

Audiology Online

FM Systems with Cochlear Implants

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I am presently working with a five-year-old preschooler with a cochlear implant in a public school setting. Our educational team is beginning to discuss her transition to the regular kindergarten classroom next year. Some of our teachers use FM systems. Would that benefit this child? Would it interfere in any way electronically with her implant? Any suggestions to make her transition easier would be appreciated.

The typical classroom presents a very difficult listening situation for a child with hearing impairment. In a typical classroom, the child must overcome three main problems- reverberation, background noise and distance from the speaker. There are many modifications that can be made to reduce reverberation and background noise in the classroom such as:

- Removing noise sources.
- Increasing distance from noise sources.
- Reducing areas of hard, sound-reflective surfaces.
- Increasing areas of soft, sound-absorbing surfaces such as acoustic tile, carpet, bulletin boards, drapes, and tennis balls on chair and desk feet.

Favorable listening conditions may be further achieved by decreasing the physical distance between the child with the cochlear implant and the teacher (preferential seating) or the use of a Frequency Modulated (FM) system.

An FM system is composed of a teacher worn microphone/transmitter and a frequency tuned receiver coupled to the child's cochlear implant processor or a speaker positioned close to the child. Authorized FM transmission ranges vary from country to country. In the USA, FM transmission is limited to 72-76 MHz and 216 MHz. These systems do not interfere with the implant transmission frequency and therefore can be safely used by children with cochlear implants.

Personal FM receivers are worn on the body and attached directly to the child's cochlear implant sound processor by means of a special FM adapter cable. With soundfield FM systems, where the teacher's voice is transmitted to one or more loudspeakers positioned near the child, no direct coupling is necessary to the sound processor. The wireless teacher-worn transmitter/microphone is identical for both personal and soundfield FMs. The table below summarizes the advantages and disadvantages for using personal or soundfield systems.

PERSONAL FM SYSTEMS		SOUNDFIELD FM SYSTEMS	
Advantages	Disadvantages	Advantages	Disadvantages
Optimal signal to noise enhancement (+20 to +30dB)	Direct connection to the FM may cause interference	No direct connection between CI and Fm	Smaller signal to noise advantage (+10 to +20dB)
Portability	Sound quality and consistency cannot be monitored by teacher	Teachers can easily monitor sound quality and consistency	"Fixed" speaker classroom systems are not easily portable
Can be worn outside during sporting activities, field trips		Desktop systems are portable	Cannot be easily used outside

When fitting a personal FM to a child with a cochlear implant, it is important to consider audio mixing. Audio-mixing allows the child's processor microphone to remain on when connected directly to an FM. This is important in order for the child to hear his own voice and sounds around him in addition to the teacher's voice transmitted through the FM. Audio-mixing also allows the child to continue to hear, even when the FM transmitter is temporarily not in use. Depending on the type of cochlear implant processor a child uses, the ratio between the FM microphone and the processor microphone can be adjusted to meet a child's unique needs.

Young children typically do not have the language skills necessary to report on signal quality. As a consequence, many clinicians are reluctant to make personal FM recommendations for young, inexperienced cochlear implant users. In cases where monitoring of signal quality and consistency are an issue, soundfield FM systems may be a practical alternative to the personal FM, since it is immediately apparent to the teacher when the system is not operating optimally. Your question refers to a five year old child. If this child has enough experience and language to report sound quality, then a personal FM can be considered as well as a soundfield FM.

Many teachers have reported noticeable benefits from the use of FM systems with cochlear implants in classrooms. However, each child is unique and the benefit of an FM system should be evaluated for each child. Should you decide to try an FM for this child with a cochlear implant, the following recommendations should be considered.

- In group discussions, try to pass the teacher's microphone to each child who speaks.
- If two transmitters are being used in the same classroom, e.g. in a team teaching situation, ensure that the transmitting frequency channels are as distinct as possible. Remind children to change channels as they move from group to group.
- If you are using the FM transmitter with a group that does not include the child with the cochlear implant, remind him to disconnect his FM receiver from the sound processor. Alternatively, he may turn down the FM volume control on the FM receiver, provided a separate environmental microphone is available on the unit.
- When working with a small subset of children and a multiple speaker soundfield FM, remember to switch off all speakers except the one closest to you, so that other groups of children are not distracted.
- For multi-media lessons e.g. on TV, tape or video, place the transmitter microphone near the sound source, or alternatively connect the TV directly to your transmitter via the auxiliary input jack (switch to AUX only or MIC/AUX settings)

Cochlear implant centers, parents and educators are encouraged to contact the cochlear implant and FM manufacturers for assistance in addressing specific fitting issues.

Dr. Patricia Trautwein received her Masters Degree in Audiology from the State University of New York (SUNY) at Buffalo and her Doctorate of Audiology from the University of Florida. Patricia worked for several years as a research associate at the SUNY's Center for Hearing and Deafness Research. She joined the House Ear Institute as a pediatric audiologist where she was actively engaged in diagnostics, amplification, cochlear implants and research. Currently, Patricia is the Manager of Auditory Education and Training at Advanced Bionics Corporation. Patricia has authored and co-authored several publications on auditory hair cell regeneration, auditory plasticity and cochlear implantation.