Issue Stories

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A Solution to Cell Phone Use for Non-Telecoil Equipped Hearing Aids

by Mark J. Sanford, MS

Interference relative to hearing aids and cellular telephones are still a major obstacle for hearing instrument users. This article presents an example of the technologies being developed to address these problems on the cell phone manufacturing end.

Editor's Note: *Interference issues relative to cellular telephones and hearing aids still pose major problems for hearing aid wearers. While much has been done by the hearing industry to improve hearing aid immunity to cell phone interference in recent years, the telecommunications companies are still seeking a solution to the problem on their end. This article represents a technical review of one of several strategies being developed to eliminate cell phone interference, and it is intended as an example of the kinds of technologies being developed relative to the cellular phone/HAC issue.*

Mobile phone usage has recently outnumbered landlines throughout the US and the world. The desire of people in our society to communicate to "anybody, anytime, anywhere" has already made the mobile cellular phone one of the most-sold electronic devices of all time. Convenience, safety, and security are only a few reasons for the device's proliferation, and the advent of photos, videos, information, email, text messages, games, MP3 music, and instant two-way communication has made mobile phones even more functional and attractive. For some, communication via cellular phones is seen as being essential for both their work and family/social life.

Today, there are close to 1 billion global cell phone subscribers. As of April 1, 2003, the Cellular Telecommunications and Internet

Association (CTIA) reports 144,096,122 US wireless subscribers—a market penetration of over 50%—and this total is climbing daily.[1] In Italy, Finland (home of Nokia), and many other European countries, subscribers of mobile phones exceed 70% of the population. The popularity of cellular phones is even growing fast for the areas of Latin America, Africa, India, Western China, Malaysia, and Eastern Europe.[1]

Overall, the technology has embedded itself throughout our planet. You see cell phones used either against the head or attached to the side of the user's body, resembling more of an appendage than an electronic device! They are everywhere—except that is, until you poll the hearing aid wearer population.

Many hearing aid wearers trying to use cellular phones hear an annoying oscillating or buzzing sound, making cell phone use uncomfortable, difficult, or even impossible. This interference is caused from the constant pulses of the digital signaling from the mobile phone. The pulsing sound can be visualized as a sort of high-speed Morse code between the mobile handset and the receiving stations. This radio frequency interference (RFI), when unchecked, is modulated at a sound pressure level (SPL) near the volume of a human voice (eg, about 65 dB or higher). The RF digital pulses are a necessary part of maintaining the basic connection or uplink to the locally placed receiver site.

According to one consumer study of hearing aid users, "there can be no doubt that a very serious problem exists and that hearing aid wearers are being severely disadvantaged in the fast-paced mobile telecoms revolution. The problem is likely to worsen very rapidly as analogue systems are closed down and long-time analogue mobile phone users must turn to digital mobile phones."[2] In a November 2002 survey by Self Help for Hard of Hearing People (SHHH), it was reported that 87% of the questioned respondents who were non-owners of cell phones were interested in using a cell phone if they could find one compatible with their hearing aid.[2]

The hearing aid/cell phone compatibility issue has been around so long (12 years) that it is not exactly "hot news" anymore; the downside is that some hearing care professionals have a misconception that the issue has been resolved. As cellular phone use has increased, hearing aid manufacturers have, in fact, addressed this problem on some of the newer digital hearing aid models. The cellular phone manufacturers are just now starting to respond, as well. As these changeovers continue to take time (estimates are up to 5 years), there continues to be insistence by consumer groups to resolve the hearing aid/cell phone incompatibility issue quickly. In addition, there are a tremendous number of hearing aid users whose aids are not immune and will not be replacing the aids with newer models for 3-7 years.

An Array Antenna

Myers Johnson Inc (MJI) was formed as a result of James R. Johnson's search for resolution to the hearing aid compatibility issue. A Silicon Valley executive for 30 years, Johnson knew energy shaping technology was available and found the expert he required in Steven Myers, PhD, who has been an antenna technologist for 30 years.

The technology has been developed from a relatively new science called interferometry which is a means of using similar, yet oppositely phased, waves to cancel out energy in desired areas. As an example, two water waves of opposite phase coming together will cancel each other out to create a calm condition in the water. If they are in phase, they are added to create a higher wave. This concept is the same for water waves, sound waves, seismic waves, or radio frequency electromagnetic waves; the energy-shaping process creates harmony where needed and is being commercialized under the name Vortis.

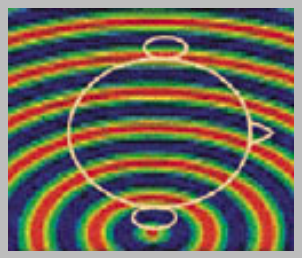
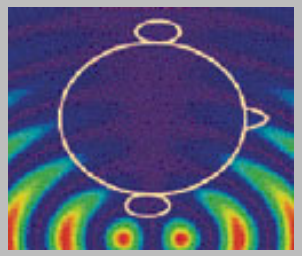


Figure 1. Wave propagation of a standard cellular phone (top) and the array antenna (bottom) relative to the user's head/ear. Graphic courtesy of Myers Johnson.

In a cell phone, the omni-directional antenna results in energy being directed 360° around the phone user (Figure 1, top). Thus, energy radiates out of the phone toward the hearing aid user which is not only wasted, relative to being useful to enhance cell phone communication, but is also the source of the interference with hearing aids. Using interferometry, the Vortis reportedly reshapes the energy directed at the head and hearing aid, redirecting it where it can be used to enhance connection with cell sites (Figure 1, bottom). The resulting benefits are not only a solution to the interference problem, but a performance advantage over standard antenna technology. Other reported benefits include a reduction in dropped calls, increased battery talk time, and improved clarity of voice.



The Vortis will be launched this month as an accessory device, attaching to the antenna jack (also called the RF connector, located on the back of the phone) of Nokia cellular phones. Because the Vortis array antenna is also embeddable, carriers and handset makers are evaluating the product for application in future cell phone models. The Vortis device, an accessory that is approximately 2-3 inches high by 1.5 inches wide and weighs less than 4 ounces, is placed on the upper rear of the body of the handset (Figure 2).

Figure 2. The array antenna attaches to the top of the cellular phone.

Study Design

In an effort to assess the viability of the Vortis antenna, a study was conducted with the assistance of CSG Better Hearing Center, Walnut Creek, CA. The purpose of this study was two-fold: Part 1 was designed to determine what, if any, of a cross-section of hearing aids were immune to the radio frequency energy coming from a cellular phone. Many hearing aid manufacturers have immunized newer hearing aids using gold shielding inside of the hearing aid. Part 2 of the study was to determine what effect an energy-shaping antenna like the Vortis would have on the hearing aids relative to RF interference, with particular attention to elimination of the annoying buzzing sounds on the hearing aids that were not immune.

Myers Johnson designed and built a test fixture with a capability to accommodate different cellular phones and hearing aids. The test fixture can locate the hearing aid and cellular phone to within the width of a human hair (±0.003 inch) and provide a relative location between the two devices in all three axis (up/down, side/side, and forward/back). Each hearing aid was oriented to a location that would mimic the position while situated in or on the ear while the user was using a cellular phone.

The most common cellular phone, the Nokia 5160, was used in the testing. This model is frequently given away free when acquiring a new service. During the testing, it was discovered that a variation of 5-10 mm (about 1/8th-inch to a half-inch) would not make much difference considering the proximity of the hearing aid to the cell phone speaker (a location described by the hearing aid standard). The test was conducted within a range of 5-10 mm. If there were extreme variations, the hearing aid and location were changed to confirm that the variation was caused by the hearing aid rather than the test fixture, cellular phone, or location.

In this preliminary test, measurements of sound pressure levels were not used. Instead, each hearing aid was graded as a simple pass or fail. If electromagnetic interference was present, as evidenced by a strong buzzing sound, then it was considered a fail on the test of immunity. If the buzzing sound was not heard, the hearing aid passed.

This test process included the correct location of the cellular phone and the hearing aid in the test fixture. A call was placed on the cellular phone and the examiner listened for the presence or absence of interference within the first few seconds where the transmission of the cellular phone would be the loudest. If a hearing aid passed the immunity test, the next device was tested. If a hearing aid failed the immunity test, the Vortis device was installed on that cellular phone and another call placed to see if the hearing aid would then pass.

Forty-seven popular hearing aids from 11 different manufacturers were tested. The hearing aids included 13 analog, 14 analog programmable, and 20 digital models and were either BTE (40 units) or ITE (7) styles. The 11 manufacturers and number of models from

each (in paraentheses) were Audivox (1), Bosch (1), GN Resound (9), Oticon (4), Phonak (5), Rexton (1), Siemens (10), Sonic Innovations (1), Starkey (8), Telex (1), and Widex (6). These devices were chosen to represent a cross-section of the hearing aids available today, as well as instruments that are a few years older that a hard-of-hearing individual might still be using.

Results

The first phase of the study revealed that all 13 or 100% of the analog non-programmable hearing aid models failed the immunity test. In addition, of the 14 analog programmable hearing aids tested, 13 (93%) of the devices failed while only 1 (7%) passed. Finally, of the 20 digital hearing aid models, 3 (15%) failed and 17 (85%) passed the immunity test.

In the second phase of the study, 100% of all the hearing aid models passed the immunity test when the Vortis array antenna was coupled with the Nokia model 5160 cellular phone.

Discussion

Using a pass/fail criteria, the Vortis device was 100% effective in eliminating electromagnetic interference between the hearing aids sampled and the specific cellular phone used in the study. This demonstrates that there is a technological and readily achievable solution to the hearing aid/cell phone interference problem. The Vortis array antenna coupled with select cellular phone models allows hard-of-hearing clients to simply pick up the cellular phone and use it normally without hearing the annoying buzzing sound that is currently present. In addition, the hearing aid will not need a telecoil, and the hard-of-hearing individual will not have to couple their hearing aid to the phone via an assistive device.

The manufacturers that have developed digital hearing aids with excellent shielding to prevent the electromagnetic interference from occurring are to be applauded. As a hearing care professional committed to providing hearing-impaired individuals with exceptional solutions to their communication challenges, I hope that all manufacturers will continue this trend as new products are introduced. Professionals should note that, while a large majority of the digital hearing instruments passed the immunity test, some (15% in this study) did not. Therefore, caution is warranted in thinking that, if the device is digital, there will be no problem with cell phone interference.

It should be acknowledged that the above study did not test a variety of cellular phone models, different transmission situations (eg, a range of proximities relative to the transmission towers, different locales, various cell phone transmission technologies, etc), or all hearing aid models (past and present), and it is possible that “results may vary.” Prudence suggests that one should evaluate each individual hearing instrument and cell phone for compatibility.

There may be a temptation to believe that the interference problem will be solved due to consumers’ preference for digital aids: between 1998-2002, sales of digital hearing aids rose from 7% to 45% of the market share, and 2002 fourth quarter sales were 53% digital.[3] While digital sales are increasing, the industry figures and this study actually suggest that a tremendous number of hearing instruments in current use are not immune to cell phone interference. Given that the average hearing aid replacement time is 7 years for current users (along with speculation that higher hearing aid costs are increasing the intervals between replacement),3 and the estimate that about half of all instruments dispensed in 2003 will be non-digital, there is a great need for providing the necessary assistance to hard-of-hearing clients who wish to use cell phones.

The Vortis cell phone accessory antenna represents a practical, affordable solution for most hearing aid users who desire to use cellular phones, and may represent a technology for cell phone manufacturers seeking to make their devices “hearing instrument friendly.”

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This article was submitted to HR by Mark J. Sanford, MS, a clinical audiologist and owner of CSG/ Better Hearing Center, Walnut Creek, Calif. Correspondence can be addressed to HR or Mark Sanford, MS, 31 Panoramic Way, 1st Floor, Walnut Creek, CA 94595; email: CSGBetterHearing@aol.com.

More information on Vortis technology can be obtained at www.thevortis.com.

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