
Multi-Center Clinical Experience Converting Patients to HiResolution™ Sound

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Introduction

HiResolution™ (HiRes™) Sound is the processing algorithm implemented in the HiResolution Bionic Ear System and programmed using the SoundWave™ software. With HiRes, the fine details of the full sound spectrum are analyzed, processed and encoded for delivery to the hearing nerve. HiRes sound is made possible by the advanced processing capabilities of the CII Bionic Ear™ and HiRes 90K implant electronics and can be implemented fully on the Platinum Sound Processor™, the CII BTE™, and the Auria™ processor.

Since the introduction of HiRes sound, many patients have been converted to HiRes from their conventional processing strategies. As a means of understanding the clinical issues involved in converting patients from conventional strategies to HiRes, a survey/questionnaire was completed by clinicians and patients from nine cochlear-implant centers. The results of the survey are summarized below, followed by two case studies in which patients—one adult and one child—had interesting experiences during the conversion.

Survey Results

Adults. Survey results were reported for 81 adults who had been switched from conventional to HiRes sound processing. Of those 81 patients, 16% had used conventional strategies for less than six months, 38% had used conventional strategies for 7-12 months, and 46% had used conventional strategies for over 12 months. Before the conversion, 40% of patients used Simultaneous Analog Stimulation (SAS). Of the SAS users, 94% liked and continue to use HiRes. Thirty-three percent used MPS before the conversion. All of the MPS users liked HiRes and use it daily. The remaining 27% used CIS. Of the CIS users, 91% liked and use HiRes. In total, 95% of the 81 adults who were converted to HiRes continue to use the new sound-processing system.

There were differences in the amount of time the adults required to adapt to HiRes. Forty-nine percent adapted to HiRes in just a few hours, 14% took a few days, and 12% took a week. More than two weeks were required by 25% of the adults. Of the adults who continue to use HiRes, 78% reported improved benefit compared to conventional

processing and 17% reported comparable benefit. Only 5% reported decreased benefit, and most of those patients switched back to their conventional strategy programs. For patients who did not like HiRes, the reasons they reported included (1) they did not want to try to adjust to a new sound (these patients typically were elderly or long-term deafened) or (2) they were good users of conventional strategies and did not want to risk changing their programs.

Patients also were asked to comment on their HiRes listening experiences. Some of their responses were:

Music sounds like music.

Music sounds like “I remember.”

Sound is clearer and smoother.

I can hear things that I couldn’t hear before.

My hearing has gone to “another level.”

Sound is more “natural” and “normal.”

Clinicians were asked to rate the ease of switching patients from conventional to HiRes processing on a scale of 0 (very easy) to 10 (very difficult). The mean rating was 1.7 for the adults.

Children. Survey results were reported for 52 children who had been switched from conventional to HiRes sound processing. Of those 52 patients, 14% had used conventional strategies for less than six months, 19% had used conventional strategies for 7-12 months, and 67% had used conventional strategies for over 12 months. Before the conversion, 67% of patients used Simultaneous Analog Stimulation (SAS), 23% used MPS, and the remaining 10% used CIS. All of the children who were converted to HiRes accepted and continue to use the new sound processing algorithm.

Of the children converted, 35% were between 19 months and three years of age, 37% were 4-6 years of age, 17% were 7-10 years of age, and 11% were 10 years old or older. There were no children younger than 18 months. As with the adults, there were differences in the amount of time the children required to adapt to HiRes. Twenty-five percent adapted to HiRes in just a few hours, 19% took a few days, and 23% took a week. Two weeks were required by 19% of the children, 3-4 weeks by 8% of the children, and more than four weeks by 6% of the children.

Parent or child reports of HiRes benefit indicated that 33% experienced improved benefit compared to

conventional processing and 63% experienced comparable benefit. Four percent reported decreased benefit, but most of those children had been using HiRes for only a brief period at the time of the survey.

Parents and children were asked to comment on everyday listening experiences with HiRes. Some of their responses were:

Speech sounds “clearer.”
Increase in verbal productions.
Increase in imitative productions.
My child hears more “accurately.”
My child hears “better in noise.”
One child reported “it sounds like my hearing aid.”
A 13 year old wrote “I really like this, it sounds very clear.”

Clinicians again were asked to rate the ease of switching children from conventional to HiRes processing on a scale of 0 (very easy) to 10 (very difficult). The mean rating was 2.9 for children.

Adult Case Study

A 61-year-old woman was implanted in her right ear with the HiResolution Bionic Ear System. She had progressive hearing loss of unknown etiology in both ears since the age of 18, with bilateral profound hearing loss since the age of 45. She used hearing aids in both ears at the time of implantation.

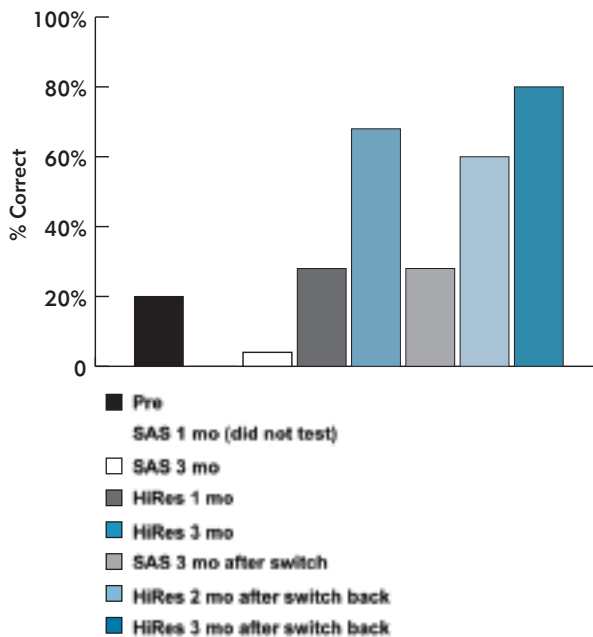


Figure 1. HINT-in-Quiet scores over time for 61-year-old patient programmed initially with SAS, converted to HiRes, converted back to SAS, and finally converted back to HiRes.

Figure 1 shows the HINT-in-Quiet scores over time for this patient. Initially, she was programmed in SAS. During her first three months of SAS use, she was unsatisfied and many adjustments were made to her SAS program. After

three months of SAS use, the patient was switched to HiRes. Following the conversion, the patient showed much better speech perception and continued to improve after three months of HiRes use. However, she complained that she could not hear as well with HiRes and insisted on switching back to SAS. After three months of SAS use, she was tested again and showed a significant decrease in performance compared to her three-month HiRes scores. The audiologist insisted that the patient try HiRes again and she was reprogrammed in HiRes. Two months later, the patient returned to confirm that she was doing better with HiRes. Her HINT scores then, and one month after, showed that she performed much better with HiRes compared to SAS and that she continued to improve when using HiRes.

Notably, this patient’s perception of benefit from SAS and HiRes did not match her clinical test results. The speech-perception scores were of great help in counseling this patient to try HiRes and to stick with it, demonstrating that HiRes provided improved benefit compared to SAS.

Pediatric Case Study

A six-year-old girl was implanted with the HiResolution Bionic Ear System in her poorer hearing ear and continues to use a hearing aid in her good ear. She used an SAS program for the first ten months of implant use and then switched to HiRes and has used it for three months. She was administered the Word Associations for Syllable Perception (WASP) test with her SAS program and after switching to HiRes. The WASP is a tool for developing a child’s phoneme perception and production. It uses simple pictures and toys that represent increasingly complex phoneme combinations. It is useful for developing a child’s perception-production feedback loop, and also for monitoring the function of the implant (Koch 1998). Figure 2 shows the child’s 10-month SAS scores and one- and three-month HiRes scores. After only one month of HiRes use, her benefit from HiRes sound processing was either equivalent or poorer than with her best SAS program. However, after three months of HiRes use, her HiRes WASP scores are equivalent or much better than the SAS scores, thereby showing a noticeable increase in benefit over a short period of time.

The child’s speech-perception scores for the Lexical Neighborhood Test (LNT) and Multisyllabic Lexical Neighborhood Test (MLNT) (Kirk et al. 1995) are shown in Figure 3. Her ability to recognize words using HiRes is significantly better than with SAS.

In sum, this child’s speech perception is much improved with HiRes compared to her conventional strategy. In addition, she now will use her implant alone (no hearing aid) for longer periods, and reports that her implant now “sounds more like my hearing aid.”

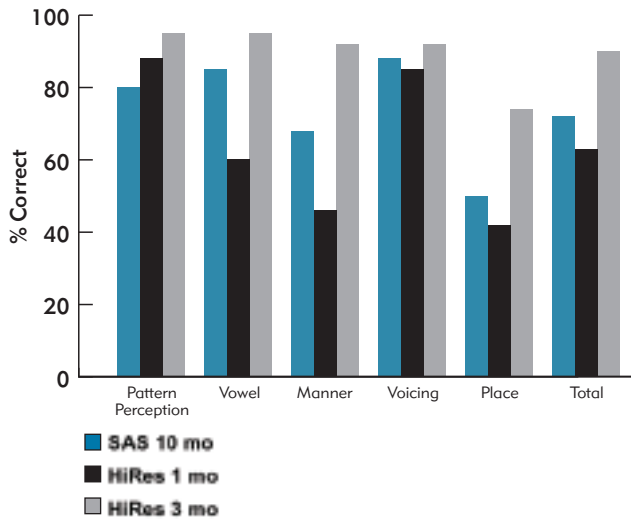


Figure 2. WASP test results for six-year-old child with conventional SAS strategy and after converting to HiRes sound processing. HiRes results were obtained at one and three months after conversion.

Summary

Based upon clinical experience with 133 patients to date, the procedures for converting to HiRes are easy, and almost all patients can be converted to HiRes with little or no difficulty. The majority of patients show improved benefit with HiRes and most of them eventually prefer HiRes to conventional sound processing. As with any implant system change, the clinician should provide support and encouragement, and should counsel users to be patient when learning to listen with the new sound-processing system. Obtaining speech perception data at each test session can be a helpful tool in counseling patients.

REFERENCES

- Kirk KI, Pisoni DB, Osberger MJ. (1995) Lexical effects on spoken word recognition by pediatric cochlear implant users. *Ear & Hearing* 16:470-481.
- Koch M. (1999) *Word Associations for Syllable Perception*. Timonium MD: York Press.

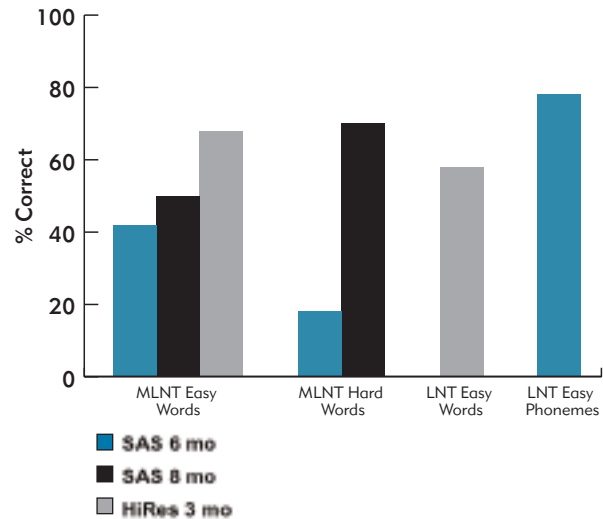


Figure 3. Word and phoneme recognition for six-year-old child with conventional SAS strategy and after converting to HiRes sound processing.

Participating audiologists and centers

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