated and a hearing aid recommended for the non-implanted ear (Cadieux, Firszt & Reeder, 2013). This approach uses bimodal hearing to give children a bilateral benefit (Scorpecci, Giannantonio, Pacifico & Marsella, 2016).

Benefits of binaural stimulation include:

- Improved audibility (due to binaural summation of loudness) and ease of listening;
- Improved localization;
- Improved speech perception in noise;
- Elimination of head shadow and increased ability to hear from both ears (Litovsky & Gordon, 2016)

Children with functional low frequency hearing may benefit from a hybrid cochlear implant speech processor, which combines a hearing aid and a cochlear implant in one device. Electric-acoustic stimulation (EAS) is possible with the use of less invasive surgical techniques that are designed to preserve residual low frequency hearing (Gantz et al., 2010). Future developments in cochlear implants will likely include fully implantable devices with no visible external component (Mitchell-Innes, Morse, Irving & Begg, 2017).

Individual outcomes following implantation vary from child to child. Factors that may affect outcomes include:

- Amount of residual hearing
- Age at identification of hearing loss and at beginning of intervention
- Duration of hearing loss
- Access to sound prior to implantation
- Status of the cochlea and auditory nerve
- Degree of involvement in (re)habilitation program post-implantation
- (Re)habilitation approaches
- Family involvement
- Other medical, social, emotional and cognitive variables

(Re)habilitation following surgery and fitting of a cochlear implant is essential for optimizing the child's proficient use of the device. Goals include maximizing the child's ability to:

- Process sound in order to understand spoken language
- Recognize and interpret environmental sounds
- Derive pleasure from listening (e.g., music)
- Develop spoken language

Effective communication for children is defined as fluency in one or more spoken languages, and may also include augmentative communication systems or sign languages such as American Sign Language (ASL) or Langue des signes québécoise (LSQ) (Dettman, Wall, Constantinescu & Dowell (2013). Professionals need to be sensitive to a range of factors when supporting a family in choosing how to communicate with their child. These factors include:

- The family's cultural background and current language(s) used
- The family's motivation and ability to learn a new language
- The child's oral motor skills and ability to perform foundational skills for speech production
- The child's fine motor skills for accessing augmentative communication devices or signs
- The child's prior access to sound (with and without amplification) and prior linguistic experience
- The child's duration of auditory deprivation prior to cochlear implantation
- The child's access to fluent users of the chosen language(s)

Rationale

Cochlear implants are widely recognized as an appropriate intervention for children with significant hearing loss; changes in technology, expanding candidacy criteria, the accumulation of a large body of evidence on the effectiveness of early bilateral pediatric implantation and increased awareness of outcomes in various forms of genetic hearing loss as well as hearing loss caused by cytomegalovirus (CMV) and meningitis have prompted a review and update to SAC's 2006 position paper on cochlear implants in children.

Recommendations

SAC supports early bilateral cochlear implantation in conjunction with Early Hearing Detection and Intervention (EHDI) programs.

Cochlear implantation in children should be considered after a comprehensive audiological, speech-language and medical evaluation of the child, along with a thorough exploration of parental expectations and commitment to implantation and (re)habilitation.

As part of the candidacy assessment, children will undergo a trial period with appropriate amplification in conjunction with a (re)habilitation program emphasizing the development of auditory/oral skills. In the case of older children and adolescents, it is recommended that their expectations, motivation, commitment and willingness to participate in (re)habilitation be explored. To help ensure that cochlear implantation provides improved access to sound and oral communication, SAC recommends the following:

- Cochlear implant centres adopt an interprofessional team approach for the assessment of cochlear implant candidates and subsequent management of implant recipients. The cochlear implant team should have a core group of medical, audiological and speech and language professionals who are knowledgeable and experienced in working with children with hearing loss and hearing technology. The team should also have access to professionals with expertise in psychology, social work, education of the deaf/hard of hearing, genetics and radiology.
- Professionals should be familiar with the position and concerns of the Deaf community regarding the right to access both spoken and signed languages (Humphries, et al., 2012) and do their best to ensure families are aware of this information. This will enable professionals to

provide appropriate counseling to parents and youth on the cultural, linguistic, educational and social-emotional issues surrounding cochlear implantation. This may include referral to other professionals or members of the Deaf community for consultation, as necessary.

Children with cochlear implants are more likely than children without cochlear implants to contract bacterial meningitis, and some of these children have an additional increased risk for meningitis due to abnormal cochlear anatomy (American Academy of Otolaryngology – Head and Neck Surgery, 2017). SAC supports immunization for cochlear implant candidates based upon best current evidence.

Following cochlear implant surgery, SAC recommends a comprehensive (re)habilitation program emphasizing the development of listening skills within a communication context with a focus on oral communication (Dettman et al., 2013; Geers et al., 2017).

(Re)habilitation professionals may be involved in transitioning children between spoken and signed languages or visual language systems and vice versa. Professionals should exercise caution in making recommendations to exclude specific languages. The child's need to continue to use established language systems with family members or peers is of utmost importance and should include both signed languages and heritage languages (Paul & Snodden, 2017). When families decide to choose two or more languages for communication, sufficient time and meaningful interactions with fluent users of those languages is necessary. SAC affirms that children with cochlear implants have the opportunity to learn multiple languages with the necessary supports (McConkey Robbins, Green & Waltzman, 2004).

Given the variable outcomes post-implantation and that the factors that predict specific outcomes are not always clear, it is important to continue to monitor the child's progress. Long-term outcomes should include educational and social-emotional outcomes (Anderson and Arnoldi, 2011; Dornan, Hickson, Murdoch, Houston & Constantinescu, 2010; Fairgray et al., 2010; Punch and Hyde, 2011). The ability to speak and listen may vary in different environments, therefore different supports may be needed in various settings. The use of assistive listening devices should also be encouraged.

Professionals must support patient access to ongoing funding, local programming and (re)habilitation centres, as well as access to trained professionals with experience working with these devices. Barriers to optimal success with cochlear implants include:

- Lack of financial resources
- Distance to programming centres
- Lack of access to (re)habilitation services
- Age at identification (early identification through EHDI programs is essential)
- Lack of access to technology upgrades
- Cost of maintaining device(s)
- Lack of access to trained professionals

Financial support for speech processor replacement is essential to ensuring that all children with cochlear implants have equal access to updated devices and support throughout their lifetime. While the internal components of the cochlear implant are expected to last for many years, the external components are worn continuously and are subject to normal wear and tear. Technological advances also result in the development of speech processors that may provide the child with improved access to sound.

There is a need for ongoing research and exploration of the effectiveness of different (re)habilitation and educational strategies for children with cochlear implants (Harrison et al., 2016). Long-term follow-up by the interprofessional team is essential to evaluate the impact of cochlear implants on the lives of these children their families.

It is important that cochlear implant teams, as well as professionals referring children to the team, maintain and update their knowledge and clinical skills in order to keep abreast of changes in candidacy, technology and the field in general.

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