CLINICAL RESEARCH

Bilateral Hearing for Unilateral AB Cochlear Implant Recipients

Phonak Naída Link™ CROS Solution

Although bilateral cochlear implantation has become the standard of care for adults and children with bilateral severe-to-profound sensorineural hearing loss, bilateral implantation may not be feasible for everyone. Because of medical or financial considerations, unilateral cochlear implantation may be the only option. The Naída Link CROS device provides an opportunity for these individuals to experience some of the benefits of bilateral hearing as well as to reduce the stress and fatigue associated with hearing with only one ear.

The Naída Link CROS incorporates Phonak technology, which allows it to link wirelessly to a Naída CI sound processor (Q70 or Q90) to stream full bandwidth audio signals from ear-to-ear in real time with low power consumption. The wireless network allows the Naída Link CROS to capture sound on the side of the unimplanted ear and transmit it wirelessly to the sound processor on the implanted ear, thereby restoring some of the benefits of bilateral hearing. Naída Link CROS users can also take advantage of StereoZoom, a Phonak Binaural VoiceStream Technology, which uses the combination of the two microphones on each device to help recipients better understand speech in noisier environments.

This clinical study evaluated the communication benefits of the Naída Link CROS for unilateral cochlear implant users. The rationale was to provide evidence for the degree and range of bilateral benefit that can be experienced by unilateral implant recipients who use non-surgical contralateral technology instead of, or prior to, a second cochlear implant.

STUDY METHODS

Subjects

Participants were 10 adults unilaterally implanted with a CII or HiRes 90K cochlear implant and fit with a Naída CI Q90 sound processor. A Naída Link CROS was fit acutely on the contralateral ear. Median age at time of testing was 50 years (range 21 to 63 years). Mean duration of cochlear implant use was 8.7 years (range 6 months to 16 years).

Materials and Procedures

Subjects were tested in a double-walled sound booth. In all test conditions, AzBio sentences were presented from loudspeakers located at 0, 90, or 270 degrees. For assessing speech perception in noise, 20-talker babble was presented from 12 loudspeakers situated around the listener 30 degrees apart.

To evaluate perception of soft speech in quiet, sentences were presented at 50 dB SPL. Subjects listened with the cochlear implant alone and with the cochlear implant plus Naída Link CROS.

To evaluate speech perception in noise, subjects were first tested in quiet with the implant alone with speech originating from the front at 65 dB SPL. Then an SNR was determined for each individual subject with their implant alone using multi-talker babble originating from the 12 surrounding speakers. Sentences were presented at 65 dB SPL from the front and the noise level was varied until the subject achieved a sentence score of approximately 50% of their score in quiet. All subsequent testing for that subject was conducted at that SNR regardless of the direction of the speech and whether the subject was using the implant alone or the implant plus Naída Link CROS.

To evaluate StereoZoom, subjects were tested with the Naída Link CROS and Naída CI Q90 sound processor using the omnidirectional microphones of both devices. Sentences were presented at 65 dB SPL from the front and the surrounding noise level was varied until the subject achieved a sentence score of approximately 50% of their score when tested with both devices in quiet. That SNR was used subsequently to evaluate the effect of turning on StereoZoom, and for assessing the performance of using the implant alone (omnidirectional mode) for comparison.

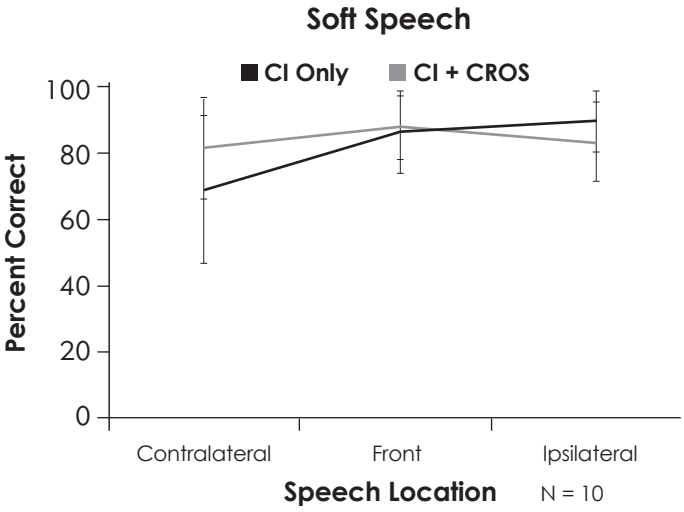

Figure 1

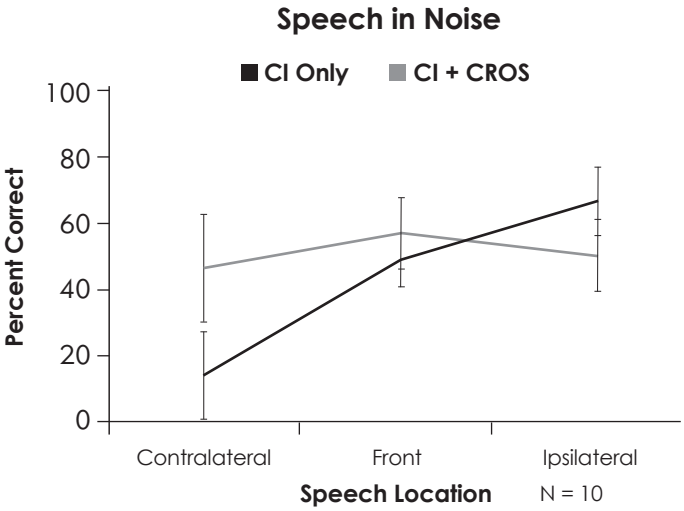

Figure 2

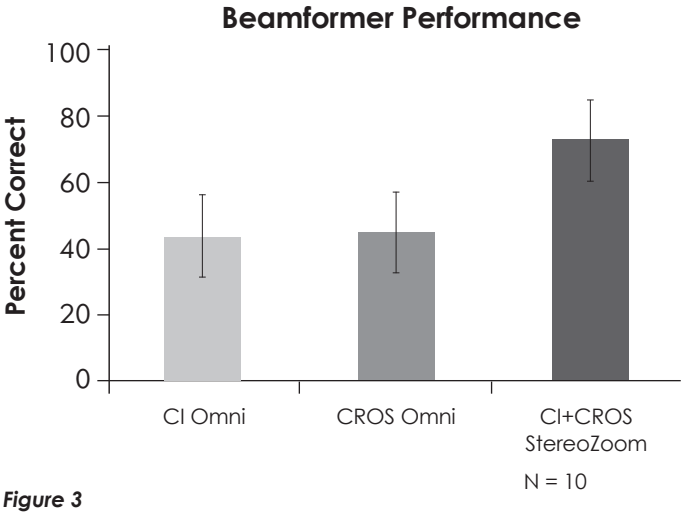

Figure 3

Clinical Study Results

Communication in quiet is improved when using the Naída Link CROS compared to using the implant alone (Figure 1). In the unilateral condition, there was a significant decrease in performance when the soft speech was presented on the contralateral side compared to the front or ipsilateral sides (Figure 1, black line). In contrast, with the Naida Link CROS, the ability to hear soft speech was relatively unchanged regardless of where the speech originated (Figure 1, gray line). That is, the mean scores were similar across all three speech directions. This result implies that unilateral implant recipients who use a wireless CROS device do not need to re-position themselves relative to the speaker to hear in quiet. The mean results also show that the greatest benefit for CROS is when soft speech originates from the non-implanted ear.

Communication in noise is more consistent when using the Naída Link CROS compared to using the implant alone. (Figure 2). Similar to the soft speech results, the unilateral condition showed the poorest performance when the speech was on the unimplanted side. With the addition of the CROS device, the ability to understand speech in diffuse noise was consistent and independent of the location of the speech signal (Figure 2, gray line). Again, the practical result is that unilateral implant recipients who use a wireless CROS device do not need to re-position themselves relative to the speaker in order to hear in noisy situations.

StereoZoom is superior to omnidirectional microphones for understanding front-originating speech in noise. There was a significant benefit when enabling StereoZoom compared to the implant alone (with omnidirectional microphone) ($p < .001$) and to bilateral omnidirectional microphones ($p < .001$) (Figure 3). The addition of the CROS device provides

access to bilateral features, such as StereoZoom, and improved understanding in very challenging listening environments.

Conclusions

The Naída Link CROS can provide bilateral speech perception benefits in quiet and in noise for unilateral implant recipients who are unable to obtain a second cochlear implant because of medical conditions or economic concerns. Along with reducing the head shadow effect when speech originates on the unimplanted side, contralateral CROS technology offers consistent hearing in quiet and noise independent of the direction of speech. This consistency means that unilateral implant recipients who take advantage of the Naída Link CROS no longer must actively position themselves with respect to a speaker, thereby increasing ease of listening and reducing fatigue compared to using the implant alone. In addition, StereoZoom allows Naída Link CROS users to understand speech in noisier environments. Finally, all unilateral Advanced Bionics cochlear implant recipients with bilateral severe-to-profound hearing loss can benefit from bilateral hearing and Phonak Binaural VoiceStream Technology. For unilateral recipients with no contralateral hearing, the Naída Link CROS can be beneficial. For unilateral recipients with aidable contralateral hearing, a Naída Link hearing aid may be appropriate.

Note: This study was conducted at Advanced Bionics facilities in Valencia, California, USA.

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