MORE THAN MEETS THE EAR:
UNDERSTANDING AND OPTIMIZING YOUR CHILD'S EARMOLDS

by Brad Ingrao, M.S.Ed., CCC-A

When I was asked to write this article, I posted a message to several e-mail listservs asking what parents wanted or needed to know about earmolds. Hopefully, since these subjects were nearly universal in my sample, they will reflect your needs as well. As David Letterman says (kind of), "From the home office in Washington, DC, here's the Earmold Top 10 List" (minus 2).

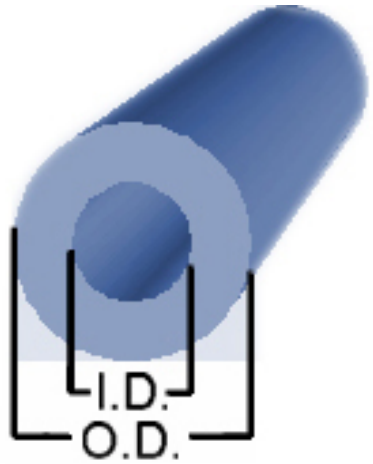
I. HOW CAN FEEDBACK BE REDUCED?

Feedback (a.k.a. whistling, singing, beeping) occurs when sound escapes from the earmold and is picked up by the microphone and re-amplified in an endless loop. Unless your kid is singing "I'm Popeye the Sailor Man [toot, toot]" there is no good reason for feedback to be a part of your life. When confronted with feedback, I generally take an "outside - in" approach.

Tubing

When I begin searching for the source of feedback, I remove the earmold and hold my finger over the end that goes into the ear. Then I turn the hearing aid up all the way Often, I hear a faint (or not so faint) "eeeeeeeeeee" coming from the tube. Earmold tubing is described by its inside and outside diameter, as seen in Figure 1.

FIGURE I



The larger the difference between the Inside Diameter (ID) and outside diameter (OD), the thicker the tube. Standard tubing is labeled #13 Medium and has an inside diameter of 0.076 inches and an outside diameter of 0.122 inches , making the thickness of the tubing 0.046 inches.

A #13 Super Heavy tube has the same inside diameter, 0.076 inches , but the outside diameter is 0.142 inches, making the thickness 0.066 inches. This thicker tubing contains sound better and reduces feedback often found with super power hearing aids. The other major reason for tubing-related feedback is a crack or hole in the tube. After 6 to 8 months, tubing will become yellow and hard, at which point it should be replaced.

Acoustic Seal

If the tubing checks out, my next step is to replace the mold and look at how it sits in the ear. Figure 2 shows the typical landmarks of the outer ear, or pinna.

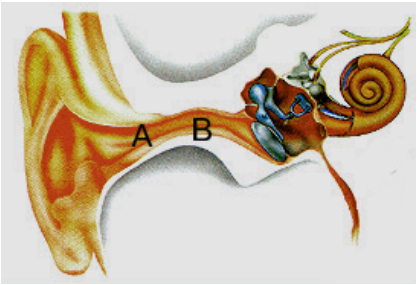
FIGURE 2

A. Helix
B. Tragus
C. Inter-Tragal Notch
D. Anti-Tragus
E. Concha
F. Anti-Helix

Since most of our kids have moderate-to-severe or worse hearing loss, earmolds typically will have an extension that tucks into the helix called, a *helix lock.* Helix locks are great *if they fit.* Many kids, and even adults, have trouble getting them in all the way. A misplaced helix lock can cause the mold to tip out of the ear slightly allowing sound to "leak" out causing feedback. Most kids have molds that fill the concha (see Figure 2), called a shell. With all that contact in the pinna, you'd think that these areas were the most important for feedback control, right? Actually, not. While these exterior points of contact can help with retention (holding the mold in place) the area

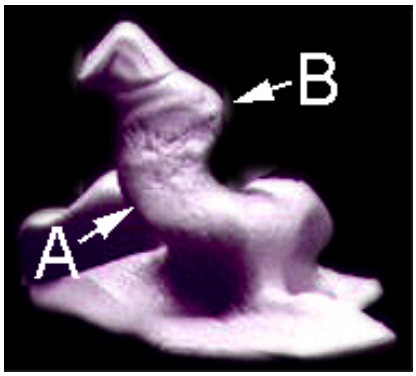
responsible for acoustic seal is farther in. Let's look at Figure 3.

FIGURE 3



Here we see a cut-away view of the ear. If you've ever looked at the ear impression taken for an earmold, you should have seen that the ear canal bends twice. The first bend (A) is the most important spot on the mold as far as feedback is concerned. A poor fit here will almost guarantee feedback. If the mold fits properly at this point in the ear canal, an *acoustic seal* will be achieved, which means no sound will leak out around the mold. When ear impressions are taken, it is a good rule of thumb to have the impression be as long as the second bend of the ear canal (B). These same locations are marked on an ear impression in Figure 4.

FIGURE 4



An accurate impression is the key to feedback control. Many of us have had traumatic experiences at the audiologists trying to get impressions. My best advice is to find someone who has a great deal of experience with young kids and takes earmolds very seriously. Have them fully explain the procedure to you *and* your child.

Impression material is less of an issue than the consistency of that material at the time it is injected into the ear. Generally, the firmness of the material as it enters the ear should increase as the hearing loss becomes more severe.

2. HOW LONG SHOULD EARMOLDS LAST?

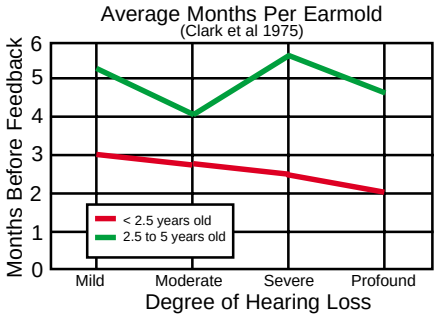
While there are no hard and fast rules, the general rule of thumb is that the younger the child and more severe the loss, the more frequent the need for new earmolds. In 1975, Clark and colleagues documented the average life of earmolds for 52 children. Molds were replaced at the first appearance of feedback. Their results are shown in Table 1.

TABLE 1

	Average Months Per Earmold (Before feedback occurs)	
Degree of Loss (Pure Tone Ave.)	**Child's Age** < 2.5 years	2.5 - 5 years
Mild (30 - 55 dB)	3.0	5.2
Moderate (56 - 75 dB)	2.7	4.1
Severe (76 - 90 dB)	2.5	5.6
Profound (91 - 110 dB)	2.0	4.6

For those of you who are visually oriented, like me, the same data are represented in Figure 5.

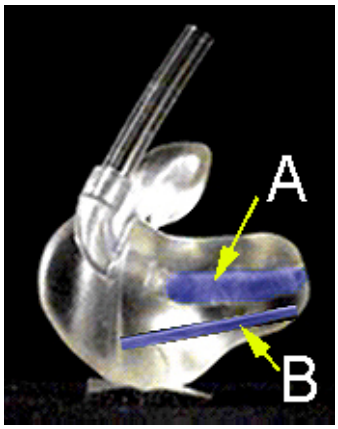
FIGURE 5



3. WHAT IS THE EFFECT OF VENTS, DIFFERENT TYPES OF TUBING, ETC.?

One of the great things about earmolds is they allow us to fine tune the response of the hearing aid to better match the hearing loss. This is achieved primarily with bore modifications and venting. Figure 6 shows the bore (A) and vent (B) of a typical shell type earmold. Let's talk about each of these parts and the role they play in the earmold fitting.

FIGURE 6



The bore is the drilled hole that sound from the hearing aid travels down. If the bore has the same inside diameter all the way through, the amplified sound from the hearing aid will not be changed. If the inside diameter increases, high frequency sounds are increased in intensity. If the inside diameter gets smaller, the reverse is true. This can have a negative effect on hearing for two reasons. First, most of our kids have worse hearing at higher frequencies and need all the help they can get to hear those sounds. Second, the most important speech information occurs at mid and high frequencies. The real problem is that many of our kids have earmolds that reduce high frequencies without us even

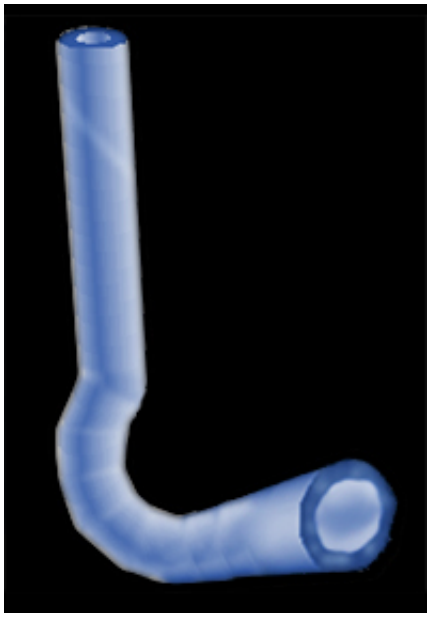
knowing it. Many earmolds are made by drilling the bore and then attaching a tube through the bore with glue. In order for the tube to stay in place, the inside diameter of the bore has to be smaller than the outside diameter of the tube. If this is done carefully, the negative effect is minimal. Over time however, the glue reacts with the tubing and causes it to shrink. The result is an inside tube diameter that is smaller at the end than at the beginning. Norm Schlaegel, president of Pacific Coast Labs developed a solution to the inconsistency of the glued in tube. The Continuous Flow Adapter (CFA) is a snap-in tube connector that connects to a vinyl ring cemented into the mold and verifies the inside diameter of the tube (see Figure7).

FIGURE 7

This joint is very convenient because it swivels, reducing the twisting that often occurs as a BTE is swung over the ear. It also allows parents to replace the tubing in about three seconds without having to drag Junior down to the audiologist's office. I actually tested the "3 second rule" by having my 9 year old son change the tube on his CFA earmold, and he made it with about a half a second to spare.

While keeping the internal diameter consistent ensures we don't *subtract* from the hearing aid response, there are times when the hearing aid can't provide enough output alone. By modifying the bore of the earmold, we can improve on the hearing aid response. The classic example of this is the Libby Horn (Figure 8).

FIGURE 8



The inside diameter of this tubing gets larger along the length of the tube. When properly used, the Libby Horn increases the output of the hearing aid by about 10 dB SPL between 3000 and 4000 Hz.

Another way to enhance the performance of the hearing aid is by using bore modifications in conjunction with the CFA adapter. While there are many possibilities within the CFA family, we're going to focus on the three most common bores for the losses our kids have.

• The CFA Bore #1 doesn't change the response of the hearing aid at all. If the hearing aid is able to do the job on its own, the bore #1 will ensure consistent amplification without tube shrinkage.

• The CFA Bore #2 adds up to 12 dB SLP to the response of the hearing aid at 4000 Hz. If the hearing aid isn't able to provide enough amplification at 4000 Hz (that's where the "s" sound is), the Bore #2 can help in most cases.

• The CFA Bore #5 with a "reverse curve" adapter adds about 10 dB SPL below 1000 Hz and reduces response above 2000 Hz by about 10 dB SPL. This is helpful when there is no hearing in the high frequencies. The acoustic boost in the lows improves sound quality, while the reduction above 2000 Hz helps prevent feedback.

Venting

The two reasons to vent an earmold are to relieve pressure and reduce low frequency response. If your child has a sharply sloping hearing loss where the hearing at 1000 Hz and below are better than 40 dB SPL, but the hearing above 2000 Hz is worse than 65 dB SPL, a small to medium vent is reasonable. For flatter or more severe losses, a very small pressure vent may be all that's possible before our old friend feedback sneaks back in.

4. WHAT MATERIALS ARE AVAILABLE AND WHAT IS THE DIFFERENCE BETWEEN THEM?

Earmold materials fit into three categories. While each lab has minor variations, the benefits and limitations are the same.

Acrylic or Lucite is a crystal clear

synthetic plastic resin that is rigid at all temperatures. It can be heat or cold cured. Lucite is recommended for mild to moderate hearing losses. It does not shrink over time. Lucite is easy to grind and buff. Tubing can be easily glued into Lucite. Most audiologists do not recommend Lucite for young children.

Vinyl is softer than Lucite and is used when a tighter acoustic seal is needed, and can be used for up to profound losses. It is relatively easy to grind, but requires solvents to buff. While it does shrink over time, it works well with children, since they usually out grow the mold before it shrinks too much.

Silicone is softer still and is often recommended for feedback reduction. It is very difficult to grind and just about impossible to buff. Most of the feedback reduction occurs because the tubing is squeezed very tightly or held with a brass "tube lock", both of which reduce high frequency response.

Weighing all the pros and cons, I prefer vinyl, and use it for my son's earmold. He has a severe loss that is relatively flat across all frequencies.

5. WHAT IS THE BEST WAY TO CLEAN EARMOLDS?

Warm water and mild soap is best for all materials. NEVER use alcohol to clean silicone. Cleaning vinyl molds regularly can help slow the eventual shrinkage.

6. WHAT KINDS OF COATINGS ARE AVAILABLE TO STOP FEEDBACK TEMPORARILY?

There are several commercial products available from your dispenser or audiologist. In a pinch, Corn Huskers lotion or water-based lubricants like K-Y Jelly can be used. Petroleum products like Vaseline can break down the surface of the mold and should be avoided.

7. IS THERE ANY GOOD USE FOR OUTGROWN EARMOLDS?

It's a good idea to keep the most recent pair just in case and use the suggestions above as needed. Other than that, audiology students always need molds to practice modifications on, so pack them up and ship them off to your local college. If all else fails, they make interesting Christmas tree ornaments.

8. HOW CAN WE GET THE MAXIMUM BENEFIT OUT OF THE EARMOLDS?

Being members of the Alexander Graham Bell Association, subscribing to Volta Voices and taking an active role in your child's hearing care are great ways to start. In addition, becoming connected to other parents via the Internet can keep you abreast of new developments or creative uses of older technology. Develop a collaborative relationship with your audiologist and work together to find workable solutions. Last but not least, take your child's earmolds seriously. They deserve as much research and care as the hearing aids they're attached to.

ACKNOWLEDGEMENTS

- Norm Schaegel, president Pacific Coast Laboratories, for tubing diameter data
- Figures 1 and 8 © 1999 BradleyB. Ingrao, MSEd
- Figure 2 courtesy of BernafonMaico Hearing Instruments www.bernafonmaico.com
- Figure 3 courtesy of Oticon Inc. www.oticonus.com
- Figure 4 courtesy of BMT Hearing Products www.bmtproducts.com
- Figures 6 and 7 courtesy of Pacific Coast Laboratories www.pcl-cfa.com

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Brad Ingrao received his Masters Degree in Audiology from the State University of New York. During the day, he is a mild mannered audiologist at a great metropolitan hospital. At all themes, he is the proud father of a Deaf son and a hearing daughter. Prior to becoming an audiologist, he worked as a Sign Language interpreter and have been an active member of local, state and national associations for the Deaf and Hard of Hearing for over 15 years. In his "spare" time, Brad is the editor of the Electronic Deaf Education Network, an informational website for families of Deaf and Hard of Hearing Children at **http://www.bradingrao.com**