CLINICAL RESEARCH

Improving Speech Understanding without Facing the Speaker for Unilateral AB Implant Recipients

Bimodal ZoomControl Feature

Unilateral cochlear implant benefit can be enhanced by adding a hearing aid to the contralateral ear, termed bimodal hearing. The ability to access low-frequency hearing through a hearing aid can help speech understanding in noise, improve music and voice pitch perception, and provide better sound quality overall for unilateral implant recipients.[1-5]

Bimodal listeners with one AB cochlear implant now can take advantage of Binaural Voice Stream Technology™. With the introduction of the Phonak Naída™ Link hearing aid, users of an AB Naída CI Q70 or Q90 on one ear have the opportunity to use Binaural VoiceStream Technology, which makes it easier to communicate in everyday listening situations. Binaural VoiceStream Technology is a proprietary Phonak technology that allows two AB Naída CI sound processors, two Phonak hearing instruments—and now a Naída CI sound processor and Naída Link hearing aid—to be linked wirelessly to stream full bandwidth audio signals from ear to ear in real time. In addition, AB bimodal listeners can benefit from the Adaptive Phonak Digital Bimodal fitting algorithm, which improves hearing by (1) aligning the frequency response of the Naída Link to the acoustic-hearing ear, (2) aligning the loudness growth between the Naída CI sound processor and the Naída Link, and (3) synchronizing the dynamic behavior between the two devices.

The ZoomControl feature uses Binaural VoiceStream Technology to improve speech understanding when the talker is to the side of the listener. ZoomControl streams audio input from the device on the side of a target talker to the contralateral device, while at the same time attenuating the audio input from the contralateral device by 12 dB so that the signal-to-noise ratio (SNR) is improved even further on that side.

This clinical study assessed the benefit of using ZoomControl to improve speech understanding in noise when the speech signal is on the side of the hearing aid ear in unilateral AB implant recipients fit with a contralateral Naída Link hearing aid. Speech understanding was evaluated in quiet and in noise using the cochlear implant alone, the hearing aid and cochlear implant together, and ZoomControl. Results were compared to assess the benefit provided by bimodal listening and by ZoomControl for communicating in noise when the talker is not in front of the listener.

STUDY METHODS

Subjects

Subjects were 19 experienced adult bimodal listeners. There were 13 men and six women. Median age at time of testing was 61 years (range 26 to 83 years). Mean duration of cochlear implant use was 4.9 years (range 1.2 to 12.9 years, median = 2.6 years). Unaided thresholds at 500 Hz ranged from 35-95 dB HL (median = 70 dB HL) in the ear using a hearing aid. For the study, 14 subjects were fit with a Naída™ Link UP and 5 with a Naída Link RIC using the Phonak Adaptive Digital Bimodal fitting algorithm. Aided thresholds at 500 Hz with the Naída Link ranged from 20-35 dB HL (median = 25 dB HL). Subjects used a Naída CI Q90 sound processor on the implant side.

Materials and Procedures

In quiet, AzBio sentences were presented to the hearing aid side at 60 dBC in three conditions.

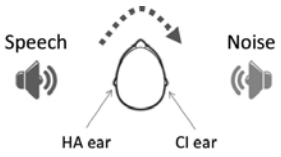
1. With the cochlear implant turned on and the hearing aid turned off (unilateral CI).
2. With the cochlear implant and hearing aid both turned on (bimodal).
3. With ZoomControl turned on, streaming from the hearing aid side to the implant sound processor (ZC).

Then, with the cochlear implant and hearing aid both on (bimodal condition above), Phonak cantina noise was added to determine a SNR for each subject that yielded an AzBio score of approximately 50% of their score in quiet. That individualized SNR was used to evaluate the benefit of (1) the cochlear implant without the hearing aid (unilateral CI), and (2) enabling ZoomControl streaming from the hearing aid side to the implant processor (ZC). SNRs ranged from -7 to +15 dB for the 19 subjects. All results are expressed as percent correct.

For all six test conditions, subjects rated ease of listening on a five-point scale ranging from 1 = extremely difficult to 5 = extremely easy.

Test Room Configuration

Subjects were tested in a double-walled sound booth. Speech was presented from a loudspeaker located at 90˚ or 270˚ azimuth (depending upon which ear wore the hearing aid). Noise was presented from a loudspeaker located at 90˚ or 270˚ azimuth (depending upon which ear was implanted).



ZoomControl streamed the speech signal from the Naída Link hearing aid to the Naída CI Q90 sound processor.

Clinical Study Results

AB bimodal listeners benefit from the Adaptive Phonak Digital Bimodal fitting algorithm and ZoomControl when listening to speech in situations where they cannot face the talker. In quiet, results show that the hearing aid plus cochlear implant (bimodal) provided an average of 15% improvement in sentence scores compared to using the implant alone. Enabling ZoomControl improved the average score by an additional 3%. In noise, bimodal hearing increased the sentence scores by a remarkable 33% over the cochlear implant alone (Figure 1). Adding ZoomControl provided an additional 28% benefit, in total a 61% improvement over the cochlear implant alone. In both quiet and noise, the ease of listening ratings were commensurate with the speech scores (Figure 2).

Figure 1

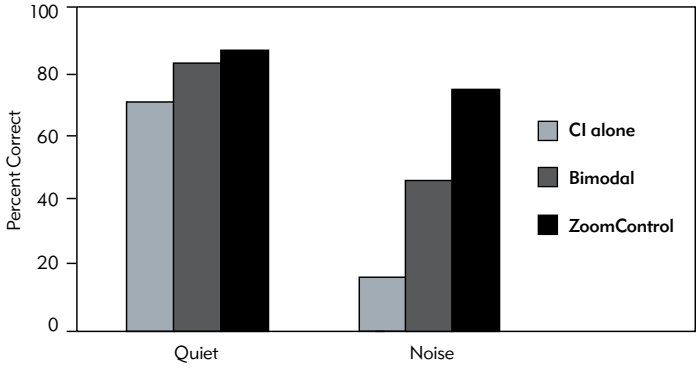
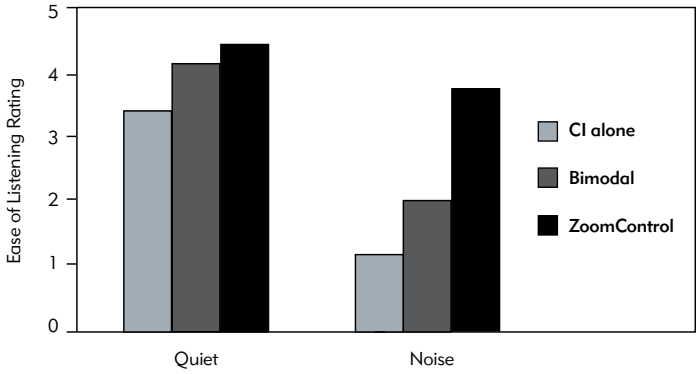


Figure 2



Individual scores show that all but one subject benefitted from adding a hearing aid to the cochlear implant when speech comes from the hearing aid side (Figure 3, bimodal benefit = bimodal score minus CI-only score). All but one subject benefitted from adding ZoomControl to the bimodal condition (Figure 4, ZoomControl benefit = ZC score minus bimodal score) in the same listening situation.

Figure 3

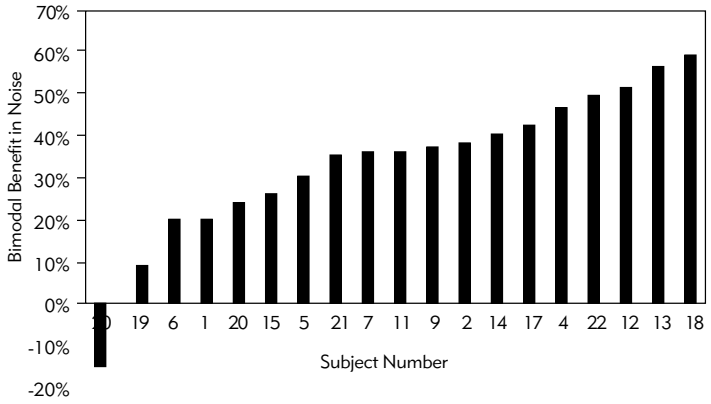
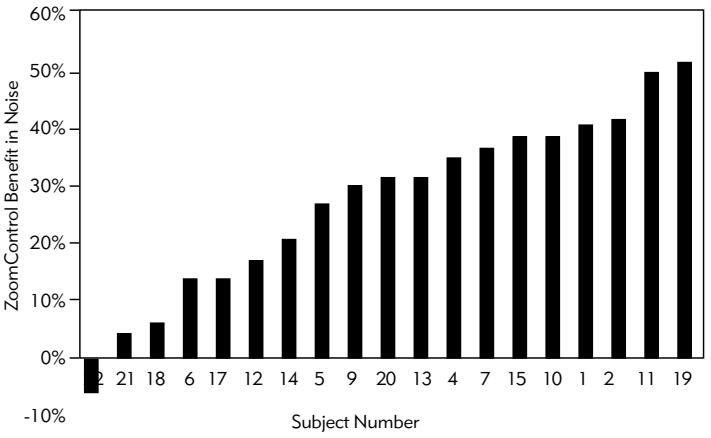


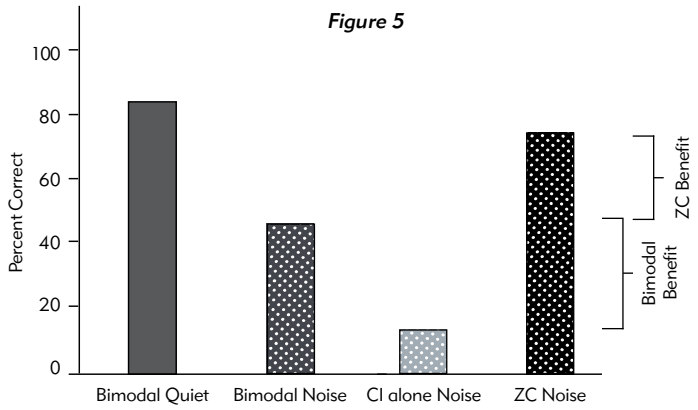
Figure 4



Discussion

For individuals with severe-to-profound hearing loss, providing input to both ears, whether bimodally or with two implants, can provide significant benefit compared to using one implant alone.[1-10] The study data indicate that, for almost all listeners, adding a hearing aid to a cochlear implant can improve sentence recognition significantly when the talker is on the side of the poorer, hearing-aided side. Furthermore, wirelessly streaming the speech from the poorer side to the implanted side using ZoomControl further improves the ability to understand speech, particularly in noise (Figure 5).

Figure 5



Practically for bimodal listeners, the effect of ZoomControl is to enhance hearing when the signal of interest is to the poorer hearing side. In other words, ZoomControl provides benefit in listeners with asymmetric hearing, whether they are bimodal listeners or bilateral implant users. Moreover, ZoomControl also provides a signal-processing solution for the problem of head shadow, the situation in which the input is attenuated to a better contralateral ear.

To conclude, this study demonstrates that using advanced acoustic signal-processing techniques to increase the signal-to-noise ratio at the input to both ears can strengthen the communication abilities of bimodal listeners who use a Naída CI sound processor and a Phonak Naída™ Link hearing aid. ZoomControl is only one implementation of Binaural VoiceStream Technology™. The StereoZoom and DuoPhone features also use Binaural VoiceStream Technology to enhance listening (1) when facing a talker in extreme noise, and (2) when talking on the phone in noisy places. In addition, the QuickSync feature makes it easy to make program and volume changes on both devices with one touch of a button. Binaural VoiceStream Technology is also available for bilateral Naída CI users and for bilateral Phonak hearing aid wearers.

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

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