

Comfort and listening benefits of the Kanso off-the-ear sound processor in children

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In September 2016, Cochlear introduced the Kanso™ off-the-ear (OTE) sound processor. This paper summarizes a clinical investigation of the Kanso device with existing pediatric cochlear implant users, and discusses considerations for use with this population. Clinical testing compared the performance outcomes of Kanso with a conventional behind-the-ear (BTE) sound processor, and collected subjective feedback on comfort, retention, aesthetics and ease of use ratings for pediatric users. The outcomes were found to be consistent with recently published results in adult Kanso users, demonstrating equivalent speech understanding in quiet and in co-located speech and noise, and positive subjective feedback on the device.

INTRODUCTION

Kanso (CP950) is the first OTE sound processor from Cochlear Limited, designed to provide increased user comfort and convenience over BTE processors, without compromising dual microphone or front-end processing features which are critical for optimizing listening performance in noise.

The Kanso Sound Processor

The Kanso OTE sound processor (Figure 1) provides similar functionality to that of the latest Nucleus® 6 (CP900 Series) BTE sound processor¹ but in a fully integrated and cable-free unit designed to maximize user comfort and discretion. Kanso includes the same sound coding strategies and advanced front-end processing (including SCAN, SNR-NR, and the full range of directional microphone technologies) as Nucleus 6, as well as an internal telecoil and 2.4GHz technology for wireless connectivity. Kanso is designed to provide a minimum of 16 hours of continuous device use from one pair of zinc-air batteries for the majority of recipients, and is available in a range of eight color choices to discreetly blend in with the user's hair.

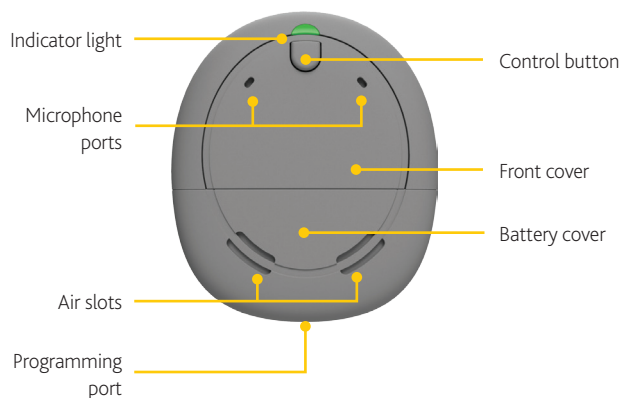


Figure 1. Kanso Sound Processor showing the location of a number of features including dual microphone ports, control button and the indicator light.

Kanso differs from Nucleus 6 in that it does not support acoustic output (as used for hybrid stimulation) or connection to external input cables.* However, Kanso is compatible with the complete range of Cochlear™ True Wireless™ Accessories (including the Mini Microphone, Phone Clip and TV Streamer), as well as both the CR210 Remote Control and the CR230 Remote Assistant. In addition, Kanso can be used with the Kanso Aqua+™ Accessory to keep the sound processor dry during use in or around water.

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* The Cochlear Nucleus Hybrid acoustic component is not compatible with the Kanso Sound Processor. The Kanso Sound Processor is not intended to be used by Hybrid L24 Cochlear Implant recipients who receive benefit from the acoustic component.

** The Kanso Sound Processor is water resistant to level IP54 of the International Standard IEC60529. The Kanso Sound Processor with the Aqua+ is water resistant to level IP68 of the International Standard when used with LR44 alkaline or nickel metal hydride disposable batteries.

OTE Considerations for Children

While OTE sound processors are new for cochlear implant (CI) users (Figure 2), they have been available for some time for users of bone conduction implants. It is expected that pediatric users of CIs and their families may have similar concerns to those reported by users of Baha® Sound Processors regarding performance, retention, device management and the stigma of using a visible hearing device.



Figure 2. Kanto, as worn on the head of a child.

A recent evaluation of the Kanto Sound Processor in adult users reported equivalent speech recognition in noise between Kanto and Nucleus 6 Sound Processors, and also demonstrated superiority of dual microphone strategies over an omni-directional microphone configuration.² The latter is particularly important as dual microphones currently offer the most effective means of reducing the negative effects of background noise in everyday listening.³ The hearing performance of children using Kanto is therefore not expected to differ from that seen with adult users.

Device retention was a prime design consideration with Kanto, especially given the higher levels of concern related to processor loss with children. To address this, a range of seven magnet strengths have been provided to deliver an optimal balance between retention force and comfort, and a variety of retention accessories are available for added security against device loss.

A potential benefit of the integrated and cable-free Kanto form factor for children, may be easier daily device use and management resulting in less reliance on parents and carers to attach and activate devices. This improved sense of ownership and independence may be especially evident for those children who are bilaterally implanted.

The slim profile of Kanto Sound Processor and its OTE placement may enhance the discreetness of the device compared with a BTE processor, offering an appealing option for school-aged children who are sensitive to social stigma.

In order to investigate these considerations, a clinical investigation of Kanto was conducted evaluating subjective impressions during take-home experience, as well as the speech understanding performance in a group of school-aged children.

CLINICAL OUTCOMES

Nine children, aged between six and nine years old (mean age of 7.6 years), participated in a four-week take home pilot study with the Kanto Sound Processor. Participants were patients of the ENT department of the Ghent University Hospital in Belgium, and together with their carers participated in this study with informed consent. All participants had at least three months experience with a Nucleus 24 series or later implant and were regular users of the Nucleus 6 (CP900 Series) Sound Processors, programmed with the default SmartSound® technologies (ADRO®, Autosensitivity™, SNR-NR, WNR*, and SCAN**).⁴

The study contained three clinic sessions with approximately two weeks take home experience between sessions. During the first test session, the Kanto Sound Processor(s) were fitted, speech performance in quiet was assessed, and questionnaires were provided to the children and their carers. During the second test session, speech understanding in noise was assessed, and surveys were collected. During a third test session, final surveys were collected, and the Kanto devices were returned.

All study participants were bilateral device users prior to the study. Due to the restricted number of Kanto Sound Processors available for the pilot, only two children were fitted bilaterally with Kanto for the trial. The remaining seven children were fitted unilaterally with a Kanto Sound Processor, but continued use of their own Nucleus 6 Sound Processor in the contralateral ear for the duration of the study. During programming of the Kanto Sound Processor, the same programs as used in the BTE processor were provided to the participants. Of the nine participants enrolled in this study, eight completed the study, while one participant's carer opted for them to be unenrolled after visit two, citing battery life and retention concerns.

Subjective Ratings

Subjective evaluation of device retention, comfort and listening performance with Kanto are reported for the child/carer questionnaires after four weeks of device use, completed just prior to the third session. For one participant who unenrolled after session two, either no result was recorded or results obtained after two weeks of device use were recorded and included in the analysis.

* SNR-NR and WNR are approved for use with any recipient ages 6 years and older, who is able to 1) complete objective speech perception testing in quiet and in noise in order to determine and document performance 2) report a preference for different program settings.

** SCAN is FDA approved for use with any recipient age 6 years old and older, to be used at the discretion of the recipient/parent/caregiver.

Carer satisfaction ratings for the Kanso device are shown in Figure 3. Six of the nine carers were 'very satisfied' with Kanso retention, one carer was 'somewhat satisfied' and one carer was 'neither satisfied nor dissatisfied' with the retention of Kanso.

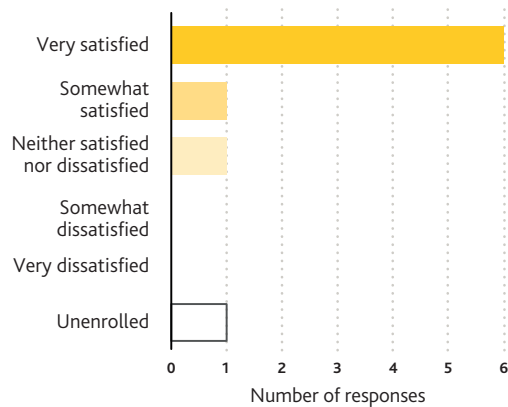


Figure 3. Survey results showing satisfaction with Kanso completed at the final session.

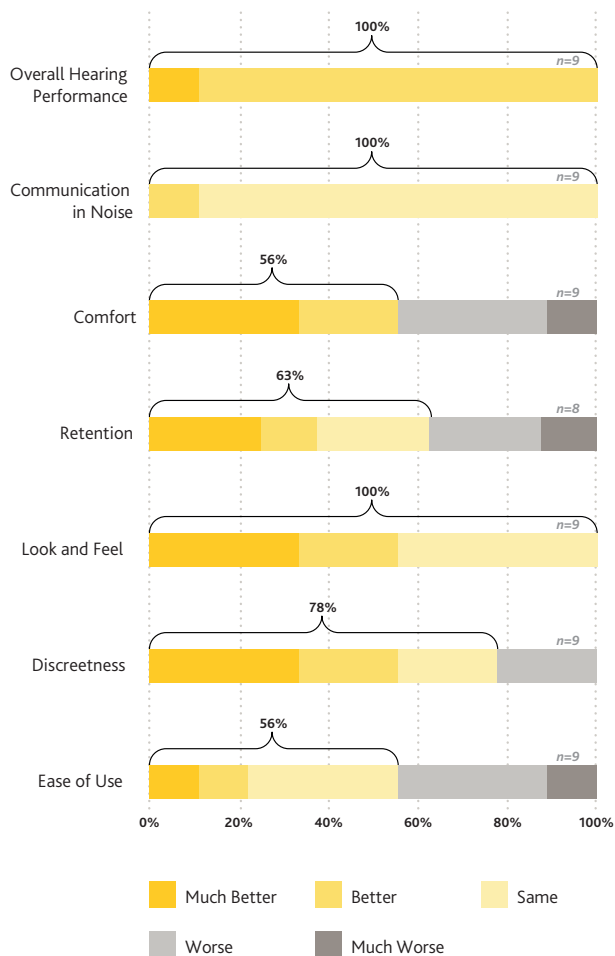


Figure 4. Performance ratings of Kanso compared to Nucleus 6 on a five-point scale. Percentage brackets show ratings of equal or improved performance for Kanso compared to Nucleus 6. n represents the number of responses.

A range of questions regarding Kanso performance, usability and aesthetics were posed via a survey. An example of the format used for the questions is as follows: "Compared with your own BTE sound processor, how do you rate the overall hearing performance of Kanso?" Carers with their children responded using a 5-point scale and results are presented in Figure 4.

The first two questions related to sound/listening performance. For 'Overall hearing performance', all participants rated Kanso as better, or much better than Nucleus 6. For 'Communication in noise' all participants gave ratings as the same, or better than for Kanso compared with Nucleus 6. Across both of these questions, no participants rated their satisfaction with Kanso performance to be poorer than Nucleus 6.

On the three usability survey questions (evaluating comfort, retention and ease of use), the satisfaction ratings were more evenly distributed across processor types. Kanso was rated the same or better than Nucleus 6 by 56% of participants for 'comfort,' by 63% of participants for 'retention,' and by 56% of participants for 'ease of use.'

Two survey questions related to the aesthetics of the processor. For 'Look and Feel', 100% of participants rated Kanso as the same or better than Nucleus 6, with 56% of those rating Kanso as improved. For 'Discreetness', 78% of participants rated Kanso as the same or better than Nucleus 6, with 56% of participants rating Kanso as improved. For both questions, 33% of participants rated Kanso to be much better than Nucleus 6.

Additional survey questions were asked regarding processor preference in specific situations (school, home, in the park, at a restaurant/party, socializing and sport). Kanso was reported as the preferred device by most carers across all situations with the exception of 'in the park' and 'sport', for which the majority of carers nominated the BTE processor as being preferred processor for their child.

Speech Understanding Outcomes

Speech testing was conducted with Flemish CVC words.¹ For each processor, two word lists each containing 11 words were presented. The average of both lists for each processor was reported. The two children fitted with bilateral Kanso processors were tested using both Kanso processors, while those fitted unilaterally with Kanso had the contralateral ear plugged during testing if sufficient residual hearing was demonstrated in that ear.

For speech testing in quiet, words were presented at a level of 60 dB SPL from in front of the child and measured in an audiometric booth.

For speech in noise testing, the speech and the noise were presented coincidentally from in-front of the listener, with speech presented at a level of 65 dB SPL and noise presented at an SNR level previously found to result in a phoneme score of 40 – 70% with the child's BTE processor.

Speech understanding outcomes are presented in Figure 5, showing the mean word scores obtained for the two processor types in quiet and in noise.

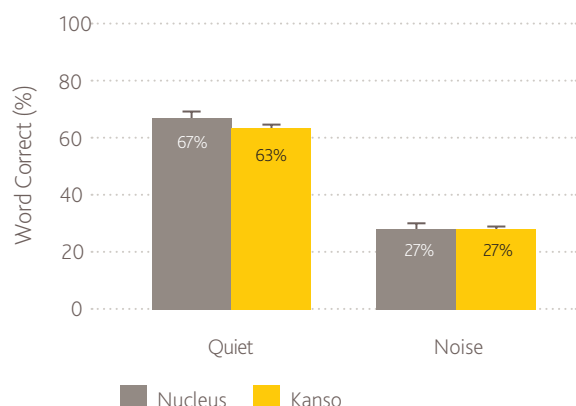


Figure 5. Mean word recognition scores obtained in quiet and noise in a comparison between the Kanso and the Nucleus 6 Sound Processor. Error bars show standard error of the mean.

There were no significant differences (two-tailed paired t-test) found between the scores obtained with Kanso and the Nucleus 6 Sound Processor in quiet ($p = 0.466$) or in noise ($p = 1.000$).

DISCUSSION

Both the subjective questionnaire outcomes across a range of listening situations and the objective speech recognition measures obtained, suggest equivalent speech recognition and listening performance with the Kanso OTE processor, as compared against the Nucleus 6 BTE processor. This finding is in agreement with a previous study comparing Kanso with BTE sound processors in adult users.²

Equivalent performance was an important design goal during development of Kanso, as the latest sound processing technologies of the current Nucleus 6 processors, including dual microphone directionality and the SCAN classifier, have been shown to be highly effective at improving speech understanding in noise.⁵⁻⁷

Whilst Kanso was not designed exclusively for adults, pediatric users of Kanso might experience more difficulties

with retention, particularly during sporting and other physical activities. The pilot study described above, showed satisfactory retention outcomes with Kanso during everyday use for all but one of the participants, suggesting that retention may not be a contraindication for pediatric use.

Six of the nine carers involved in the study expressed an overall preference for Kanso over the BTE processor for their child, primarily due to the improved discreetness and cosmetic appearance of the OTE device, especially when considering bilateral use. Of the three carers who reported an overall preference for the BTE processor, all cited better retention by the BTE during physical activities as the primary motivation, although two indicated the lack of a rechargeable battery option for Kanso was a further consideration.

An anecdotal finding from the study, was that several carers commented that their children showed greater interest in, and ownership of their processor since the fitting of Kanso, because it was easier to operate, manage and re-position relative to their conventional BTE device.

In conclusion, the Kanso Sound Processor, whilst not specifically designed for use in children, may offer a suitable alternative to conventional BTE processors for this population. Special consideration should be given to appropriate retention during play and sporting activities.

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