Fitting Complications of Small and Distorted Ear Canals

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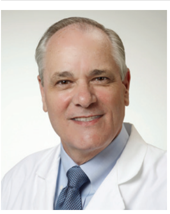
Coupling the earmold or dome to the ear canal is crucial to ensuring audibility across speech and environmental sound frequencies. Different degrees and configurations of hearing loss require different acoustic strategies. Flat and high-frequency ski slope hearing loss configurations are at opposite ends of the occlusion spectrum. Hearing aid fitting for a flat or reverse curve hearing loss must provide occlusion, while that for a high-frequency hearing loss needs venting to avoid occlusion and to low-tone signals unimpinged. For these reasons, the question of venting is always addressed during the hearing aid selection process.

A rule of thumb for determining whether some degree of occlusion should be added to the coupling is when the hearing loss at 1,000 Hz and below is greater than 30 dB. At this degree of loss, most patients do not observe the occlusion effect. This allows for increased low-frequency gain that can be accomplished with changes to the coupling, such as modifying the vent length bore or depth, or choosing a different design such as a solid (vs. a hollow cavity) mold. Dome options can easily vent off occlusion. On the other end of the scale, power domes can be used to increase low-tone input up to a certain limit. For example, in moderate hearing loss, any issue with shape conformity such as a narrow canal can void the desired occlusion.

Regardless of the hearing loss configuration, achieving the desired gain could be difficult when dealing with patients with very small or distorted ear canals. In some cases, feedback and occlusion control are more difficult to achieve and may take multiple remakes of earmolds or trials with domes. This is because small ear canal volumes, lumens, or isthmuses can produce higher frequency canal resonances and acoustic gain that make feedback and over-amplification more likely. Small ears and canals result in difficulty retaining an earmold, creating leaks and feedback. Although feedback can be controlled with electronics by reducing soft gain, this is counterproductive in most cases. The following cases demonstrate methods that may be used in high-frequency or flat hearing loss configuration for small ear canals.



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THE CASE OF THE SURGICALLY CREATED STENOTIC CANAL

The patient is an 82-year-old man who was initially evaluated for a bilateral mild to moderately severe, moderately sloping, high-frequency sensorineural hearing loss. He was fitted binaurally with Signia Pure Px products with medium (119/60) #2 receivers-in-the-canal (RIC) using 6 mm closed domes. The fitting was verified using real ear probe measurements set to NAL-NL1. After a few follow-up visits and minor alterations to the high-frequency prescriptions, the fitting was validated by COSI, and the patient was released from care. However, after nine months, the patient returned to report that he has not been able to wear his right ear hearing aid for months after undergoing an ear surgery to remove a lymphoma of the ear canal.

Prior to the surgery, otoscopic examination showed that the patient had normal ear canals free of debris and tympanic membranes, and with appropriate light reflexes, and translucency, position, and color. No deformity to the pinna or concha were noted. After the surgery, the patient's right ear (see Fig. 1) had a very small opening (4 mm) that was displaced superiorly but provided access to the larger ear canal space. The right ear canal volume, measured using a type A tympanogram, was 0.5 cc. There was essentially no change in hearing sensitivity in either ear. The challenge was to fit the RIC hearing aid to

Figure 1. Surgically-created Stenotic Right Ear Canal

the right ear, provide retention, and produce the real-ear results previously acquired. Fortunately, this case involved a high-frequency hearing loss wherein venting was desired.

Because of the size of the external auditory canal lumen, a 4 mm dome was used without a retention handle. The receiver was placed into the canal and pushed through the opening into the larger canal space. This prevents the receiver from falling out of the ear and provides an open fit. The receiver wire was set close to the head, and the hearing aid fitted comfortably behind the ear. In this case, the real-ear testing did not alter more than a few decibels in the high tones. After four weeks of use, the patient noticed no difference in hearing between the ears, and the receiver sensation was habituated.

THE CASE OF THE TINY EAR

The patient is an 80-year-old woman with a small build and very small ears. She initially presented with moderate to severe sensorineural hearing loss with a slight high-frequency recovery in both ears. Otoscopic examination revealed small, convoluted but normal-looking ear canals that were free of debris and tympanic membranes with appropriate light reflexes, translucency, position, and color. The external ears, concha, and pinna had no deformity. However, both ear canals are approximately 6 mm in width and 12 mm in height at the canal opening. Both ear canals had sharp posterior bends, and the left canal was collapsing. At the first bend, the canal size was 2 mm x 8 mm. At the second bend, the canal made a reverse angle and its size reduced to 3 mm x 5 mm. However, when fitting the ear with an earmold, the collapsing canal was not the only difficult issue. Placing the tip of the mold into the canal initially cut off the sound bore as it was pressed against the posterior canal wall. This was resolved by reducing the length.

Figure 2. Left earmold impression. This shows the treacherous canal contours and the collapsible external canal walls.

To ensure maximum benefit to the patient, who was a musician and an experienced hearing aid user, it was important to include as much low-frequency information as possible. The challenge was to fit both ears with RIC hearing aids and provide maximum occlusion without collapsing the canal or occluding the earmold sound bore. Fitting the ears with an RIC product is not as easy as using a mini-tube since the receiver must be properly placed. In this case, the patient was fitted binaurally with the Signia Pure Px with medium (119/60) #1 receivers placed in solid, half-shell acrylic earmolds without vents.

Figure 3. Left acrylic earmold with build-up material inserted into ear. The earmold is placed in the ear after silicon impression material is coated onto the mold.

Because of the canal and fitting issues, the factory remade four sets of earmolds before obtaining the correct amount of occlusion, depth of insertion, and snugness of fit. To help the factory remake the molds to maximize fit, the acrylic earmolds were coated with silicon impression material and inserted into the ears to harden (Fig. 3). The molds with the attached build-up were then sent to the manufacturer, who can better evaluate the fitting issues for the remake.

Once the earmolds are made correctly, they are verified with sound field testing for audibility. Real-ear testing was not possible in this case due to the limited canal architecture. After using the hearing aids for a month, the patient returned for validation, which revealed an excellent outcome.

Fitting hearing aids to patients with very small or deformed ears can be challenging. Regardless of the hearing loss configuration, scrutiny should be given to the amount of occlusion necessary to make the low frequencies audible as needed and without feedback. A technique for those with high-frequency hearing loss and a stenosed canal is to place the receiver snuggly into the canal, locking it in place against the tension of the receiver wire. When occlusion is needed for a flat hearing loss with a small, convoluted, or collapsible canal, strategies like obtaining the correct depth to avoid closing off the earmold bore, keeping the lateral canal walls snug to fit, and maintaining placement with a half-shell or skeleton style mold can prevent feedback and maintain the necessary gain. Finally, providing the patient with proper training on best practices in earmold or dome insertion can make all the difference in the fitting and the patient's quality of life.