WI SERIES™: OPTIMIZING THE WIRELESS EXPERIENCE

Elizabeth Galster, Au.D. & Matthew Burk, Ph.D.
Research Audiologists

Wireless technologies in hearing aids can enhance the patient journey by adding convenience, enhancing signal processing performance, and offering media connectivity. The Wi Series from Starkey Laboratories, Inc. introduces IRIS™ Technology, the only wireless hearing aid system to offer ear-to-ear communication, wireless programming, and wireless media streaming without any relay devices. Surpassing the limitations of existing wireless systems, IRIS Technology leverages the 900 MHz band within the Industrial and Scientific Medical Spectrum to accomplish a unique combination of near-field and far-field wireless communication. Starkey's commitment to evidence-based design drove the design and implementation of this advanced wireless technology, providing professionals and patients with a seamless and effortless wireless solution.

Starkey's IRIS Technology was evaluated in a large scale field trial. Forty-seven patients from nine private practice and university audiology clinics evaluated Wi Series i110 receiver-in-canal (RIC) hearing aids, SurfLink™ Programmer, SurfLink Remote, and SurfLink Media over a period of eight to 12 weeks. Subjective feedback regarding the devices was collected, and clinicians and patients alike were overwhelmingly satisfied with Starkey's wireless system. Results of the Device Oriented Subjective Outcome scale (DOSO) (Cox, Alexander, & Wu, 2009), displayed in Figure 1, indicated greater satisfaction and improved performance with Wi Series devices over the patients' own devices.
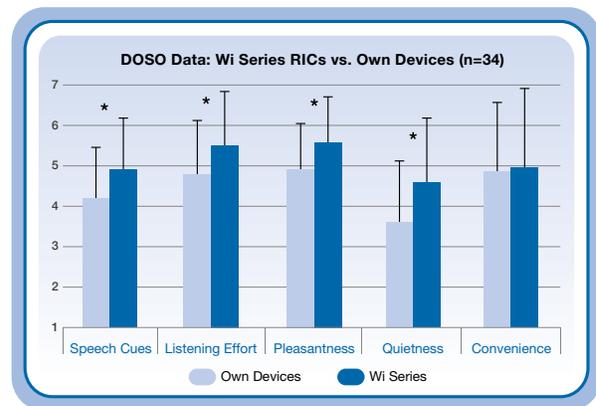

Figure 1: DOSO questionnaire results (34 participants completed the DOSO twice: at the beginning of the study for their own hearing aids and at the conclusion of the study for the Wi Series hearing aids). Asterisks (*) mark significance at the $p < 0.05$ level.

Adaptive Frequency Agility

With advancements in technology, hardwired connections are giving way to completely wireless systems. One of the challenges faced when implementing a wireless system is that the system must be smart enough to handle interference created by a multitude of wireless signals. Starkey's IRIS Technology utilizes Adaptive Frequency Agility, which continuously monitors the 900 MHz band. If an alternate frequency channel would improve the quality of signal transmission, IRIS Technology will transition to that channel seamlessly. This not only allows for optimum wireless performance in varied environments but also makes it possible for multiple clinicians and patients to be operating their wireless programmers, hearing aids, and accessories within the same environment.

SurfLink Programmer

In developing IRIS Technology, Starkey was committed to designing something that is as easy for professionals to use as it is for patients. Our goal was to make wireless programming truly wireless, such that a clinician can bring a patient into the office and begin a programming session, without the need for cables or neck-worn devices. Thus, the distraction of connecting the hearing aids to programming cables or hanging a relay device around a patient's neck is eliminated, allowing the professional to focus on the patient and the patient to focus on their hearing needs.

The SurfLink Programmer, displayed in Figure 2, connects to the professional's computer via a USB cable and can be positioned where convenient. The SurfLink Programmer performs high-speed wireless programming at a range of at least 20 feet, allowing the patient to move about the room during a programming session. The Inspire® fitting software automatically detects instruments within range and allows the professional to select the devices to be programmed. Additionally, the Inspire fitting software sends programming changes to the hearing aids instantaneously, so if a patient walks out of range, there is no need to worry that their adjustments have not been saved. Finally, there is no need to reboot the hearing aid after a programming session. For clinicians, the move from wired to wireless programming is an easy and quick transition, with a minimal learning curve.

Figure 2: SurfLink Programmer

Subjective reports obtained in our field trial with private practice and university audiologists indicated that the SurfLink Programmer was easy to install and use and was faster than other wired and wireless programming methods. One audiologist reported that programming with IRIS Technology is one of the most convenient advancements in hearing aid technology.

Synchronized User Adjustments and Binaural Spatial Mapping

Through the Inspire fitting software, an audiologist can configure IRIS Technology to meet each patient's needs. Synchronized User Adjustments in Wi Series devices maximize convenience for the patient. Performing bilateral volume or memory changes can be accomplished with the single push of a button. When asked about the convenience and value of Synchronized User Adjustments, participants in the field trial reported that Synchronized User Adjustments add both convenience and value to the fitting (Figure 3).
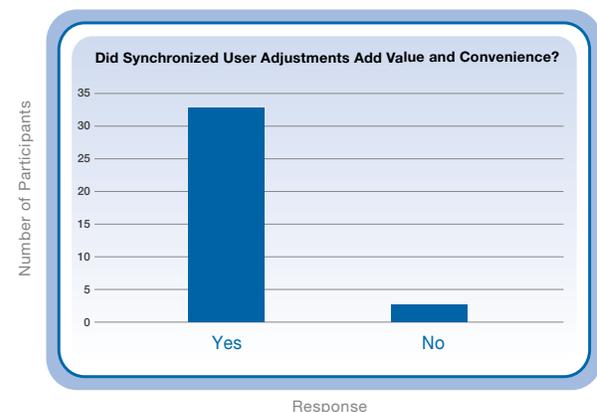

Figure 3: Subjective data collected during the Wi Series field trial (36 of 47 total participants responded to this question). Patients were asked to report on the value and convenience of Synchronized User Adjustments.

In addition to Synchronized User Adjustments, Wi Series devices also utilize Binaural Spatial Mapping, which coordinates digital signal processing algorithms between the patient's two devices. Ear-to-ear communication coordinates the performance of InVision Directionality as well as the Wind and Machine AudioScapes, ensuring that the algorithms are optimized for any given acoustic environment. Algorithm performance with Binaural Spatial Mapping is optimized, not necessarily synchronized. Internal research has indicated that synchronized digital signal processing algorithms, in which settings between the two ears are identical, is not always optimal (Banerjee, 2010). This data, along with that of Hornsby & Ricketts (2007), both indicate that there are situations in which asymmetric settings for digital signal processing algorithms can be advantageous.

Based on this evidence, Starkey developed Binaural Spatial Mapping. The Binaural Spatial Mapping system uses data, including estimates of signal-to-noise ratio (SNR), from both hearing aids to determine optimal settings, whether symmetrical or asymmetrical, for speech understanding and comfort. When no speech is detected in the patient's environment, InVision Directionality and the Wind and Machine AudioScapes are designed to improve listening comfort by reducing background noise by utilizing the gain reduction settings of the ear with the poorer SNR. As soon as speech is detected within the patient's environment, the algorithms optimize the SNR in order to maximize speech understanding for the patient. This optimization may result in asymmetric hearing aid settings, in order to optimize hearing aid settings for the patient's environment.

SurfLink Remote

In addition to Wi Series hearing aids, Starkey has introduced the SurfLink Remote. This small, lightweight device allows patients to control their hearing aid settings using a straightforward keypad. LED indicators confirm patient adjustments and switches allow patients to make monaural or binaural adjustments and lock the remote control when not in use. An additional benefit of the SurfLink Remote is that it requires no charging; a single battery is designed to last the life of product.

Recognizing that professionals must tailor hearing aid fittings to the needs and capabilities of their patients, the SurfLink Remote is available in three different configurations: Basic, Intermediate, and Advanced. The three remote control configurations are displayed in Figure 4. As such, the professional can select the remote control option that is most appropriate for a given patient: Basic for the patient that wants to make simple volume adjustments or Advanced for the savvy patient that wishes to manipulate multiple hearing aid settings. Additionally, a remote control can be modified in the clinician's office as a patient's needs change simply by changing the faceplate of the remote control.

Advanced   Intermediate   Basic

Figure 4: SurfLink Remotes

Clinical evaluation of the SurfLink Advanced Remote demonstrated that 15 out of 20 patients would purchase the remote control for use with the hearing aids (Figure 5). The five patients who responded "No" simply preferred not to carry a remote control. Anecdotally, patients reported that the Advanced Remote was very easy to use and clinicians noted that it was more user-friendly than other remote controls currently on the market, requiring less training and counseling time with patients.

Figure 6: SurfLink Media

SurfLink Media can function automatically: when a patient enters a room and turns on the television, the audio stream will initiate without any user action. After turning off the television in one room, Intelligent Media Mobility allows a patient with multiple media streamers to move to a different room and automatically begin listening to music streaming from a separate SurfLink Media device. Of course, these are optional settings; if the patient prefers to manually initiate audio streaming, this option is also available in the Inspire 2011 software.

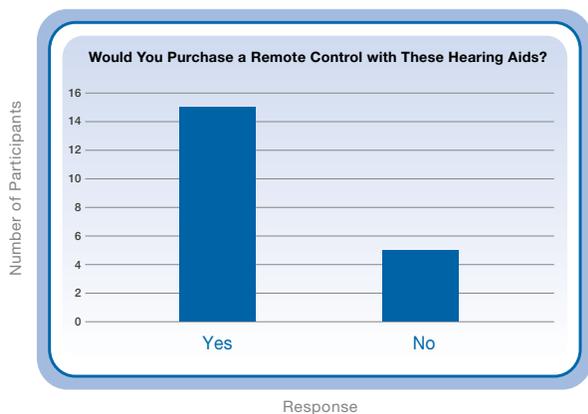**Would You Purchase a Remote Control with These Hearing Aids?**

Figure 5: Subjective data collected during the Wi Series field trial (20 of 30 patients who used a remote control in this study responded to this question). Patients were asked to report on the value the SurfLink Advanced Remote.

SurfLink Media

Starkey also offers SurfLink Media, pictured in Figure 6, as a convenient solution for streaming audio from a television or any media device directly to Wi Series hearing aids. This frees patients from the typical relay devices that require frequent recharging and cumbersome pairing routines. These relay devices used in the transmission of the audio signal create an intermediate step that may delay the audio signal and may send a lower fidelity signal, degrading the overall media experience. Therefore, Starkey's IRIS Technology enhances the patient's experience by eliminating the need for this relay device.

The media streamer is easily installed and offers multiple connection options for use with a variety of media devices, ranging from televisions to personal media players. Installation requires only two steps: **1)** SurfLink Media must be connected to the television or media device using a cable, such as a standard RCA cable and **2)** SurfLink Media must be plugged into a power source or wall outlet. Both patients and professionals have reported SurfLink Media to be very easy to install. Figure 7 displays patient questionnaire data regarding the ease of installing SurfLink Media. Most patients in the field trial found the installation easy or very easy and appreciated that multiple connection options (for example, RCA and optical cables) are available. Additionally, multiple patients in the same household or living center can seamlessly connect to a single SurfLink Media unit, without requiring pairing of the hearing aids to the media streamer.
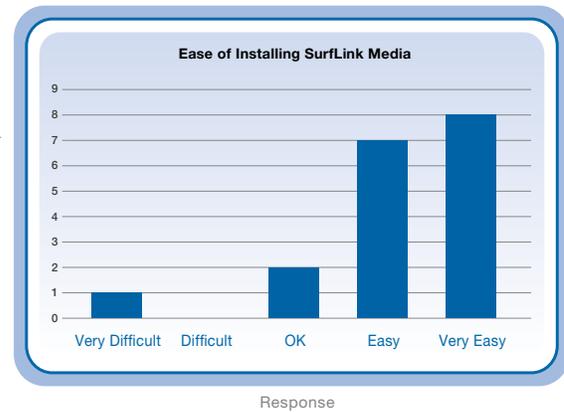

Figure 7: Subjective data collected during the Wi Series field trial (18 of 30 patients who used a media streamer in this study responded to this question). Patients were asked to report on the ease of installing SurfLink Media.

Summary

Wireless technology has changed the way people interact with their environment. IRIS Technology, available in Wi Series hearing aids, makes it possible for hearing impaired patients to take full advantage of the benefits of wireless technology. Wi Series is the only wireless hearing aid system to offer ear-to-ear communication, wireless programming, and wireless streaming without any relay devices. Starkey continues to develop innovative hearing solutions and is committed to providing the functionality and form factors that patients demand.

References

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Starkey®

A global hearing technology
company headquartered in
Eden Prairie, Minnesota, U.S.A.

Starkey Laboratories, Inc.
6700 Washington Avenue South
Eden Prairie, MN 55344-3476
800.328.8602

StarkeyPro.com