Managing Patients with Precipitous High Frequency Hearing Loss

By Earl R. Harford, PhD & James R. Curran, MS

Precipitous high frequency hearing loss is very common, especially among the older adult male population. It may be one of the most complex and tenuous types of hearing loss to fit successfully with amplification. Special management skills are required to serve this population effectively. Further, it requires more than a routine knowledge of hearing instruments to fit this type of hearing loss well. The most important factor in ensuring success is the degree and quality of pre-fitting counseling that is provided. With adequate preparation of the patient, the dispenser is more likely to achieve a satisfactory outcome. This article offers five recommendations for fitting precipitous high frequency loss, as well as perspectives on handling patient expectations and hearing instrument distortion, feedback and occlusion.

Fitting patients with precipitous high frequency hearing loss with custom hearing instruments, so that they use their hearing instruments most of the time, is a complex and challenging problem. It is well known among hearing care professionals that high frequency (i.e., above 1 kHz) hearing loss is common in the older adult population (See Fig. 1). It is more prevalent in men, especially those who have spent many years in farming, construction and building trades, mechanized industry, noisy hobbies and loud recreational activities, such as flying airplanes, hunting and shooting, and motor sports. This audiometric configuration also is seen in women, but not as often. This paper addresses strategy for management of older adult patients with precipitous high frequency hearing loss during pre-fitting, fitting and post-fitting sessions.

The most common auditory behavioral characteristic of people with a hearing loss limited to the high frequencies is their inconsistency in everyday listening situations. That is, these persons seem to have normal hearing at times, yet at other times appear to be very hard of hearing. Those exceptional patients who experience a sudden, abrupt precipitous hearing loss, perhaps due to an explosion or gunfire, will immediately notice it and seek help. In most cases, however, the onset and progression of the loss is gradual, usually over a period of several years or even decades. For this reason, the hearing loss can go untreated for many years. By the time the loss is recognized and diagnosed, the individual has adjusted to hearing through a low-pass auditory filter and lacks the motivation to rectify the problem.

Some people with precipitous high frequency hearing loss tend to underestimate the significance of their hearing problem. Conversely, those who live, work, and/or associate with the patient are, indeed, all too aware of the problem. They become progressively exasperated and frustrated to the point where they wish to find help for this person. It is not uncommon for a significant number of patients with precipitous high frequency hearing loss to be "brought in" for professional help by a spouse, a family member or someone else, rather than to voluntarily seek assistance. In other words, the patient often seeks help primarily to appease a spouse or another family member or friend, even though this may not be expressed during the intake interview and history. This often-concealed variable can undermine the fitting process and lead to its failure, especially if the patient allowed him/herself to be persuaded to seek help only to prove to others that a hearing instrument will be of no help.

In contrast, there are others who finally decide, after years of postponing, that they must do something about their hearing problem. These patients are usually motivated to seek professional help for their problem because of communication problems on the telephone, in their work environment, or for other significant real-life situations. Even though these patients are properly motivated, they also may experience reluctance to commit to amplification. How does the dispenser differentiate one group of patients from another, and should different strategies be used to manage each? The answer is that both groups of patients essentially require a similar counseling approach and management strategy.

Earl R. Harford, PhD, is director of univ. services and James R. Curran, MS, is director of prof. services at Starkey Labs. Both men have served as private practice audiologists and are the authors of literally hundreds of articles and presentations.

Using Custom Hearing Instruments

It is important to consider fitting precipitous high frequency losses with custom hearing instruments, especially the completely-in-the-canal (CIC) and the in-the-canal (ITC)

styles. There is ample evidence in the literature that these styles of hearing instruments are capable of providing the amplification that is required, and they are increasingly desired by hearing instrument candidates. The tendency by some dispensers is to resort to behind-the-ear (BTE) instruments with open molds for precipitous hearing loss. Our experience suggests that, even if the patients accede to this recommendation, the advertising and information they have been subjected to in the media will cause them to wish they had been fitted with small, inconspicuous aids. Two events usually occur: either the patients fail during their adjustment periods because they wish they did not have to wear BTE instruments, or, if they purchase the aids, the aids are eventually not used. Some time later, this person may try again, but this time with another dispenser who advertises small hearing instruments.

Some dispensers support their choice of BTE instruments by stating that custom aids cannot provide the gain that is required and that it is more important to provide "optimal" amplification than to bend to the patient's desire to hide hearing loss. We believe this is inappropriate for two reasons. First, history has demonstrated that careful adjustment of the hearing instrument's frequency response and venting will provide appropriate amplification for these losses using custom instruments. Second, it is a losing proposition to fight human nature, especially when the patient believes he/she really has only a small problem.

To compound matters, many of these patients are reluctant to wear two hearing instruments because, in their minds, two hearing instruments suggest that they are "twice as deaf." In brief, these individuals are not only reluctant to admit a hearing problem, but if they *do agree* to try amplification, it must be the smallest instrument available and only for one ear. Most dispensers know that fitting a patient who has a bilateral loss with only one hearing instrument sets up a condition for failure. This is especially true in cases of precipitous high frequency hearing loss. One of the significant advantages of binaural amplification is the "squelch" effect (i.e., the central process by which the signal-to-noise ratio is improved when listening to speech in noise with two ears that are within normal limits, as opposed to listening with one ear).[1] Since listening in noise constitutes one of the most common complaints that accompanies high frequency hearing loss, it stands to reason that use of binaural aids should be recommended.

The smaller the hearing instruments, usually the higher the cost. Consequently, the dispenser is faced with the challenge of motivating a patient who perceives that he/she has a minor problem to spend considerably more for hearing instruments than might be expected. Not only are the smallest hearing instruments the most expensive, but the patient must face the cost of two. It is understandable why the cost/benefit question may be raised. It is at this point that the dispenser determines if the initial counseling has increased the patient's level of motivation to take action.

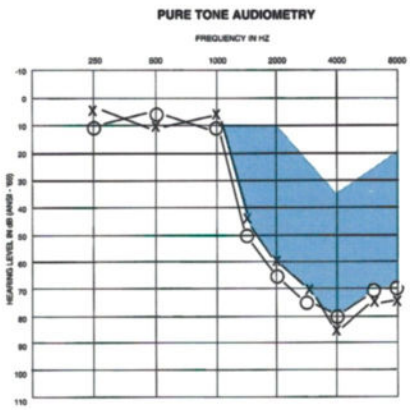

Fig. 1. *The shaded area covers varying degrees of high frequency hearing loss. The information contained in this article pertains to losses that fall within the shaded area.*

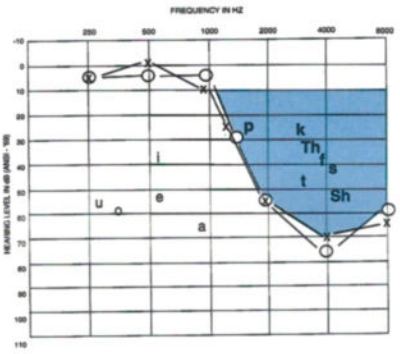

Fig. 2. *An excellent visual aid, showing the patient's precipitous high frequency hearing loss with the area of loss shaded. A transparent overlay, containing vowels and some high frequency consonants, is laid over the audiogram.*

The patient's mind-set must be dealt with. The best way to deal with it is: 1) spend more time than usual in explaining and counseling during the initial visit; and 2) use the fitting strategies we discuss below.

The Initial Visit

It may seem too obvious to say that long-term successful rehabilitation for high frequency hearing loss begins during the initial visit to the dispenser, but this axiom is especially true with this type of hearing loss. It cannot be assumed that, because the patient showed up for the appointment, gave a good history and responded well in the audiologic test situation, that he/she is ready and willing to follow professional advice. In fact, just the reverse may be true. The reasons are simple. Recall how we described this patient population earlier. As a group, they are often poorly motivated, fail to understand the magnitude and implications of their hearing loss, and they may be looking for an escape route from the person who is pushing them to do something about their problem. As a result, failure to enlighten and stimulate the patient's motivation during the initial visit may conclude with a failed fitting.

The dispenser must be able to explain succinctly and meaningfully to the patient (and the person who accompanies him/her) the nature of the problem and what can be done to improve the ability to hear in a variety of situations. This is a more challenging skill than it appears. The consequences of low-pass filtering on speech intelligibility can be a complex and confusing phenomenon for the lay person, especially when explained under the stress of a busy clinic schedule. Thus, we offer the following five recommendations that have been successful for us in fitting precipitous high frequency losses.

Recommendation #1

First, develop, perfect and adopt a counseling technique that clearly explains to lay persons the nature and consequences of a high frequency hearing loss. We believe this objective is virtually impossible to achieve without the use of visual aids and possibly the use of an auditory demonstration. A transparent audiogram overlay containing all the vowel sounds and most of the high frequency consonants, works well (Fig. 2). With a pencil, shade in the area of the patient's loss on the audiogram. After explaining how to read an audiogram and comparing the patient's hearing with normal hearing, the overlay is superimposed over the patient's audiogram. The high frequency consonants will fall on the shaded area showing those that are "lost." Following this, give a simple explanation of what happens to speech understanding when high frequencies are missing. Use examples (e.g., responding to the question, "What kind is it?" with the answer, "Three o'clock"). One of the most effective methods is to sketch out the illustration shown in Fig. 3 derived from the work of Fletcher[2] explaining why it is important to hear soft,

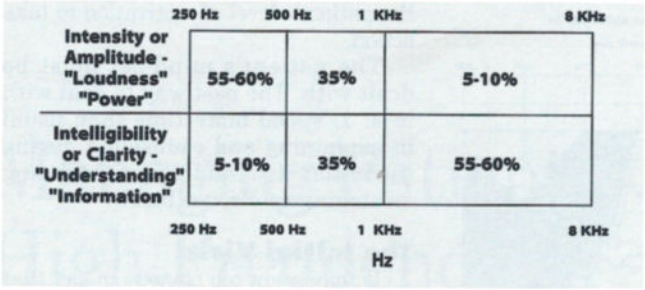

Fig. 3. *The relationship of intensity to intelligibility within the long term average speech signal. (After S. Gerber's* Introductory Hearing Science, *p. 244; based on Fletcher, 1929.*[2]*)*

less intense, high frequency sounds.

Also emphasize the consideration of problems that are caused by increasing distance between speaker and listener and the presence of low levels of noise in the environment. An example would be trying to understand someone who is talking from another room while the hearing instrument user is running water at a sink. The individual knows very well that he/she is being spoken to, but may not know the exact nature of the message. In this way, the validity of the problem and the root cause of inconsistent listening behavior is better understood by the patient and his/her companion. It also verifies that the dispenser understands the problem, which is important for building confidence with the patient.

Recommendation #2

It is helpful to let the patient hear what it would be like to use high frequency amplification. Two compression limiting BTE instruments, with wide range adjustments of SSPL90, low cut and high cut may be used for this demonstration. Acoustic modifier earmolds with short canals, hollowed out canal tips and select-a-vents are used. Speech, music and some simple environmental sounds are played at relatively low levels, determined by the extent of the loss, to demonstrate the effects of amplification. Then the instruments are removed and some of the stimuli are replayed. The greater the high frequency hearing loss, the more convincing the demonstration. It is also helpful to have another person, such as a spouse, friend or another family member, speak while the demonstration instruments are being worn.

Recommendation #3

Obtain a commitment from the patient to wear the recommended amplification every day, all day, under all conditions for at least four weeks. This must be communicated positively to the individual. With practice, the chances are very good that the patient will be successful. But this will not be apparent to the patient until some time has passed. On the other hand, since this is a difficult loss to fit, the patient must be made aware that there are no guarantees of perfect hearing. This must be done without discouraging or frightening him/her away. Obviously, the dispenser should be cautious in what is promised, for here—more than ever—the patient must not be allowed to develop over-expectations.

It is at this point that the reluctant, "I'll show you" patient is sometimes discovered. The prospect of wearing the hearing instruments continuously for so long a period is unexpected and presents a different aspect. Although we do not customarily believe in the usefulness of wearing schedules, a simple handwritten note detailing the nature of the four-week wearing commitment can be drawn up on the dispenser's stationery during the initial visit. It is handed to the patient to symbolize the importance of the agreement to wear the instruments. It points out clearly what will be expected from the patient. If the patient objects at this point to the fitting regimen, the dispenser must search for the cause of the objection and deal with it forthrightly. It is better to lose the patient than to enter into a fitting regimen where the outcome is already negatively determined.

For those patients who object to wearing two hearing instruments, the following strategy is applied. Payment for one hearing instrument is arranged at the time of the fitting, with the agreement that the patient will either return the second hearing instrument after four weeks or pay for it if he/she decides to keep it. Our experience is that most patients pay for their second hearing instrument after comparing their experience with aided binaural versus monaural hearing.

Professional Attitude

When it comes to managing precipitous high frequency hearing loss, the dispenser can possess all the knowledge and technical skills to meet the challenge of this complex hearing problem, yet fail to enjoy a high success rate because of a negative approach. Success in the majority of these cases requires that the dispenser must truly believe in the efficacy of amplification for precipitous high frequency hearing loss. A strong positive attitude and approach to the problem is essential. Equivocation or ambiguity on the part of the dispenser is likely to be sensed by the patient who already is hesitant to accept help.

Some hearing care professionals may feel that it is below their professional dignity to appear to be "selling" or "manipulating" a patient to follow his/her advice. It is essential to instill a sense of confidence in those being served, without compromising professional ethics, the facts or the truth. In the case of high frequency hearing loss, this principle is even more important. Of course, there is a higher risk of failure in fitting patients with high frequency hearing loss. This can be stated by the dispenser without allowing it to permeate the management regimen and result in a negative recommendation by the dispenser or denial by the patient.

If a dispenser honestly does not believe that precipitous high frequency loss can be fitted successfully with custom amplification when it is desired by the patient, professional ethics dictate that it is the dispenser's responsibility to refer these individuals to someone who does. Assuming the dispenser has been successful in motivating the patient to try amplification, the next step, of course, is to select the style, circuit, matrix and venting.

Recommendation #4

CICs, or deep canal, hearing instruments are the most ideal fittings for patients with high frequency hearing loss. Not only are they concealed from view, but they provide excellent high frequency amplification with relatively little fear of feedback. Regardless of the frequency response of the CIC in the 2cc coupler, when placed in the ear canal, the instrument will provide a high frequency emphasis response (Fig. 4). CIC hearing instruments require substantially less 2cc coupler gain than other types of instruments in order to provide comparable sound pressure at the ear drum. The peak gain (2cc coupler) required for some losses that fall within the range shown in Fig. 1 can be as little as 10-15 dB, depending upon how deeply the CIC is inserted and how tightly the shell fits. The actual peak gain in the ear canal may vary from 25-35 dB or greater, which is more than enough gain for many losses.[3]

To assure an acceptable fitting, the canal tip of the CIC must be deep enough to obviate the occlusion effect, without being so deep that it is uncomfortable. The vent should be no greater than 1/32", or less, to forestall feedback. Finally, the slope of the response in the 2cc coupler should be approximately 20 or 25 dB between 500 Hz and the primary peak. Sometimes a 30 or 35 dB slope may be required, especially if

the loss is relatively mild or confined to an area on the audiogram beyond 3000 Hz. These slope recommendations also hold true for ITC and ITE fittings.

Recommendation #5

Fit a compression rather than a peak-clipping circuit. More specifically, when fitting CIC instruments, the benefits and advantages provided by wide dynamic range compression (WDRC) circuits with or without TILL processing are impressive. The TILL feature is particularly useful, for it provides extra boost for the soft, high frequency sounds that are contained in the speech signal. Our experience is that the *combination of WDRC circuits and CIC style instruments* provide nearly ideal amplification for every kind of high frequency loss, including both precipitous and gently sloping. WDRC circuits, however, are specifically *not recommended* when fitting precipitous high frequency losses with ITC or ITE instruments that have large vents. Compression limiting circuits are the recommendation of choice in ITC and ITE custom instruments when large vents are employed, for they provide desirable non-distorting high frequency signals not available in peak-clipping instruments. Also, they will not exhibit feedback as quickly as WDRC circuits when large vents are present.

Fitting and Post-Fitting Visits

Although it is recognized that there are numerous issues and problems that must be addressed during the fitting and post-fitting sessions, we chose four problems that may accompany the fitting of a patient with precipitous high frequency hearing loss: 1) lack of appreciation for improved hearing; 2) distortion of high frequency sounds; 3) feedback; and 4) complaints about occlusion. Each will be addressed separately:

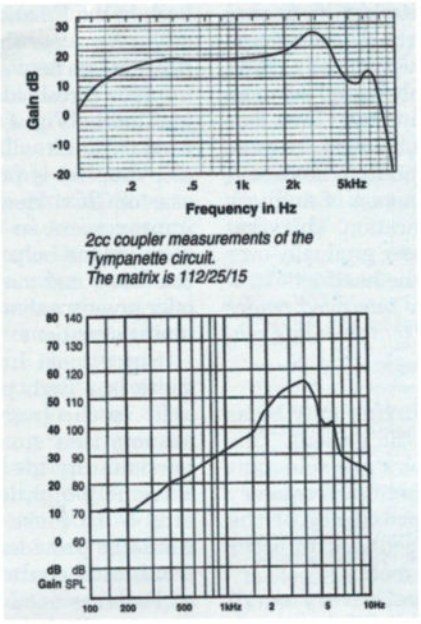

Fig. 4. *Comparison of frequency response of a CIC hearing instrument in 2cc coupler and real ear aided response of same instrument in patient's ear canal.*

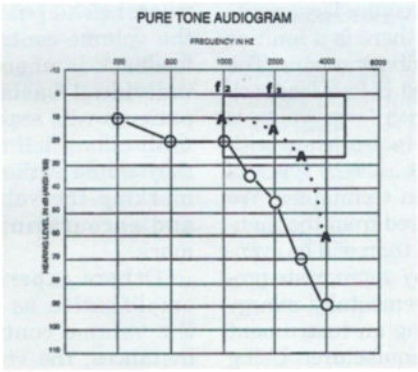

Fig. 5. *Area within box depicts target that aided thresholds should fall within in order to provide "less of a hearing loss". "A" indicates functional gain aided thresholds.*

▶ *Cannot appreciate improved hearing:* In our opinion, the hallmark of a good fitting for precipitous high frequency hearing loss is when the patient is unaware of amplification, yet is able to demonstrate significant improvement in communicative performance. In the beginning, it may be difficult to convince the patient that he/she has been fitted ideally. A significant number of patients who are fitted with custom ITC or ITE instruments that amplify only high frequencies conclude that the aids are of little value because they cannot distinguish between amplified and unamplified listening. Often, this judgment is made following self-administration of a popular do-it-yourself TV test which results in the remark, "I hear the TV just as well without them on as I do with them."

Typically, the patient wants to "hear his money's worth." The individual expects to have a sensation of loudness, which is essentially the property of amplification in the mid and lower audiometric frequencies. Here again, there is a risk that if individuals are fitted with the appropriate amount of high frequency amplification initially, they may perceive that they are not getting much help. New hearing instrument users, or those with losses confined to the frequencies beyond 2000 Hz, especially have difficulty recognizing the presence of high frequency amplification. As many times as not, patients turn the instrument up until it starts to feed back because they do not recognize the presence of adequate high frequency amplification.

Therefore, it is suggested that either the low frequency trimmer on the instrument be set to provide a slightly wider frequency response than will be eventually required, and/or the venting be reduced slightly to provide the new user with an initial experience of loudness. Of course, one runs the risk of hearing the complaint that everything is too loud, or that the user's voice sounds too loud, or that they sound like they are talking in a barrel. However, this will provide the user with the perception of amplified sound initially. After a short period of use, the trimmer and the venting can be adjusted gradually to reduce the low frequencies. The new user will increase the gain slightly upwards, which will increase the high frequencies. With practice, the patient will become aware of the benefit of high frequency amplification, even though the amplified signals may not sound "loud" to him/her.

▶ *Distortion and "tinniness" in the high frequencies:* Until more recent times, Class A circuits were used in hearing instruments almost exclusively. Distortion in the high frequencies is very common in these circuits. Whenever a high frequency sound is to be amplified, because of limitations of battery current and because impedance to transmission of high frequencies is high, the transducer is unable to cleanly reproduce high frequency signals. This may be perceived as tinniness or shrillness in the hearing instruments, especially when input levels are high.

The transmission of high frequencies is markedly superior in Class D circuits as opposed to Class A. When the input signal is high enough, however, a Class D *peak-clipping* circuit will also be forced into saturation and distortion will occur. To obviate the aversive effects of peak clipping, we advocate the use of Class D *compression* instruments for high frequency losses. By using these circuits, one of the main causes for the perception of tinniness will be essentially eliminated. If the hearing instruments are producing undistorted signals, such as occurs with Class D compression instruments, we conclude that the user's complaint is probably due to subjective unfamiliarity with the amplified signal.

Experience suggests that the patient is hearing sounds that he/she has been deprived of for many years, and obviously they sound shrill or tinny. The patient has been listening through a low pass filter for years, and now, even while listening to a comparatively high-fidelity amplified signal, high frequency sounds are being imperfectly processed by the

abnormal auditory nervous system. The new high frequency sounds are going to sound unfamiliar, disturbing or distorted.

When the problem seems to be centered within the patient, time using amplification seems to be the only logical solution. This is another reason to gain a commitment for at least four weeks of continual use. Clearly, at this point, changing circuits, matrixes, styles, etc., can be an exercise in futility. The patient must be counseled concerning the phenomenon of auditory relearning and persistence in using amplification. This complaint and perception almost always disappear gradually over a period of time, assuming no distortion in the hearing instruments. *(Authors' Note: We recommend to the interested reader articles by Gatehouse & Killion[4] and Palmer[5] that treat this subject in a more extensive manner.)*

▶ *Feedback:* The chance of feedback occurring may be as much a problem for the dispenser as for the patient. This is one of the reasons why some dispensers are reluctant to fit custom instruments for precipitous high frequency loss cases, for they believe that the proximity of the microphone to the receiver will cause feedback to occur earlier than if using BTE aids with open molds.

In CIC instruments, as stated above, a very small pressure-relief vent is usually all that is required, because theoretically there should be no need to vent in order to reduce the occlusion effect, and only equilibration of atmospheric pressure is required. Of course, in canal and full-concha instruments the larger vents play a critical role in the acceptance of the fitting.

Since precipitous high frequency losses require large vents (unless CIC instruments are being fitted), there is a limit as to how much gain can be used before feedback occurs. The amount of aided gain that can be obtained before feedback occurs from ITE and ITC instruments with large vents is close to that found in fittings using BTE instruments with open molds. This depends upon using the correct types of vents and correct use of shell modification techniques. We believe that the instrument should be ordered from the manufacturer in a *more occluding configuration* than will be eventually needed. The dispenser should employ appropriate procedures designed to systematically and incrementally enlarge the venting as required, rather than using an instrument that is already maximally vented by the manufacturer. Using the technique of shortening the vent from the canal tip rather than drilling out the inner diameter of the vent to enlarge it is strongly recommended. *(The complete subject of how to vent and modify custom instruments is too extensive to be treated here, but must be mastered in order to fit custom aids correctly. The reader is referred to a series of tutorials concerning these topics.[6,7,8,9] Copies of the articles may be obtained by contacting James Curran.)*

If the full-on peak gain (2cc coupler) in the instrument exceeds 25-30 dB in large vent, open-mold ITC-ITE fittings, feedback will almost certainly occur prior to having provided satisfactory amplification. Aids that have full-on peak gain values (2cc) above 35 dB will assuredly go into feedback at low levels. So the first rule of feedback control in custom ITC and ITE instruments is never to use gain that exceeds 35 dB peak full-on gain (2cc) in ITC aids, *irrespective of the amount of loss in the high frequencies.*

Some dispensers observe the presence of severe loss in the very high audiometric frequencies (3000-8000 Hz) and assume, therefore, that a large amount of high frequency gain (i.e., approximately proportional in dB to the amount of loss) will be needed. If one attempts to fit an instrument having high gain in the high frequencies, the only way to do it is to occlude the mold, which is invariably objectionable to the patient because it can result in an occlusion effect. Instead, one should seek to provide usable amplification without feedback in the F2 and F3 areas (1000-3500 Hz). The overall goal of the dispenser should be to provide the patient with less of a hearing loss between 1000 Hz and 3500 Hz, not necessarily to improve thresholds at 4000, 5000 and 6000 Hz to within normal limits (Fig. 4). Keep in mind that when large vents are used feedback will occur if more than 25-30 dB of peak gain (2cc coupler) is present, except as mentioned earlier in the case of CICs. However, even that little amount of threshold improvement in the region of the hearing loss can be of tremendous help to the patient, especially in the binaural condition, and may actually be all the gain that is needed to offer greatly enhanced speech intelligibility in a variety of listening situations.

Since most high frequency losses are sensorineural, there is a high probability that recruitment will be present in the high frequencies. Consequently, one can assume that small amounts of gain will provide disproportionately greater loudness and obviate the need for extremely high levels of gain. In addition, with binaural aids 5 dB more gain is available to the patient than would be provided by a monaural aid having similar electroacoustic characteristics.

Patients need to be counseled that feedback will occur occasionally because it is a by-product of this type of fitting (i.e., it does not necessarily mean that something is wrong with the hearing instruments). For example, when eyeglasses fog up for a few minutes when one comes indoors on a cold day, the eyeglasses are not faulted. The patient should be told to expect momentary feedback when he/she puts on a hat, stands next to a wall, rotates the volume control, etc. Of course, chronic, uncontrolled feedback is unacceptable and must be dealt with on an individual basis. Of particular importance are those patients who experience feedback and are not aware of it until others tell them. This can be so embarrassing that they would rather not wear the instruments. We suggest marking the volume control at the appropriate setting and encouraging the patient to try not to exceed the mark.

Others experience a shift in hearing or seek more amplification as they become accustomed to it, turn up the volume control and experience feedback. In these instances, the vent can be carefully reduced or the outside diameter of the shell increased with patching material to provide greater occlusion of the shell. Often, as patients become accustomed to amplification, they will withstand greater amounts of occlusion (and the concomitant increased low frequency amplification) than they would have in the initial stages of the fitting.

Check for sharp spikes in the high frequencies in aided real ear recordings. These spikes indicate that the aid may be teetering on the edge of feedback.[10] Temporary reduction of the spike can be effected by inserting an acoustic damper or lamb's wool in the receiver spout. The spike may be caused by an interaction of the receiver system with the physical properties of the ear, or it may be an indication of a faulty instrument that may require repair.

▶ *Occlusion effect:* One of the main reasons for installing large vents in ITC and ITE instruments is to reduce the occlusion effect. Another reason is to allow unamplified low frequencies to enter into the ear canal, since hearing for low frequencies is usually within normal limits. The patient will surely be dissatisfied unless the occlusion effect is dealt with adequately.

The literature suggests that a *low cut trimmer* in concert with a *vent* is a more powerful and satisfactory method to control the amount of low frequency amplifica-

tion that is provided than either one alone.[11,12] The dispenser's goal is to adjust both until the patient is provided with effective high frequency amplification without feedback, the occlusion effect is minimized, and without over-amplification in the low frequencies. We strongly suggest that ITC and ITE fittings should never be undertaken unless a low cut trimmer (preferably an active or wide range type) is provided with the instruments to enable the necessary fine-tuning that must be accomplished. There have been occasional reports that in large vent fittings a low cut trimmer is of little value, based on an apparent lack of change in the low frequencies in real ear aided response tracings. Our experience contradicts this. A probable reason why no apparent change in the tracings is observed is related to the great amount of low frequency reduction provided by the large vent. The degree of reduction provided by the trimmer appears minimal (i.e., its contribution becomes obscured by slit leak and vent effects). Our experience is that patients are immediately aware of the change and react positively to it, even if it is not observed in the real ear aided response tracing. The low cut may also have the effect of minimizing circuit noise, which is sometimes detectable by people with good low frequency hearing levels when they are in a quiet environment.

In CIC instruments, shortening the vent minimally often resolves an occlusion effect complaint. If this fails, we recommend that the length of the canal be extended, if possible. Sometimes, simply using the hearing instrument constantly over a period of several days will resolve the complaint.

Summary

Precipitous high frequency hearing loss is very common, especially among the older adult male population. It may be the most complex and tenuous type of hearing loss to fit successfully with amplification. Special management skills are required to serve this population effectively. Further, it requires more than a routine knowledge of hearing instruments to fit this type of hearing loss well. The most important factor in ensuring success is the degree and quality of pre-fitting counseling that is provided. With adequate preparation of the patient, the dispenser is more likely to achieve a satisfactory outcome. ■

References

1. Olsen, WO & Carhart R: Development of test procedures for evaluation of binaural hearing aids. *Bul Prosth Res* 1967; Spring: 22-49.
2. Fletcher H: *Speech and Hearing*. New York: Van Nostrand, 1929.
3. Seewald RC, Cornelisse LE & Block M: Transforms and correction factors for fitting completely-in-the canal (CIC) instruments. Poster presented at the 8th Annual American Academy of Audiology Convention, Salt Lake City, 1996.
4. Gatehouse S & Killion MC: HABRAT: Hearing aid brain rewiring accommodation time. *Hear Instrum* 1993; 44 (10): 29-32.
5. Palmer CV: Deprivation, acclimatization, adaptation: What do they mean for your hearing aid fittings? *Hear Jour* 1995; 47 (5): 10: 41-45.
6. Curran JR: Practical modifications and adjustments of in-the-ear and in-the-canal hearing aids. Pt 1. *Aud Today* 1990; 2 (1): 27-28.
7. Curran JR: Practical modifications and adjustments of in-the-ear and in-the canal hearing aids, Pt 2. *Aud Today* 1990; 2 (3): 23-25.
8. Curran JR: Practical modifications and adjustments of in-the-ear and in-the canal hearing aids, Pt 3. *Aud Today* 1991; 3 (1): 24-26.
9. Curran JR: Practical modifications and adjustments of in-the-ear and in-the canal hearing aids, Pt 4. *Aud Today* 1992; 4 (1): 22-25.
10. Cox RM: Combined effects of earmold vents and suboscillatory feedback on hearing aid frequency response. *Ear Hear* 1982; 3: 12-17.
11. MacKenzie K & Browning GG: The real ear effect of adjusting the tone control and venting a hearing aid system. *Br J Audiol* 1989; 23: 93-98.
12. MacKenzie K & Browning GG: Relationship between earmould venting, comfort and feedback. *Br J Aud* 1989; 23: 335-337.

Correspondence can be addressed to Earl R. Harford, PhD, Starkey Laboratories, Inc., 6700 Washington Ave. S., Eden Prairie, MN 55344. Copies of the series of articles on venting and modifying custom instruments may be obtained by contacting James R. Curran, MS, at the same address.