

Loud & Clear!



A Cochlear Implant Rehabilitation Newsletter

Issue 1 2005

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CLINICAL RED FLAGS for slow progress in children with cochlear implants

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In the early years of pediatric cochlear implants, it was difficult for clinicians to judge whether a child was making adequate listening progress with the implant. This was due to the small number of children who had been implanted and the heterogeneity of the population. With each implant center seeing only small numbers of children who represented wide ranges of age and communication styles, how were clinicians to set accurate expectations? Should a signing child implanted at age nine be expected to achieve listening milestones at the same points in time as an oral child implanted at age two?

Now that large numbers of children have received implants and published studies document their function, we know much more about how the average child performs in the first year of implant use. It is, therefore, possible to set auditory benchmarks for listening skill development (Tables 1, 2, 3). These benchmarks are based upon average performance and can never be used to

predict the exact outcome for a given child. Nonetheless, clinicians should be familiar with the sequence and time course of listening skill development in children with cochlear implants so they can raise a red flag of concern when a child is performing substantially lower than expected.



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WHY IDENTIFY RED FLAGS?

The acquisition of listening is a developmental process that involves a sequence of cumulative skills—one skill depends upon the acquisition of earlier skills. For this reason, delays early in listening development often lead to long-term delays, and long-term delays usually lead to life-long deficits, clearly an undesirable outcome. Clinicians should be familiar with the range of progress in typical children

progress than to adopt a wait-and-see approach. The author's clinical experience has led her to have a high index of concern about a child's slow progress rather than a wait-and-see approach. The earlier a concern is raised about a child's inadequate progress, the sooner the problem can be addressed and, often, remedied.

What Is Considered a Red Flag?

Clinicians are accustomed to combining test information with clinical experience

three months delayed on a given skill, raising an initial red flag is appropriate. An initial red flag is an expression of mild concern. A delay of six months requires flying two red flags vigorously. *The greater the number of skills that are delayed at an interval, the more substantial the concern.*

A child who is behind in only one skill at a given interval is considered in need of a little more attention, whereas a child who is behind in many skills requires a serious look at multiple factors. For example, if a child in Group 2 has achieved all but one of the six skills (e.g., spontaneous recognition of own name versus others' names) expected by nine-months post-implant, we would make a note to emphasize this skill at home and in therapy. On the other hand, if a Group 2 child at nine months post-CI had only achieved one of the six skills expected, there should be a much higher level of concern.

The last benchmark in each group is "Major improvement in language." Major improvement refers to either a noticeably faster rate of language learning after implantation than before, or a full year of language growth during the first year of implant use. This benchmark is based upon research that shows the average child with an implant makes one year of language progress in one year's time. This benchmark is based upon research that shows dramatic increases in many children's rate of language growth after implantation as compared to their preimplant rate.²



with implants so they are comfortable raising a red flag when a child's performance lags behind that of peers. **However, it is important to note that what we term a red flag is not a diagnosis of a problem or a statement of permanent disability, but a notice to pay attention to the skill.** Experience suggests it is preferable to have a high index of concern about a child's slow

and intuition when evaluating how well children are performing. Common sense requires that clinicians use the same approach to distinguish a minor concern from a serious concern when it comes to red flags. The most important factors about severity of concern relate to: a) the length of the delay and b) the number of skills delayed. Clinical experience suggests that if a child is more than

Tracking Auditory Progress in Children With CIs

What are the auditory benchmarks for average progress in CI children during the first year of implant use? Auditory benchmarks have been established independently for three groups of children, based upon research findings and clinical experience.^{1,3-6}

These groups are:

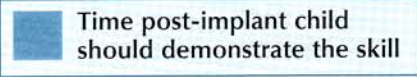
GROUP 1: Children implanted in the preschool years (age four or earlier).

GROUP 2: Children implanted at age five or later with some residual hearing/speech perception skills who have consistently worn hearing aids and who communicate primarily through speech.

GROUP 3: Children implanted at age five or later with little or no residual hearing/speech perception skills who are highly dependent on sign (and other visual cues) for language learning.

The benchmarks shown for each of the three groups in Tables 1, 2, and 3 are based on data collected and reported by the investigators cited above.

*Note that full-time implant use is an unconditional prerequisite to auditory development. If a child is not wearing the implant during all waking hours—at home, school, and other activities, these benchmarks are not applicable. *Children who fail to bond to their device and to wear it full-time within a few weeks of initial stimulation may exhibit insufficient progress and are at high risk of becoming non-users of their implants.*

Tracking Auditory Progress in CI Kids					
Note: Child is credited only for skills in listening-alone condition. Spontaneous means without prompting or modeling, and when not in a listening set.					
					
Table 1 GROUP 1: Children implanted at age four years or earlier					
Skill	1 mo.	3 mos.	6 mos.	9 mos.	12 mos.
1. Full time use of CI	■				
2. Changes in spontaneous vocalizations with CI use		■			
3. Spontaneously alerts to name 25% of time		■			
4. Spontaneously alerts to name 50% of time			■		
5. Spontaneously alerts to a few environmental sounds			■		
6. Performance in audio booth consistent with what is reported at home				■	
7. Evidence of deriving meaning from many speech and environmental sounds					■
8. Major improvement in language					■
Table 2 GROUP 2: Children implanted at age five years or older (Some residual hearing, consistent HA use prior to CI, primarily oral)					
Skill	1 mo.	3 mos.	6 mos.	9 mos.	12 mos.
1. Full time use of CI	■				
2. Understands some words or phrases closed set		■			
3. Understands many words or phrases closed set			■		
4. Spontaneously alerts to name 50% of time			■		
5. Understands familiar phrases in everyday situations when listening auditory alone			■		
6. Spontaneous recognition of own name versus names of others				■	
7. Knows meaning of some environmental or speech signals when heard auditory only					■
8. Major improvement in language					■
Table 3 GROUP 3: Children implanted at age five years or older (Limited or no residual hearing, limited or no HA use, heavily rely on visual cues or signs)					
Skill	1 mo.	3 mos.	6 mos.	9 mos.	12 mos.
1. Full time use of CI	■				
2. Begins to discriminate patterns of speech (syllable number, stress, length, etc.)		■			
3. Understands some words in closed set			■		
4. Begins to spontaneously respond to name			■		
5. Reports when device is not working (i.e., dead battery)				■	
6. Understands many words or phrases in closed set					■
7. Understands a few things open-set					■
8. Major improvement in language					■

What Do We Do About Red Flags?

Clinicians first must know the typical performance benchmarks of CI children to spot those who are not making at least average progress. Once clinicians are able to spot those students, what is next? There is little value in raising a red flag for a listening skill unless we can suggest ways to monitor and improve that skill. Remember that a clinical red flag is not a diagnosis of a problem, but an indication that increased attention needs to be given to a specific skill area.

ONE-FLAG RESPONSES. The typical first response is to pay increased attention to a specific skill, which can take a number of forms. Table 4 contains suggestions for one-flag responses including speaking to parents, getting information about the child’s listening at home, checking CI equipment, examining whether prerequisites to a skill are not adequately established, assessing whether the environment has created a need for the child to use the skill, using different materials, increasing the intensity of training toward the skill, tallying how many opportunities the child has to practice the skill at home and school, writing a plan of action, and checking monthly for three months.

IMPLANT EQUIPMENT AND PROGRAMMING—WORKING AS A TEAM.

The functioning of the cochlear implant is always considered a possible source of change when dealing with red flags because it provides the child access to the listening world. Clinicians should be familiar with the basic steps to verify proper device (i.e., sound processor) function and troubleshooting procedures. Clinicians will want to share their red-flag concerns with the implant audiologist who may suggest further device troubleshooting procedures, equipment changes, or possible reprogramming of the implant, just to name a few. Because a child’s slow progress is viewed as the entire team’s concern, not just the teacher’s, a collegial approach is essential.

If a child in my practice is not making adequate progress, I often will call or email the CI audiologist about my concern. The two of us discuss possible sources of the problem, and the audiologist will often suggest that the child be seen for a CI check. When possible, I try to provide specific observations, such as, *Three months after initial stimulation, David still doesn’t alert to his name; Tommy imitates the s sound by making a high-pitched squeal; or Sally doesn’t pick the correct object out of a small closed set.* Depending upon my concern, the audiologist may offer an opinion about whether (s)he

TABLE 4: HOW TO RESPOND TO ONE RAISED RED FLAG



- Share ideas with child’s parent
- Confirm child wears CI all waking hours
- Contact CI Center regarding possible equipment/programming changes
- Assess that home/school environment creates a need for child to use the skill
- Verify that prerequisites to a skill are adequately established
- Break down skill into smaller steps, and teach those steps
- Use different materials/teach the skill in another way
- Increase the intensity of training toward the skill
- Write plan of action/check every month for three months

TABLE 5: HOW TO RESPOND TO TWO RAISED RED FLAGS



- Share concern with child’s parent
- Confirm child wears CI during all waking hours
- Contact CI Center regarding equipment/programming changes
- Utilize any 1-flag response
- Change in teaching methods/techniques
- Add sensory modality
- Consult with a colleague for new ideas
- Refer for learning profile testing
- Refer to specialists to rule out additional disabilities

feels the problem is device-related or not. The audiologist sees the child, may make some alternate programs, and then asks the parents and me to observe the child's listening behaviors when using these programs.

The fact remains that slow listening or language progress may not be device related, but rather related to issues internal to the child or part of school or home. Thus, clinicians who refer to the CI center for re-assessment may learn that the implant is functioning optimally and should be prepared to initiate other changes in the child's situation. Audiologists who see the children with red flags and find no device-related concerns should still use the opportunity to counsel parents. In particular, the audiologist plays a pivotal role in reinforcing the importance of children reaching listening benchmarks in a timely manner. Our goal is to work in concert so that the family feels supported and informed.

TWO-FLAG RESPONSES. If delays have persisted over time and place the child six months or more behind expectations, two-flag responses are appropriate (see Table 5). Two-flag alerts are considered more urgent and of greater concern. Possible two-flag responses include repeating any of the one flag responses, contacting the CI center to reconsider programming changes, changing teaching method or techniques, requesting consultation from a colleague to give new insight or ideas, referring to specialists for an outside expert opinion, among others.

Discussing Red Flags with Parents

One of the first responses to red flags is to communicate with the child's parents in a supportive way. As always, *how* we share concerns with parents is as important as *what* we share. Remember that parents may have insights that will put things into perspective, help us understand a child's behavior, or unlock a door to learning for their child. Our interaction with parents regarding red flags is different at the two intervals. At the one-flag level, we talk to the child's parents with the goal of making them more aware of a particular skill and of learning more about the child's functioning in the home environment. We would not express undue concern to the parents but simply make them aware of the areas to which more attention should be devoted. I might say to a family, *I've been so pleased*

with Susie's growth in confidence, but I'm puzzled that she doesn't respond to environmental sounds consistently. What have you noticed at home? I'd like to work together to get more spontaneous responses from her. Let's talk about ideas for doing that and meet again in a few weeks to see what changes we've seen. At the two-flag level, contact with parents should include an expression of concern regarding the child's slow progress, relative to average CI children with similar characteristics, and ideas for a specific plan of action. I once explained to a family of a child in Group 2, *I haven't found a good way to teach Penny to recognize common phrases in a closed set through listening. This is an important skill because it is the foundation for other skills. It is also required on almost any test Penny will take. Let's brainstorm*



about what might be happening here. Referral for a multidisciplinary evaluation revealed that Penny had significant deficits in her working memory, attention, and processing speed, most likely as a result of meningitis. I needed to break tasks into smaller units, practice them, and slowly build to more complex units. I restructured teaching to always include visual trials at the onset to establish the task, transferring to audition once Penny was successful. We also limited the sets to only two

items, practiced at that level, and slowly increased set size.

Penny's case is an example of slow progress that can be addressed but probably not fixed. Her underlying cognitive processing makes her a slower learner who requires more time at each level of instruction. Identifying the red flags did not make her process faster but it motivated us to seek advice that keeps her moving along the auditory continuum, even if at a slower rate.



Understanding what is a reasonable rate of progress for Penny has taken pressure off her parents who previously became frustrated and impatient with their daughter. They still have high expectations for her, but recognize the challenges she faces. Their acceptance of Penny's unique learning needs has freed them to praise her genuinely when she accomplishes new skills and has established a more relaxed environment in the home.

DOES THE CHILD REALLY HAVE FULL-TIME USE OF THE COCHLEAR IMPLANT? Another important factor to discuss with parents is whether or not the child wears the implant during all waking hours without resistance. Slow or spotty auditory progress can be a sign of inconsistent device use because the child does not receive steady and predictable input from the environment. Research suggests that a young child's neural networks are built and mature with increasing implant experi-

ence. Specifically, connections must be established and nurtured between the auditory and visual cortices of the brain with consistent sensory input.⁷ For example, every time a child sees the dog's mouth move, the child hears an accompanying barking sound.

Some children, particularly those implanted at older ages, may associate wearing a sensory aid only with school. They remove the implant on the bus ride home or take it off after dinner

for the remainder of the evening. Similarly, acceptance of full-time device use may be difficult for some very young children. Some parents who have behavioral management issues may not have gained compliance from their child. Parents allow the child to take the implant on and off at will rather than confront the child and deal with a tantrum. To achieve true full-time device use, the parents may need to use a behavior reinforcement system or seek intervention from a behavior specialist.

Red Flags and Children Who Use Sign Language

Maintaining adequate progress in the first year of device use is important for any child who receives an implant. However, programs that include the use of sign language must be especially vigilant about listening development because learning is occurring in multiple modalities. Teachers in signing programs have a complicated task: They must instruct and evaluate their students' progress in both an abstract visual language and an abstract auditory-oral language. Thus, careful monitoring of listening development is essential. Data have shown (and our red flag tables reflect) that even for older-implanted children who use signs, improvements in listening skills are observable after only three months of full-time implant use.³

I once shared with a parent of a child in Group 3, *Steven has had his implant for a year, but didn't respond spontaneously*

when I called his name during the evaluation. Most children like Steven start doing that after only six months of implant use and are doing it frequently by now. We need to talk about how you get his attention at home and how his teachers do so at school. I'm concerned that if we don't establish this skill soon, Steven's progress with his implant will lag further and further behind.

It came to light that both parents and school staff had always tapped him on the shoulder, stomped on the floor, or waved their arms to get his attention. After implantation, they continued to do so, but also called his name. They believed that by adding a spoken cue, Steven would get good multisensory input and would figure out to pay attention to voice (the "more is better" philosophy). In fact, Steven would not learn to attend to his name being called **until the environment created a need** for him to pay attention through listening. The parents began to see the need for meaningful use of listening in the environment and changed their behavior, communicating an expectation for listening. They were able to establish name-recognition at home within a matter of weeks. This need to listen was not established in the classroom, however, even after discussions and suggestions to the teachers. Steven's placement was changed to a different total communication class where strong emphases were placed on speaking and listening.

Steven's case is an example of a child who is given an implant and then

placed in a setting where two important components are missing: 1) the presence of staff who are knowledgeable and experienced in auditory development and 2) a communication environment in which a need for listening and speech are addressed appropriately on a daily basis. Unfortunately, students such as Steven may learn isolated skills that they can perform with their cochlear implant, but often demonstrate little benefit from the device in real-world



communication situations.⁸ Such children need red-flag monitoring more than anyone.

Red Flags, Clinical Sensitivity, and Caveats

The auditory benchmarks listed here form only a skeletal outline of the sorts of skills typically seen in implanted children. Many fine materials exist to encourage development of these skills. We have only addressed listening development in the first year of device use

although clearly, this process is much longer and more complex. Clinical judgment will determine the appropriateness of applying red flags to children who have multiple disabilities. In many such cases, the sequence of listening development remains valid, although the time course of learning will be considerably longer and the ultimate achievement level unknown. In other implanted children with multiple disabilities, listening milestones may be irrelevant. In general, the more severe

the additional disabilities are, the more severely altered is auditory development. As an educator, audiologist, or parent, you know that group performance data provide guidance for setting expectations. Your work, however, ultimately focuses on the individual child. Each child may represent the exception, not the rule. For this reason, it is important to set and maintain expectations that take into account the unique abilities and life circumstances of each child and his or her family.

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