Fitting Binaural Amplification to Asymmetrical Hearing Loss

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Introduction

Almost every psychoacoustical effect appears to be enhanced when binaural rather than monaural listening is involved. (Harris, 1980)

Fifty-two years ago Carhart (1946, 1950) observed that the problem of hearing aid selection is “currently one of the most controversial aspects of clinical audiology.” Commenting on the “holy grail” of hearing instrument fitting, he stated, “There is a series of clinical goals to be reached provided these goals are attainable within the constraints of contemporary technology and the patient’s hearing disorder.” Chief among the goals were the need to “restore to the user an adequate sensitivity for the levels of speech and of other environmental sounds he finds too faint to hear unaided.” The need to “restore, retain or make acquirable the clarity (intelligibility and recognition) of speech and other special sounds occurring in ordinary, relatively quiet environments” and the need to “keep the higher intensity sounds that reach the hearing aid from being amplified to intolerable levels.” To these goals the authors would add the following: To achieve as closely as possible, adequate binaural function when an asymmetrical hearing loss exists.

Some 26 years ago J. Donald Harris (1976) made a rather somber analysis of hearing aid fitting rationale. The following comments reflect his thinking: “Even if one has a good candidate and the theoretically ideal prosthesis for him, there is no validated way to measure, much less to predict, what that aid does in the wearer’s daily life. Without such research and validated evaluation, the audiologist today is in no position to state on any basis other than his own ‘clinical judgment,’ however good that may be, which aid is best for his patient and how much good it will do. To state otherwise is to arrogate to the audiologist a level of objectivity and scientific caution, which is not apparent to the scientist” (p. xix).

Over the past 26 years, audiologic advances have successfully addressed some of the issues that were expressed by Harris. Our profession has made great progress in the administration of objective and subjective tests and procedures beneficial to patients with hearing loss. True, one does not always agree with colleagues regarding the fitting of patients with asymmetrical hearing loss. With the fairly recent introduction of digital signal processing (DSP), and the increased use of programmable hearing aids, the profession is approaching some reason-
able consensus relating to the electroacoustic needs of patients.

The fitting of hearing aids is, in part, a very subjective process. The clinician is concerned with not only the magnitude of the hearing loss, but also the social and psychological consequences of the use of hearing aids. The wide variety of asymmetrical hearing loss, and the subsequent problems associated with fitting this type of hearing loss, would seem to demand that audiologists adopt an attitude embracing experimentation in the assessment of need, benefit, and use.

**Purpose and Definitions**

This chapter reviews the current thinking on the selection and verification strategies for fitting asymmetrical sensorineural hearing loss.

First it is important to propose a reasonable definition of bilateral asymmetric hearing loss. It can be defined as significant interaural differences in threshold sensitivity. This definition, however, is not a very functional definition when making decisions concerning hearing aid use for this very broad hearing loss group. For example, in one patient one ear could be within normal limits whereas the opposite ear has a profound hearing loss that is “unaidable.” In another patient both ears could have equal hearing loss, but one ear may be significantly different from the other on word recognition scores. In still another patient, the audiometric configuration could be significantly different, requiring special consideration in determining the electroacoustic properties of the recommended hearing aids. Word recognition scores may differ significantly, creating additional concerns in the decision-making process. In other cases, the loudness growth function may contribute to asymmetrical impairment. That is, the dynamic range on one ear may be significantly different from the dynamic range on the opposite ear. As a result, the amplification needs may vary greatly from one ear to the other. We believe, based on our combined clinical experience, that there are many patients who have bilateral asymmetrical hearing loss. That is, the threshold sensitivity for those discrete frequencies assessed in the evaluation process is not identical for each ear. The clinical issue is whether to fit the better ear, poorer ear, or both.

Perhaps a working definition of asymmetric hearing loss, relative to the application of hearing aids, would be the following: Given that an asymmetric hearing loss implies a significant difference between ears, the use of amplification must improve hearing performance so that it can be verified by threshold improvement, most comfortable listening level (MCLL), word recognition scores, or loudness growth measures, and so that a positive subjective response to amplified sound is present in the patient’s everyday listening environment. In this definition, subjective preference is a major consideration. Depending on the severity of the hearing loss, the patient’s benefit, when benefit is measured by traditional assessment procedures, cannot accurately be measured. This may be especially true if one relies exclusively on word recognition scores as the major criterion in determining benefit.

If the audiologist cannot demonstrate the immediate benefit from binaural amplification, should any effort be made to fit a hearing aid to each ear? Sammeth and Levitt (2000) made the following cautionary statement: “Although binaural hearing aid fittings are generally preferred, patients with a large asymmetry in hearing loss, particularly one that includes a significant discrepancy in maximum speech between the ears, may show degraded performance when a hearing aid is placed on the poorer ear” (p. 219).

Briskey (1978) suggested the following criteria be imposed when fitting binaural instruments for those patients with asymmetrical hearing loss:

1. The average hearing loss at 500, 1000, and 2000 Hz should be within 15 dB hearing level (HL) or less between ears.
2. Two of these three frequencies must be 15 dB HL or less between ears.
3. The word recognition scores between ears should be within 8% of each other.
4. The uncomfortable loudness level (ULL) in each ear should be within 6 dB of the other.
5. The most comfortable loudness level (MCL) in each ear should be within 6 dB of each ear.
6. There should be a high activity index. The activity index is based on the lifestyle of the individual. For example, if the lifestyle is rather sedentary, perhaps binaural amplification should not be considered. On the other hand, if all other criteria are met and the patient has a very active lifestyle, then binaural hearing aid amplification may provide assistance.

Briskey (1978) states that not all the criteria need to be met for a successful binaural fitting. For example, binaural fitting can be achieved by considering either criterion 1 or 2, any two of criteria 3, 4, and 5; and always have criteria 6. Briskey’s recommendations may be straightforward regarding the possibility of achieving maximum benefit from binaural amplification, but they tend to underestimate the advantages gained by binaural amplification for those patients with asymmetrical hearing loss who do not meet all the suggested criteria. One may embrace the need to adhere to strict criteria when justifying a binaural fitting to document sound source location, binaural summation, and word recognition in environmental noise. Nonetheless, there are advantages to fitting binaural hearing aids for patients whose hearing loss is significantly different between ears to the point where the patients may not fully enjoy the binaural advantages of improved word recognition in noise. We believe that many patients with asymmetric hearing loss can benefit from binaural amplification, even though they may not be able to enjoy completely the binaural advantages, which are easier to demonstrate when significant interaural differences are not present.

Courtois and his colleagues (1988) take issue with such restrictive practices as suggested by the Briskey (1978) model. They state, “It is amazing that an asymmetry as small as 15 dB HL between the two ears and a difference as small as 8% in word discrimination is seen by some audiologists as a contraindication to binaural treatment” (p. 243).

Mueller and Hall (1998) commented on the “old” versus “new thinking” regarding binaural hearing loss. They stated that the old thinking was, “if unaided pure tones thresholds differ by more than 15 dB HL between ears, the individual is not a binaural candidate” (p. 139). Current thinking suggests that if aided pure tone thresholds are within 15 dB between ears, the individual will probably use, and benefit from binaural amplification.” It is critical to point out that the new approach for patient candidacy is determined by the aided threshold values, whereas the old thinking relied on unaided thresholds to determine whether or not the patient is a reasonable candidate.

Regarding word recognition, the old thinking suggested that if word recognition in the poorer is significantly poorer than the better ear, only fit the better ear (e.g., 10% or greater often was considered significant). That thinking was based on the feeling that the poor word recognition score in the poorer ear will “drag down” the better word recognition ability of the better ear. Current thinking dictates that if the “true” maximum word recognition score is obtained for both ears, assuming that the audiologist took the time to measure the maximum word recognition in each ear, rarely is there a significant difference in word recognition scores between ears. Even when a significant difference in word recognition scores exists between ears, binaural aided performance usually will be no worse than the best ear performance. The exception might occur when there is a significant central processing deficit in the poorer ear (Mueller and Hall, 1998). The reader will note that even current practices regarding bilateral asymmetric hearing loss include some
objective formula for determining patient candidacy, which is not unlike that suggested by Briskey (1978). We feel that the new thinking is superior to that of the old thinking. More new thinking, however, needs to be proposed for effective patient management.

In assessing the insertion gain of the hearing aid, the old thinking would dictate the use of functional gain (i.e., the difference between aided and unaided thresholds measured in a sound field for narrow bands of noise and/or speech). Currently, few audiologists use functional gain to assess hearing aid performance to meet the electroacoustic needs of the patient. Most audiologists prefer to use rear-ear measures for verifying the gain of the hearing aids. Current thinking is that the real-ear insertion gain (REIG) is a very accurate, reliable, and objective method for measuring hearing aid performance. That is, if the audiologist can show that the measured REIG “hit” the prescribed REIG, then the fitting goal has been achieved.

Measuring word recognition scores in a background of noise was addressed by Mueller and Hall (1998) in the following way:

**Old thinking:** If I do monaural versus binaural speech testing in the background noise in my sound booth, and there is no significant improvement for binaural, then the individual should be fit monaurally. **New thinking:** It’s very likely that traditional clinical speech testing is not sensitive enough to extract the benefits of binaural amplification for understanding speech in background noise—unless our patient has a central auditory deficit, the benefits shown in research studies should be present. Moreover, even if there is no speech intelligibility-in-noise improvement for binaural, there are many other compelling reasons to select two hearing aids over one. [p. 139]

Wayne Staab (2000) commented on Briskey’s (1978) generalized criteria for fitting binaural hearing aids: “Still it would be inappropriate to eliminate binaural amplification as a consideration if these criteria (i.e., the Briskey, 1978 guidelines) are not met, just as much as it would be inappropriate to insist on binaural amplification just because these criteria are met. Good judgment and understanding of the patient’s needs should be the determining factor” (p. 64). Staab (1996) advises, “Potentially, every individual with a hearing impairment may be a candidate for hearing aid use. Concepts that dictate hearing aid candidacy on the basis of specific levels or types of loss should be discarded. The emphasis should be on the handicap and the problems a particular hearing loss presents” (p. 433). Although Staab (2000) did not directly address asymmetrical hearing loss, it is clearly implied in his statement that the decisions audiologists make must not be governed by generalized fitting concepts. Further, audiologists cannot overgeneralize what is and is not appropriate for an individual with hearing loss. Walden and colleagues (1983) expressed similar concerns regarding the assumptions underlying hearing aid evaluation process.

Deciding how to demonstrate benefit from binaural amplification is of primary importance. Skinner (1988) describes two approaches to fitting bilateral asymmetrical hearing loss. The first approach is to fit one ear and have the patient determine the benefit over a defined period of time. If beneficial, the patient could return to be fitted with a second aid on the opposite ear. The other approach is to fit the patient initially with binaural amplification and have the patient alternate between binaural and monaural fits during the trial period to determine which fitting provides the greatest benefit and satisfaction. This second approach implies, and rightly so, that subjective analysis of perceived benefit is tantamount to assessing the value received from amplification. To assume there is a magnitude of interaural threshold differences that preclude the use of binaural hearing aids appears to be less than clinically astute. Skinner does not tell us, however, what kind of assessment should be made during the experimental period to determine whether the binaural or monaural system provided greater benefit. Other related studies of binaural advantage and limitations include those of MacKeith and Coles (1971), Markides (1977), Causey
Hawkins (1985) discusses several approaches that have been used in the decision-making process regarding monaural versus binaural amplification. The first approach seems to be “prove binaural is better, then I’ll recommend it.” Proponents of this approach tend to utilize word recognition scores to demonstrate the superiority of monaural versus binaural performance. Studebaker et al (1980) and Hawkins agree that the reliability and/or validity of this method of evaluating binaural advantage has been questioned repeatedly because the variability of word recognition scores may exceed the differences between any two aided conditions. A second approach is to recommend binaural amplification unless there is a clear reason not to. This approach tends to depend more on patient subjective preferences during a specified trial period when determining the objective binaural advantage. The philosophy for not fitting binaurally to a patient with asymmetrical hearing loss because of the presence of interaural differences in word recognition scores or threshold differences has been pointed out by Hawkins as having “little evidence in the research literature to support this position” (p. 147).

Opinions regarding the efficacy of fitting binaural amplification to asymmetric loss vary greatly. There is no compelling research data that suggest that the presence of asymmetric hearing loss should, a priori, result in rejecting a recommendation to dispense binaural amplification. The binaural advantage for asymmetric hearing losses has been demonstrated by a number of investigators. Davis and Haggard (1982), however, report decreased word recognition in the presence of noise for those having asymmetric hearing loss when fit with binaural amplification. They suggest that when an interaural threshold difference of 15 dB HL or greater is present there may be a contraindication for binaural amplification. Their conclusions may serve to cloud the issue of fitting asymmetric hearing loss binaurally. One would think, with the advent of the advances in hearing aid technology, the constraints offered by Davis and Haggard would no longer apply to hearing aid selection and fitting protocols.

Audiologists can agree in general terms that there are patients with bilateral asymmetric hearing loss who cannot benefit from binaural amplification. The question is whether one should include in the diagnostic procedures more than word recognition scores and the magnitude of difference in hearing level between ears to assess candidacy and predict benefit. It is known, for example that it takes time for the patient to adjust to a new auditory image (Barfod 1979; Goldberg 1988; Turner et al, 1996). The amount of time it takes to adjust to a new auditory image, in part, depends on the age of the patient, previous experience with hearing aids, expectations of performance, mental capacity, and the degree to which the patient is willing to participate in a program for which there are no absolute predictors of success.

Individuals with sensorineural hearing loss have a lessening of sensitivity to acoustic stimuli. That is, there is an elevated threshold over a defined frequency range. The ULL, however, for these patients does not differ significantly from that of normal listeners (i.e., the dynamic range is reduced). For most patients with hearing loss, the magnitude of the hearing loss tends to be symmetrical. The dynamic range is reduced and, as a result, there are changes in perceived loudness growth. For the most part, hearing instrument selection is a straightforward procedure for symmetrical loss, but what kind of selection and fitting decisions do audiologists make for those with asymmetric hearing loss? Is it possible to manipulate the electroacoustic parameters of the hearing aid so that there is perceived benefit to the user? Chapter 1 presented a comprehensive overview of prescriptive formulas, which tend to calculate the required electroacoustic needs of the patient.

In a nonscientific, random approach, we asked a number of colleagues what criteria they employed to fit or not to fit hearing aids
for their patients with bilateral asymmetric hearing loss. By far the majority of our colleagues who responded to our questionnaire stated they would fit amplification for the poorer ear. It is not surprising that the majority of those who elected to fit the poorer ear stated that they relied more on the results of subjective preference than on the objective electroacoustic performance of the hearing aids. They also commented on the ability to control more acoustic parameters offered by digitally programmable analog hearing aids and with DSP. Some of those who responded to our questions relied on word recognition scores to determine benefit from aiding the poorer ear.

Perhaps stated in a simpler form, the audiologist’s judgment of benefit may differ from that of the patient. Two probable behaviors come to mind. First, audiologists may accept or reject binaural fitting for asymmetric hearing loss based on their clinical judgment, which demands that certain audiometric criteria be met in order for the patient to be a candidate. Second, the patient, however, may express benefit and acceptance of the hearing aids even though all audiometric fitting criteria (symmetry in threshold and word recognition) have not been realized. Audiologists have two choices. In the first instance, they can ignore the audiometric guidelines and permit the patient to experiment with the binaural fittings in order to achieve acceptance. In the second instance, they may suggest that the patient is not a good candidate for binaural amplification and recommend against the use of binaural amplification. The authors suggest that the second choice is less than acceptable and will deny the patient the opportunity to evaluate the contribution of the poorer ear.

Staab (personal communication) reported on two separate events related to bilateral asymmetric hearing loss in response to our request for an opinion regarding asymmetric hearing loss:

Many years ago, around 1973, Jim Curran, Bob Briskey, myself and a couple of others met in Minneapolis to respond to an FDA [Food and Drug Administration] proposed regulation relating to hearing aid dispensing practices. This issue came up and everything written seemed as if it came from the same unidentified source. We were about to mimic their statements when Jim Curran said something to the effect, “Why can’t we fit asymmetric loss with hearing aids? I see it quite often.” Many people write that it is best if thresholds are within 15 dB HL of each other and that word recognition scores should be within 7 to 12% of each other. Others suggest that the decision might be made on selecting the ear with the widest dynamic range, the best word recognition score, or ear preference. The thinking is that too great a discrepancy between the ears may result in the poorer ear reducing the performance of the better ear. Still we believe it would be wrong to eliminate binaural amplification for asymmetrical loss, except for certain lifestyles (i.e. physically challenged, home-bound, etc.) or if it may make use of two instruments more difficult to manage than one. We believe there can be no hard-and-fast rules for this.

Staab also told us of his experience with a young lady with an asymmetrical hearing loss:

Her word recognition score on the poor ear was 54% and the better ear score was quite high. An instrument on the poor ear alone sounded muffled to her. However, when we added the aid to the better ear (based on word recognition score), her ability to hear, localize, provide balance, etc., was so great that she started crying immediately, because she had never heard so well. The audiologist who had fitted her previously had fitted her with a single instrument to her better ear because the word recognition score in her poor ear was too low to be of any perceived benefit. I will always try to fit both ears unless the patient tells me that it just isn’t working or if there is some other kind of extenuating circumstance. The following is my own basic philosophy, regardless of what texts and other may say: I believe that patients will tell you what the problem is, tell you what they need, and not to make predetermined judgment about what we think is best for them or to satisfy our need. Even with asymmetric hearing
loss, I believe that instead of [audiologists] generally defining the criterion for binaural candidacy, patients should be given the opportunity to experience a complete system before decisions are made about which half of the fitting is not necessary.

Dr. Carol Mackersie (San Diego State University, personal communication) offered the following comment:

It seems like there is little consensus on most hearing aid issues these days. I generally agree with your [R.E.S.] philosophy of fitting binaural as a general rule and letting the patient decide if it is beneficial. This has worked for me for twenty years and I have often been surprised that patients choose to keep the second aid given an enormous asymmetry. Veterans Administration audiologists tend to compare monaural word recognition scores to see if binaural amplification makes things worse. I don’t know if there are any studies on this. I would doubt that they would find significant differences if they are applying binomial confidence intervals (Thornton and Raffin, 1978). Jerger has done some research on binaural hearing interference you might want to look at. He suggests that prognosis for successful hearing aid can be predicted from dichotic sound-field results.

Clearly, there needs to be some general consensus for a recommended guideline regarding the clinical practice to be followed when fitting asymmetric hearing loss. In view of the existing controversy, consider the following as a workable definition of asymmetric hearing loss and the subsequent selection and fitting of hearing aids.

Given that an asymmetric hearing loss implies a significant difference between ears regardless of magnitude, the amplification must improve hearing performance so that objective and subjective evaluations can verify the improved performance. Such differences can be expressed in terms of narrowband threshold improvement (i.e., functional gain), most comfortable listening level, word recognition score, loudness growth compensation, and positive subjective responses to amplified sounds. Granted this is a loose definition, but it is one that embraces the importance of empirically determining the advantage or disadvantage of binaural amplification when asymmetric hearing loss exists.

In view of the divergence of opinion regarding binaural amplification by those with asymmetric hearing loss, a dilemma presents itself to the audiologist.

In Figure 8–1, the right ear has a pure tone average (PTA) of 40 dB HL. A word recognition score of 88% was obtained when speech stimuli were presented at a comfortable level. For the left ear, the PTA was 63 dB HL and the word recognition score was 32%. Is this patient a reasonable candidate for binaural amplification, or does one fit only the better right ear? Should the patient fail to gain any benefit from binaural use, the audiologist may want to determine whether a right contralateral routing of signals (CROS) or right BICROS configuration might be helpful. Look at the asymmetric loss in Figure 8–2. Only the pure tone thresholds are presented in Figure 8–2, but the difference between ears is fairly typical of asymmetric hearing loss. There is little doubt that the left ear is a viable candidate for amplification. We also think that the poorer right ear should be fit as well. One can always change one’s mind should the binaural use of amplification fail to demonstrate benefit and/or satisfaction.

Figure 8–3 presents an even greater challenge to the audiologist. In this case, the PTA in the right ear is 48 dB HL and the PTA for the left ear is 90 dB HL with no measurable hearing beyond 1000 Hz. Few audiologists would question a recommendation for fitting the right ear. The question is whether or not one should recommend a hearing aid for the poorer ear. The magnitude of hearing loss in the poorer ear may preclude the possibility that binaural amplification would offer any benefit. If one were to fit the left ear, what clinical rationale would be used to justify the decision do so?

The recommended fitting strategies expressed in this chapter are those that we
have developed over the last 25 years as well as the contribution of colleagues and patients during that span of years. To state with absolute impunity that such fitting strategies are those to be employed by all who select and fit hearing aids would be illogical. Nonetheless, it is fair to state that the fitting strategies described in this chapter have been very useful in meeting the amplification needs of patients having asymmet-

**Figure 8–1.** Audiogram indicating a mild to moderately severe hearing loss for the right ear and a moderately severe to profound hearing loss in the left. Note that the interaural threshold difference exceeds 15 dB at each frequency. Word recognition scores between ears differ by 56%.

**Figure 8–2.** Audiogram indicating a moderate to severe hearing loss with a gradually sloping configuration for the right ear. Results for the left ear reveal a slight to moderate hearing loss that is steeply sloping from 2000 to 4000 Hz.
The fitting strategies discussed here have been modified over the years as additional information and fitting protocols became available. Additionally, one must take into account the rather recent advances in hearing aid design and function, which permit a much more efficient interface with hearing loss. Digital signal processing aids have contributed greatly to the fitting of bilateral asymmetric hearing losses. Holube and Velde (2000) list the following advantages of DSP: (1) miniaturization, (2) low power consumption and low internal noise, (3) reliability, (4) stability, and (5) programmability and signal processing of acoustic signals. To these we would add cosmetic appeal, noise reduction algorithms, rapid statistical analysis of sound entering the hearing aid, and speech enhancement algorithms.

**Binaural Advantage**

Catherine Palmer reviewed the binaural advantage in Chapter 7. Some of the problems encountered in fitting bilateral symmetric hearing loss are not unlike those problems encountered by patients with bilateral asymmetric hearing loss. Obviously there are some significant differences between symmetrical and asymmetrical loss. Binaural amplification has been embraced for well over 50 years. Yet it was not until the mid-1980s that binaural fittings became commonplace when a binaural hearing loss was identified. To some extent this extended delay between concept and common acceptance is true for asymmetric hearing loss. Some audiologists assume that one could not successfully fit patients with significant differences in threshold sensitivity between ears. Whether this was due to limitations of linear analog hearing aids to successfully fit asymmetric hearing loss is not clear. It now seems that more audiologists are willing to experiment with binaural amplification to determine if any substantial benefit can be confirmed. But more attention needs to be given to the patient’s assessment of benefit, with somewhat less emphasis on objective electroacoustic measures. That is, there is more to a successful fitting than assessing pure tone threshold levels and word recognition scores. It is evident that audiometric assessment of those with bilateral asymmetric hearing loss constitutes a determination.
of candidacy. Assuming that the patient is a reasonable candidate for assessing the benefit of amplification, two issues come to mind: verification and validation. Verification is an objective assessment of the hearing aid’s electroacoustic performance and whether or not specific criteria are met. Validation implies that the patient is receiving, or not receiving, benefit and/or satisfaction. There are a number of rating scales for determining benefit, acceptance, and satisfaction that will be discussed later.

Stated more simply, the audiologist’s acceptance of benefit/satisfaction may differ significantly from the patient’s. Two ramifications come to mind. First, audiologists may accept or reject binaural fitting of asymmetric hearing loss based on their clinical approach, which demands that certain audiometric criteria (meeting target gains, percent of word recognition, interaural differences, etc.) be met. Second, patients may not care whether the audiologist’s criteria are met if they feel that benefit has been achieved. This is a double-edged sword. The audiologist may achieve whatever measurement criteria were imposed, yet the patient may reject the use of hearing aids. On the opposite side, the patient may find binaural amplification useful, even though objective hearing aid measures were not met.

We question whether objective real-ear measures and word recognition scores are sufficiently sensitive to determine patient benefit/satisfaction in typical listening environments. We are not suggesting that such objective measures should be abandoned, rather that they should not constitute the entire database from which decisions affecting use are made.

Dr. Raymond Carhart (1950) commented on the “holy grail” of hearing instrument fitting:

There is a series of clinical goals to be reached provided that goals are obtainable within the constraints of contemporary technology and the patient’s hearing disorder. Most clinicians recognize three achievements as the minimum to be sought. First, restore to the user an adequate sensitivity for the levels of speech and of other environmental sounds he finds too faint to hear in the unaided condition. Second, restore, retain or make acquirable speech in ordinary and relatively quiet environments. Third, keep the higher intensity sounds that reach the hearing aid from being amplified to intolerable levels.

To these three laudable goals we would add the following: To achieve as closely as possible adequate binaural function when an asymmetric hearing loss exists. It would appear that these goals are equally applicable to those with asymmetric hearing loss and those with symmetrical loss.

Objective versus Subjective Measures

Since the introduction of hearing aids, there has been some controversy involving the appropriate approaches for selecting and fitting hearing aids. It is unlikely that the controversy will be resolved in the near future, but it is possible that DSP may lessen the magnitude of the controversy. Audiologists who have failed to keep current with the technologic advances run the risk of denying patients the possible binaural benefit received from the latest technology. Some audiologists hesitate to fit binaurally when the patient presents with an asymmetric hearing loss. Such decisions may be a matter of ignorance. That is, the audiologists may not be aware of the new DSP technology, coupled with advances in programmable and multi-programmable linear amplification. There are a number of clinical procedures (existing fitting formulas) that may be useful in the hearing aid decision-making process. Now that we have a technology promising significant benefit to the patient with hearing loss, audiologists may be able not only to achieve consensus for measuring auditory behavior, but also to apply the results of such an analysis to the fitting of hearing aids. We believe that these technologic advances will obviate the necessity of “flying by the seat of one’s pants.”

Objective Measures

By “objective measures,” we mean that some electroacoustic performance goals have been
established that should be met by the hearing aids. For example, of the many prescriptive formulas in use today, McCandless (2000) lists several methods that seem to be the most widely accepted. They are the Berger et al (1988) method; prescription of gain and output (POGO) (McCandless and Lyregaard, 1983); the National Acoustic Laboratories revised method (NAL-R) (Byrne and Dillon, 1986); the Libby (1986) \( \frac{1}{2} \) to \( \frac{3}{4} \) method; and the Cox et al (1985) method. Some of the earlier fitting methods were limited to linear hearing aids. Recently, several fitting formulas have been modified to answer some of the signal processing associated with nonlinear hearing aids. Among the more recent formulas used for nonlinear hearing aids, one must include the following: NAL nonlinear version 1 (NL1) (Dillon et al, 1999), the Independent Hearing Aid Fitting Forum (IHAFF) (Cox, 1995b), and DSL input/output (i/o) (Cornelisse et al, 1995).

The primary objective of many fitting strategies is that the measured real-ear gain matched the prescribed gain. Once the recommended target gain has been established, it is assumed that the actual gain of the hearing aid will equal or approximate the recommended gain. However, in some cases the recommended target gain cannot be reached due to the magnitude of the hearing loss, or the design characteristic of the hearing aid.

In addition to providing target gain requirements, some formulas include the computation of the prescribed output saturation sound pressure level (OSSPL90).

Objective methods assume that the optimal amplification needs of the patient have been met if the target gains are achieved. In practice, however, this assumption may be invalid in that the qualitative assessment of the prescribed amplified signal may be less than positive. Even if the target gain has been achieved, the patient may not like the sound quality and may even reject amplification. In support of this scenario, Humes and Houghton (1992) stated: “Matching obtained gain to prescribed gain does not ensure that the hearing instrument wearer is receiving significant benefit from amplification. Benefit must be verified with the wearer” (p. 33). This observation regarding instrument performance and patient acceptance would seem to support the necessity of monitoring the subjective responses of those utilizing hearing aids. Additionally, there is no general agreement among audiologists about which of the numerous fitting protocols most closely meets the needs of the patients. Most of the fitting methods were established based on monaural sensorineural loss using linear amplification coupled to an occluding earmold.

Regarding bilateral asymmetric hearing loss, it may be more difficult to match target gain, particularly for the higher frequencies. Thus more emphasis should be given to subjective assessment.

**Subjective Measures**

Understanding the importance of a patient’s subjective reactions to amplified sound is critical in the selection and fitting of hearing aids for those patients with bilateral asymmetric hearing loss. The audiologist should be aware that there are several possible responses found among inexperienced users of amplification having asymmetric hearing loss. One response is immediate acceptance of amplification with little or no negative reaction or extended periods of adjustments to amplified sound. Other patients adjust fairly well to amplification, but their trial period may need to be extended. Still other patients report considerable difficulty in adjusting to amplification and never completely accept the hearing aid regardless of its electroacoustic performance. Finally, there is the possibility of incorporating some of the assistive listening devices (ALDs) to augment the patient’s ability to react more appropriately to amplified sound.

It is the attitude not only of the patient that is of considerable importance in the successful selection, fitting, and utilization of hearing aids, but also that of the audiologist. If audiologists fail to appreciate the value of empirical evidence (trial and evaluation) regarding bilateral asymmetric hearing loss, they may deny the patient the advantages arising from binaural amplification. If there
is rigid adherence to hard-and-fast rules concerning candidacy for binaural hearing aid use, much may be lost to patients who fail to meet whatever restrictive audiometric criteria are employed.

We are not suggesting that all patients with bilateral asymmetric hearing loss can benefit from binaural amplification. In some instances, there are those who may gain limited benefit from CROS, BICROS, or power CROS. In our clinical experience, CROS configurations have not met with a great deal of success. The point here is the need for audiologists to consider evaluating binaural amplification when measurable hearing is present in the poorer ear. The possibility that sound may be made audible through amplification should be assessed. Even though minimal acoustic clues become audible, there may be sufficient hearing to assist in understanding the intended message or to allow a greater awareness of one’s acoustic environment.

Technological Advances and Fitting Asymmetric Hearing Loss

With the introduction in 1996 of DSP, a major advance toward greater flexibility in the fitting process was made. This is because when one converts the incoming electrical signals to a series of binary codes there are unlimited ways in which the codes can be processed. Audiologists now have a rather advanced technology in hearing aid design and function to more closely meet the amplification needs of those with bilateral asymmetric hearing loss. For example, most patients with asymmetric hearing loss have significant interaural differences in dynamic range. In general, the narrower the dynamic range, the more difficult it will be to provide the appropriate amplified signal when using linear hearing aid devices. Certainly, hearing aids with some form of compression have contributed to the greater success with which symmetric hearing loss can be fit (Venema, 2000). The benefit of input and output compression as a means of interfacing with the amplification needs of patients is well established. More importantly, hearing aids are now available in which the frequency-gain response can be processed in two or more channels. Some of the current DSP hearing aids have at least nine channels. Each channel is independent in function, thereby permitting the audiologist to manipulate the parameters in each channel to improve the patient’s ability to better understand speech. The number of signal processing channels needed to more closely meet amplification needs is still undecided. For example, the frequency-gain response can be divided into two or more channels and gain, compression ratio, compression kneepoint, and attack and release times can be independently managed. This type of independent processing function in each channel increases the possibility that those patients with bilateral asymmetric hearing loss may benefit appreciably, as suggested in Figure 8-4. In this case, aside from the obvious differences in interaural thresholds, there are significant differences in the dynamic range between ears. With the recent introduction of DSP power instruments, those patients with severe to profound hearing loss may be helped greatly.

There have been advances in nonlinear analog hearing aids as well. Such advances are reflected in the contribution of programmable and multiprogrammable hearing aid systems. The increased performance of these analog systems has resulted in an enhanced ability of patients to appreciate their acoustic environment and respond more appropriately to speech. We do not intend to ignore the contributions of advanced analog hearing aids; rather, we underscore the additional advantages offered to the patient with asymmetric hearing loss. The advantages of DSP were discussed earlier in this chapter.

Prior to recent technologic developments in DSP and nonlinear analog hearing aid devices, it was difficult to meet amplification needs of those with a narrow dynamic range (Fig. 8–4). Several hearing aid systems are now available that permit the audiologist to provide sufficient amplification so that audi-
bility, even in most severe cases, may be achieved. Because of the loss of outer and inner hair cells due to drugs, aging, or disease processes, there is a change in loudness growth. The greater the damage to the inner hair cell population, the more restricted is the dynamic range. The more restricted the dynamic range, the greater the rate of loudness growth. It is possible that the patient may have one ear in which abnormal loudness growth is greatly different from the other, as shown in the left ear in Figure 8–4. Fortunately, hearing aids are now available in which the compression ratio can be better controlled within specific frequency channels. By so doing, the sounds to the poorer ear may be amplified sufficiently to achieve audibility. To repeat, with DSP instrumentation, the number of channels can be increased. In addition, each channel performs independent processing tasks.

**Meniere’s Disease and Asymmetric Hearing Loss**

One example of a disease process often resulting in an asymmetric hearing loss is Meniere’s disease. This disease process usually results in a unilateral, low-frequency hearing loss, vertigo, tinnitus, and a sensation of fullness. In addition, the affected ear usually reveals a sensorineural hearing loss that is rising in configuration and exhibits reduced word recognition and intolerance to loud sounds. In this case, the audiologist must decide whether to fit CROS or BICROS amplification to the better ear, fit a hearing aid directly to the poorer ear, or do nothing at all. Whenever there is a narrowing of the dynamic range, interaural threshold differences become more apparent.

When these interaural differences in hearing exist, the fitting of hearing aids presents a challenge to the audiologist. It is our firm conviction that in these cases the poorer ear should be fit with an appropriate instrument. However, there is a caveat: Meniere’s disease tends to be episodic. Therefore, the electroacoustic characteristics need to be changed over time. Not only are multiple channels needed for this population, but also hearing levels need to be reassessed to determine if changes in the hearing aid response are indicated and appropriate. One of the more astute methods of fitting hearing aids to those patients experiencing an attack
of Meniere’s disease is the selection of a multiple memory hearing aid. The electroacoustic parameters can be set to yield one response when the Meniere’s disease process is at its worst and another when the process it is at its best. The use of the words “appropriate hearing instrument” suggests that, for the most part, linear amplification will not optimally resolve the amplification needs of the patient because of a reduced dynamic range. Earlier it was briefly mentioned that abnormal growth of loudness was present as a result of specific disease processes. The audiologist must exercise care to avoid overamplifying the affected ear and reducing the dynamic range. Assessment of the patient’s ULL in both ears will assist in avoiding overamplification.

For many patients, the problems associated with Meniere’s disease will resolve over time. If the audiologist decides to fit a CROS or BICROS hearing aid without assessing the value of amplifying the poorer ear, it may very well constitute an error in clinical judgment, one that may compromise the patient for whom benefit was intended. One advantage of CROS/BICROS amplification is that it provides awareness and discrimination of sound arising from the side of the poorer ear. The greatest benefit derived from such fittings occurs in quiet listening environments. For those environments in which background noise is appreciable, the value received from CROS/BICROS amplification is decreased.

On the opposite side of this clinical coin is the careful selection of the frequency-gain response to best correspond with the ear’s capacity to process acoustic information. With attention given to hearing aids representing the latest technology, which has more discrete control of the output limiting function of the hearing, it may be possible to approach equal, or nearly equal, sensitivity of the good ear. This statement is not intended as a condemnation of CROS fittings. Rather, this suggestion is intended to indicate the value of empirically evaluating the extent to which amplification can be employed when an asymmetric hearing loss exists.

As mentioned earlier, Meniere’s disease usually results in a sudden onset of a unilateral loss accompanied by nausea, dizziness, and vertigo. Each of these symptoms may resolve over time. During the process of recovery, amplification requirements will change. The magnitude of that change is not predictable. Thus the audiologist must select a hearing aid that provides appropriate amplification when the condition is at its worse or at its best. If the patient has been fitted with a hearing aid for the affected ear, the audiologist may be best advised to consider selecting a programmable hearing aid to adapt to fluctuations in hearing level. As the electroacoustic needs of the patient change, adjustable parameters could be changed to meet the patient’s amplification needs. Rather than having to return the hearing aid to the manufacturer for modification, it would be a simple matter to reprogram the frequency-gain response to meet the acoustic demands of an unstable hearing loss.

**Case Studies Involving Asymmetric Hearing Loss**

Audiometric results have been selected to illustrate a wide variety of asymmetric hearing loss. Additionally, only those patients benefiting from binaural amplification are presented. The patient selection is not intended to overstate the value of clinical judgment in fitting asymmetric hearing loss. Selections were made, rather, to underscore the importance of assisting individuals in gaining a better appreciation of their acoustic world through the judicious use of binaural amplification, when possible.

Figure 8–5 presents an audiogram from a 62-year-old man with bilateral hearing loss of long duration. At the urging of his son, an otolaryngologist, he was referred to an audiologist. One will note that there is a significant disparity in threshold sensitivity between the right and left ears. The left ear has a slight improvement at 8000 Hz. The right ear has a moderate to severe hearing loss gradually sloping in configuration. If conventional fitting rules were applied in this
In certain cases, the patient would be fit with monaural amplification to either ear but not to both. It is possible the patient would be fit with a left CROS hearing aid. However, when the Central Institute for the Deaf (CID) W-22 list was administered to the right ear, a word recognition score of 80% was achieved at MCL. For the left ear, word recognition was 88%. This patient had no prior experience with amplification and indicated a desire to be fitted with a hearing aid to the left ear only. Nonetheless, the patient was counseled to evaluate binaural amplification to determine if improved word recognition in noise could be accomplished, when compared to listening with amplified sound in the left ear only.

Binaural in-the-ear (ITE) hearing aids were recommended. Each aid had signal processing functions specifically prescribed to provide maximum benefit for the patient’s bilateral asymmetric hearing loss. The ULL for each ear was somewhat different. For the right ear, the live-voice ULL was 95 dB HL. For the left ear it was 90 dB HL. With current technology, the need to provide amplification with different output limits could be accomplished without difficulty. In the aided condition, little change was measured in the word recognition score.

As can be seen in Figure 8–5, the aided threshold for the left ear is better than the aided threshold for the right ear at 500 to 3000 Hz. Even though the conventional audiometric criteria are not met for recommended binaural amplification, the patient performs better with binaural than with either ear alone. To emphasize this point, observe that the differences between threshold sensitivity for 250 through 4000 Hz are markedly less in the aided mode than the unaided mode. Following a trial evaluation in a number of everyday listening environments, the patient soon appreciated the contribution of binaural amplification. He admitted that aided binaural hearing was significantly better than aided monaural hearing in all listening situations. One assumes that the objective contribution was that of improving audibility of the acoustic stimuli in the poorer ear. From a subjective point, follow-
ing a trial period with binaural amplification, the patient was able to obtain benefit, acceptance, and satisfaction.

Had this patient been fitted with amplification to the left ear, it would have been very difficult for him to process acoustic information arriving from the unaided right ear. Coupled with the severity of the hearing loss, along with the head shadow effect, the patient's acoustic world existed primarily on the left. This is true not only for speech but also for other information-bearing signals.

It cannot be stressed too strongly that patients with asymmetric hearing loss should be provided a trial fitting with binaural amplification. Clearly, if contraindications are not present, the audiologist should initiate clinical trials of binaural amplification.

Figure 8–6 shows the audiologic data for a 74-year-old woman with a long-standing bilateral asymmetric hearing loss. She presented with mild to severe sensorineural hearing loss for the left ear. There was a moderate to severe to profound loss in the right ear. Word recognition scores were 88% in the left ear and 32% for the right ear, when CID W-22 word lists were presented at MCL. ULLs were 85 dB HL for the right and 95 dB HL for the left ear. The patient was aware of the marked disparity in word recognition between ears. She strongly favored binaural amplification, however, because it created a balanced hearing environment that could not be achieved with monaural amplification alone. We did not feel that the interaural differences in word recognition presented any obstacle sufficient to deter her from trying binaural amplification.

Interesting enough, at a later date she indicated a desire to be evaluated again, with specific references to her left ear. Subjectively, she felt that the acoustic level of speech signals to that ear should be greater than provided by her current hearing aid. She did not question the value of additional amplification to the right ear, but wished to improve the efficiency with which the better ear performed.

Again, had the audiologist followed traditional audiometric guidelines the patient may not have been considered a candidate for binaural amplification because of the

![Figure 8-6](image)

**Figure 8–6.** Audiogram indicating a gradually sloping moderate to severe to profound hearing loss for the right ear. Results for the left ear reveal a mild to severe hearing loss from 500 to 8000 Hz with a gradually sloping audiometric configuration between 1000 and 8000 Hz. Note that the difference in word recognition scores is 56%.
large interaural differences in word recognition scores and differences in thresholds. As such, it would have been judged that the right ear could not really contribute a great deal to understanding the intended message. Nonetheless, the patient functioned better because she felt binaural amplification provided a more natural sound. Therefore, she was able to better recognize speech in her everyday listening environment.

Figure 8–7 shows the audiometric results of a 68-year-old man. The hearing loss is asymmetrical, with hearing in the left ear being significantly better. The patient had been using a BICROS aid since 1986. Note that the word recognition score for the right ear was 76% when the words were delivered at MCL. There was no tolerance problem. Even in view of these audiologic findings, the patient was not considered a candidate for binaural amplification by the audiologist who fit the patient with a left BICROS.

The patient was dissatisfied with the performance of the left BICROS, except in relatively quiet listening conditions, and seldom wore it. Furthermore, he reported that sound localization was not improved by the BICROS configuration and there was no perceptible improvement in word recognition. Further, the patient stated that in crowds where the noise level was rather high, it was extremely difficult, if not impossible, to understand the spoken word. His rejection of BICROS was evident when he refused to wear the system.

Following a hearing aid evaluation, the patient was fitted with binaural behind-the-ear (BTE) hearing aids with automatic low-frequency reduction circuitry. When assessing real-life differences between monaural and binaural amplification, the patient stated that he experienced superior performance with the binaural fit in essentially all conversation environments where noise was present.

It is reasonable to assume that this patient could have realized the benefit of binaural amplification some 6 years earlier if the binaural fitting had been recommended instead of the BICROS. One can assume only that the audiologist fitting the patient was convinced that the presence of an asymmetric hearing loss argued against using binaural amplification.
amplification. One cannot state with im-
purity that all asymmetric hearing loss will
respond as favorably to binaural amplifica-
tion. In this case, however, the patient per-
formed better to his acoustic environment
with binaural amplification.

Figure 8–8 illustrates a fairly typical asym-
metric hearing loss. A review of the audi-
ometric data suggests an asymmetric hearing
loss in which the left ear has hearing within
normal limits through 1000 Hz, but a severe
to profound loss at 2000 through 8000 Hz.
Word recognition scores for the left ear at
MCL was 76%. The right ear has a mild-to-
severe hearing loss gradually sloping in con-
figuration. The word recognition score was
82% at MCL. The question is whether the left
ear should be fitted with a hearing aid. There
is no question that the right ear is a candidate
for amplification. In this case, little is to be
gained by aiding the left ear, in view of the
severity of the loss above 1000 Hz.

This patient would probably perform best
with a hearing aid fitted only to the right ear.
To achieve maximum benefit, the gain of the
right hearing loss should be adjusted so that
the threshold sensitivity at 500 and 1000 Hz
approaches the threshold sensitivity of the
left ear at 500 and 1000 Hz. In this manner
binaural function may be enhanced, permit-
ting the patient to achieve better sound local-
ization and improved word recognition in
noise. One may question whether this is a
contradiction in one’s philosophy of fitting
asymmetric hearing loss. We do not think so
because the loss of hearing above 1000 Hz is
so precipitous that current hearing aid tech-
nology cannot make the impaired range audi-
ble without risking overamplification of that
frequency range between 500 and 1000 Hz.

**Contraindications for Fitting Bilateral
Asymmetric Hearing Loss**

Contraindications for binaural amplification
in the cases of asymmetric hearing loss may
include the following instances:

- When performing functional gain mea-
sures for the poorer ear and there is
measurable hearing in the aided and unaided modes at the limits of the audiometer. It may be clinically astute to investigate the use of a CROS configuration.

- When there is medical evidence contraindicating the use of amplification to active pathologic ears: Such cases, however, should be considered for binaural amplification when the medical condition is resolved and the physician approves the application of hearing aids.

- When the patient has an asymmetric hearing loss and had experimented with binaural amplification and this experience showed little or no benefit from a second hearing aid to the poorer ear: For these patients, a CROS or BICROS arrangement may provide some degree of assistance in relatively quiet environments. Equally as important is the appropriate counseling of the patient. The counseling should emphasize the advantages and limitations imposed by the poorer ear and the subsequent difficulties of understanding the intended message in the presence of unwanted noise.

**Verification of Hearing Aid Fitting and Performance**

Electroacoustic assessment is an objective method of verification that indicates if the measured frequency-gain response of the hearing aids meets the prescribed gain. Based on thresholds for discrete frequencies, the frequency-gain response of the hearing aids should provide sufficient gain so that the measured real-ear approximates the prescribed real-ear gain dictated by a specific fitting formula. The assumption is that the patient has been provided satisfactory amplification. In reality, however, achieving prescribed gain may provide only a “first approximation of need” (Libby, personal communication). As mentioned earlier, there is often a need, regardless of the fitting formula utilized, for adjusting the frequency-gain response to achieve patient acceptance and optimal electroacoustic performance.

When fitting asymmetric hearing loss, fitting formulas are, for the most part, of limited value. For example, if the patient has a severe to profound impairment in one ear, the recommended prescribed target may not be reached simply because the hearing aid is incapable of providing audibility. With recent changes in some fitting formulas, namely the National Acoustic Laboratories-Revised Profound (NAL-RP) (Bryne et al, 1990) and POGO II (Walden et al, 1983), closer approximation of electroacoustic needs can be reached. For the profound hearing loss there is no instrument, including the latest DSP hearing aids, that can provide sufficient gain. Therefore, other interventions should be undertaken to assist those with profound, bilateral asymmetric hearing loss.

With the advent of programmable hearing aids, and especially DSP, the task of determining the appropriate electroacoustic response of the hearing aids in a specific listening environment is a challenging one. That is, most existing fitting formulas provide only a single recommended frequency-gain response. The assumption is that when the prescribed gain is achieved, the hearing aid is thought to be satisfactory in most, if not all, conversational environments. To provide some objectivity to the decision-making process, some hearing aid manufacturers provide a fitting formula for specific listening conditions. Obviously, such fitting methods can be verified by real-ear measurement. With programmable hearing aids providing more than a single response, it is a somewhat easier task to fit hearing aids on those patients having bilateral symmetric hearing loss. Although there is no consensus regarding how many individual channels are needed to meet acoustic requirements, it would seem that three or more are needed. We believe that the latest innovation in DSP instrumentation in 2002 will offer a great assistance to the fitting process.

**Patient Evaluation of Perceived Benefit**

We support the notion of using patient preferences to modify the initial frequency-gain
response, which may have been selected using one or more prescriptive formulas. The premise on which such assumptions are made is simply that the patient will make the final decision concerning acceptance or rejection of hearing aid use. With the introduction of programmable and DSP hearing aids, audiologists now have a significantly greater latitude in modifying the electroacoustic response of the hearing aids. For some patients with asymmetric hearing loss, the only way in which one can assess the benefit gained from amplification is by having the patient try to assess the benefit received over a period of time. For example, if the patient has a severe loss in one ear and a moderate loss in the other, what value is gained by fitting a hearing aid only to the poorer?

There are no universally accepted guidelines on which to base the contribution of amplification for the poorer ear. There are two avenues for evaluation. One approach is whether sounds are audible when amplification is provided. The other is whether, regardless of how restricted the frequency range is, the hearing aid provides some useful information about the acoustic environment in which the patient functions. To determine the latter, some form of self-assessment scale or inventory may be successfully employed. Hosford-Dunn and Huch (2000) present a thorough review of a host of self-assessment inventories.

**Psychoacoustic Assessment of Hearing Aid Utility**

Prior to the development of real-ear measures and the subsequent advantages offered to the audiologists, psychoacoustic assessment was the only quasi-objective method of assessing hearing aid performance. Aided and unaided measurements in a sound field (i.e., functional gain) provided useful data about the contributions of hearing aids. Improvement in threshold sensitivity and word-recognition scores and assessment of unaided and aided MCL and ULL were useful indicators of aided benefit. Psychoacoustic measurements (i.e., functional gain measures) are of considerable value today and a very useful tool in deciding whether patients are benefiting from amplification. This is especially true for some asymmetric hearing loss, where real-ear assessment is limited in the kinds of information that can be provided in making decisions about perceived benefit. Obtaining the patient’s responses to speech and pure tones presented in a sound field yields information as to aided audibility and word recognition. Such information is most useful in counseling the patient on the benefits and limitations of the hearing aid. This is so because sharing information (word recognition, threshold sensitivity, ULL, aided versus unaided response, etc.) about hearing aid use, coupled with sharing information about the limitations of hearing aids, is very helpful. Further, the more aided information the audiologist can obtain, the more effective is the information given to the patient and the more realistic are the suggestions given to the patient to enhance hearing aid use.

The kinds of objective electroacoustic information given to the patient depend in part on the type of hearing aids the patient is wearing. If the patient is wearing a linear analog hearing aid, its use will impose limitations that are greater than those for nonlinear hearing aids. However, reliance only on word-recognition score as a means of determining efficiency of hearing aid benefit is suspect at best. In most cases, word-recognition scores are usually obtained in a sound-controlled quiet environment. Even if the audiologist assesses word recognition in an acoustically controlled background of noise, it does not replicate all of the environmental sounds the patient will encounter in activities of daily living.

Jerger (personal communication) stated, “Although systems for the measurement of real-ear gain of hearing aids represent significant technologic advance over analogous closed coupler measurements in quantifying the frequency-gain response of hearing aids, a good fitting involves much more than the
determination of the optimal frequency-gain response." The audiologist must answer the following questions:

1. Is the use of any hearing aids appropriate?
2. What is the best arrangement and configuration of the hearing aid system (e.g., BTE, ITE, canal, monaural versus binaural, CROS/BICROS)?
3. Does the patient perform adequately with the recommended aids in understanding speech in realistic environments?
4. Is there a better solution than a hearing aid (e.g., assistive listening devices)?

To answer these questions, a thoughtful and responsible audiologist must necessarily incorporate into the evaluation system measures that go far beyond the real-ear frequency-gain response. They will typically involve some measure of the patient’s ability to understand real speech in a realistic environment. They may involve sound quality judgments, paired comparison, adaptive measures of signal-to-noise ratio (SNR), or more traditional speech audiometric measures. Whatever their nature, however, they will broaden the evaluative spectrum beyond the narrow confines of frequency-gain responses.

Jerger’s comments would seem to reinforce the idea of looking at other behaviors such as the patient’s assessment of value in a number of listening environments. This type of evaluative process is certainly indicative of assessing benefit of amplification for those with bilateral asymmetric hearing loss.

Recommended Guidelines in Determining Hearing Aid Candidacy

Probably no text dealing with hearing aid fitting strategies would be complete without some suggested guidelines to determine when patients are candidates for binaural, monaural, or CROS/BICROS fitting. The reader should keep in mind, however, that the primary intent of this chapter has been that of clinical justification for binaural amplification for asymmetric hearing loss. Therefore, comments about binaural application shall be restricted, for the most part, to hearing loss evidencing significant interaural differences in response to acoustic stimuli, either speech or pure tone. The working assumption presented here is that the better and/or poorer responders are candidates for amplification in most, but certainly not all, cases.

**Rule one:** Do not determine, a priori, that the utilization of binaural amplification is not appropriate simply because interaural differences (pure-tone threshold, word recognition, ULLs) are present that may fall within untested criteria recommending that binaural amplification is not appropriate.

**Rule two:** Always be aware of technologic advances that may alter significantly what can be provided electroacoustically for making the amplified sound one that provides information to those with bilateral asymmetric hearing loss (cochlear implant, middle ear implant, wired CROS/BICROS with dual microphones). The current contributions of DSP instrumentation are primary examples of recent advancements (introduced in 1996) in hearing aid technology, which promise great benefit to patients with hearing loss.

**Rule three:** Never underestimate the value of the patient’s subjective response to amplified sound. There are a number of self-assessment scales that can aid the audiologist to access the subjective impressions of the patient.

**Rule four:** For those cases in which the patient or the audiologist is unsure of the value received from amplification to the poorer ear, never hesitate to carry out a carefully constructed trial period to determine benefit/satisfaction. The purpose of the trial period is to permit the patient to determine the degree to which contributions from the poorer ear add to signal audibility, information processing, awareness of environmen-
tal noise, and sense of comfort while using the hearing aids.

Rule five: Given an asymmetrical hearing loss, if the poorer ear cannot respond to pure-tone stimuli presented at the limitations of the audiometer, CROS or BICROS hearing aids may be the most appropriate, depending on the magnitude and configuration of the hearing loss in the better ear. That is, if the input signal is not audible, little can be accomplished from fitting the poorer ear, although some tactile sensation may be present.

Rule six: Given an asymmetric hearing loss, if the poorer ear significantly degrades speech understanding, following an appropriate period of trial and evaluation, it is unlikely that continued use of amplification to the poorer ear can be justified. It is important for the audiologist to remember that the recognition of monosyllabic words, or lack thereof, in an acoustically controlled test environment does not correlate, necessarily, with understanding connected discourse in a variety of ambient environments. The patient should be able to assess the audibility of sentences during the fitting process and the subsequent trial period to determine, in part, the efficacy of fitting the poorer ear.

Rule seven: Given a bilateral asymmetric hearing loss, never attempt to assess binaural function if one or both ears have an active disease process. Any attempt to fit hearing aids in these cases is ill advised.

Rule eight: Given an asymmetric hearing loss in which the poorer ear has hearing within normal limits for a restricted range (250 through 1000 Hz) but has a precipitous and profound loss above 1000 Hz, fit only the better ear. It has been our experience that when there is precipitous hearing loss, little is to be gained by amplifying in the range where hearing is within normal limits (Fig. 8–8).

Rule nine: In the final analysis, the fitting of asymmetric hearing loss often involves clinical judgment rather than adherence to prescriptive formulas. Always discuss the advantages and limitations of hearing aid amplification. The presence of bilateral asymmetric hearing loss is a rather common finding among the hearing loss population. There is no common consensus of how the patient should be managed relative to fitting or not fitting a hearing aid for the poorer ear. If the audiologist decides to fit the poorer ear, the patient needs to be an integral part of the evaluation process in determining perceived benefit/satisfaction.

Rule ten: Never hesitate to modify any of these rules, if you’re able to improve the performance of any patient who has a bilateral asymmetric hearing aid. That is, no rule should be sacrosanct or inviolate.

Beyond Objective Measurements

Within the past decade, much more attention has been given to acceptance, benefit, and satisfaction as reasonable indicators of hearing aid use and the subsequent success. It is our opinion that these terms are mutually exclusive. That is, the patient may accept hearing aids amplification and faithfully use them on a daily basis. The acceptance and use of the devices, however, is not tantamount to the presence of benefit and satisfaction. The patient may accept the hearing aids, but actual benefit may be minimal and satisfaction may not have been realized. On the other hand, some patients may not accept the use of amplification even though there is strong evidence that positive benefit is measurable. Satisfaction in this case is relatively unimportant because the patient has already determined that the hearing aids are not acceptable. Obviously, one can be satisfied with amplification, but benefit may be lacking. For a more thorough review of the significance of benefit, acceptance, and satisfaction, the reader is referred to the work of Hosford-Dunn and Huch (2000), and to Chapter 5. We mention accep-
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tance, benefit, and satisfaction because those with asymmetric hearing loss have the same self-analysis as patients with symmetric hearing loss. Realistically, it may be more difficult to achieve success in fitting asymmetric hearing loss, but one must be cognizant of patient attitudes relative to determining acceptance, benefit, and satisfaction.

A number of surveys by Kochkin (1993, 1995, 1996, 1997) should be of interest to everyone involved in selecting and fitting hearing aids. He identifies some 60 variables that appear to be related to satisfaction. Some of these variables are (1) audiologist knowledge, (2) comfort and fit, (3) performance in specific listening situations, (4) visibility, (5) battery life, (6) ease of use, (7) quality of service, and (8) cost and expense. Granted, these variables are related to any number of hearing losses but are especially important to the fitting of hearing aids for patients with bilateral asymmetric hearing loss. We suggest this because one should not rely solely on electroacoustic performance at the expense of knowing how the patients respond to hearing aid use.

Acceptance is an "either-or," binary, decision. Either the hearing aid candidate accepts the device or does not. Satisfaction and benefit are not guaranteed, even though the patient may accept the hearing aids. Since 1996, audiologists have fitted DSP hearing aids, which provide subsequent advantages. The increase in the number of fitting parameters that can be controlled by DSP hearing aids permits audiologists to modify the gain and output to more closely meet the needs of the patient. In essence, more objectivity and subjectivity in the selection process can be realized.

There is a growing consensus among audiologists (Bentler, 1994; Sweetow, 1999; Hosford-Dunn and Huch, 2000) that much attention should be given to effective counseling and management strategies. Over the past 10 years, the hearing aid market has remained relatively flat. That is, market penetration has not been impressive. The dilemma is one of trying to rationalize why it is that so few hearing aids are dispensed. If there are about 26 million Americans needing some form of amplification, what is the major barrier impeding market penetration? One answer is quite clear and compelling: there is a need for a nonobjective protocol that evaluates the subjective needs of the patient. What are some effective management strategies that tend to assist the patient in arriving at an intelligent decision?

What Does the Patient Want the Hearing Aid to Do?

Not infrequently, the patient’s concept of hearing aid use is that of achieving normal hearing through amplification. Although a laudable goal, the patient needs to understand the limitations of amplification based on the magnitude and morphology of the hearing loss. A case in point would be that of a bilateral asymmetric hearing loss. It is quite possible for this patient to achieve significant benefit/satisfaction by using a second hearing aid in the better ear. However, caution is the operative word in fitting the poorer ear. If one chooses to fit the poorer ear, one should make certain that there is some type of process in the fitting protocol that includes some outcome measures. In our view, the audiologist should be willing to experiment with fitting a hearing aid to the poorer ear. There are a number of reasons why the audiologist may be a bit hesitant to fit the poorer ear. For example, some audiologists believe, as stated earlier, that if the threshold value of the poorer ear is 15 dB HL or worse than the better ear and the word recognition score is below a certain value, the patient is not a good candidate for binaural hearing aids.

This kind of clinical rigidity is not tenable. Such limitations may have been appropriate when most of the hearing aids were nonprogrammable analog linear devices. We think that it is never appropriate, regardless of the hearing aids selected by the audiologists. With advances in programmable hearing aids, however, and the introduction of DSP, some of the clinical taboos are no longer applicable. The current state of hearing aid
technology is such that audiologists no longer have to question whether hearing aids can or cannot perform the desired electroacoustic tasks. Rather, what do audiologists want the hearing aids to do in meeting the acoustic needs of the patient?

A Willingness to Be Different

A number of years ago, when at the office of a colleague, one of us (R.E.S.) noticed a small sign on his desk that read: “If you have never been criticized, it probably means you are not doing anything.” At first glance, one may feel that this is a rather harsh and unjustified expression. Perhaps it is true, but for us the sign suggests that learning is achieved by questioning the status quo. By challenging concepts, audiologists often advance the science we represent. One may ask what these statements have to do with asymmetric hearing loss.

Many years ago, as a neophyte in audiology and hearing instrument dispensing, one of us (R.E.S.) was taught that seldom, if ever, should one consider binaural hearing aid fittings. The general consensus was that binaural fitting could not be justified. To recommend such an approach to resolving hearing problems was just short of being unethical. The general consensus among members of the audiological community was that the fitting of binaural hearing instruments was primarily for the purpose of making a profit. Most members of the medical community held this bias against binaural amplification. Seldom would a physician, even an otologist, recommend binaural amplification, let alone refer a patient with bilateral asymmetric hearing loss.

In 1978 a rather scathing report from the Bureau of Consumer Protection to the Federal Trade Commission (16CFR Part 440) stated:

Binaural amplification is generally considered appropriate only for people with a relatively symmetrical hearing loss although some industry representatives dispute the point. Manufacturers and dispensers are understandably enthusiastic supporters of binaural amplification, since it means the sale of two hearing aids, rather than one. Audiologists are less enthusiastic principally because of the dearth of clinical evidence of binaural superiority. The advantages of binaural hearing include improved sound source localization, better word recognition ability, greater ease of listening and better sound quality. The advantages are essentially subjective and therefore often cannot be demonstrated with existing clinical techniques.

Libby (1980) edited a two-volume book on the status of binaural amplification at that time. His intent was to change the thinking of those who either recommended or dispensed hearing aids. A number of highly qualified persons contributed chapters to the book. One would like to believe that the book was instrumental in changing the minds of those recommending, selecting, and fitting only monaural hearing aids to patients with bilateral hearing loss.

Since 1980, there has been a rather marked change of clinical attitude regarding binaural amplification. For most audiologists who select, fit, and dispense binaural hearing aids, a binaural fitting is now standard practice. There is still, however, much controversy regarding the fitting of asymmetric hearing loss. Although patients with asymmetric hearing loss are candidates for binaural fitting, clinical criteria for the selection process eliminate many that may have benefited had they used binaural amplification. That is, much emphasis is placed on differences in hearing threshold levels. Other criteria demand that a certain word recognition score for the poorer ear be met relative to the word recognition score for the better ear. We believe that imposing such restrictive criteria serves only to deny those with bilateral asymmetric hearing loss the opportunity of experimenting with binaural amplification.

With the advent of programmable analog devices and DSP hearing instruments, the audiologist can manipulate the electroacoustic characteristics to achieve output responses that were impossible with earlier nonprogrammable analog hearing instruments. It is highly probable that those persons with asymmetric hearing loss can benefit from the advanced analog and DSP technology.
Auditory Deprivation

Silman and his colleagues (1984) suggest that it is generally assumed by audiologists that auditory deprivation is experienced as a result of an asymmetric hearing loss wherein the poorer ear has not been acoustically stimulated. Although auditory deprivation is not understood completely, the effects of the magnitude of hearing loss in the poorer ear, the age of the patient, and the acoustic environment during the communicative process are in part responsible. Many patients experiencing late onset of symmetrical loss and auditory deprivation may have difficulty in discriminating words and sentences.

The fitting of binaural amplification to asymmetric hearing loss is not always successful in improving auditory function. The incidence of improved performance following a period of hearing aid use is sufficient for most audiologists to experiment with the benefit derived by binaural hearing aid use (Turner et al, 1996).

Auditory Acclimatization

A common clinical experience is that, after meeting all of the electroacoustic needs based on reliable and objective measures of improvement, the patient says that the hearing aids are unacceptable, or that the spoken word is not discriminated very well. There is a growing awareness by audiologists that time is needed for the patient to acclimate or adapt to the new acoustic (auditory image) signals. There is no absolute consensus of the time needed to gain maximum benefit from hearing aids. Estimates vary from 3 weeks to 8 weeks or more. It seems quite likely that the period needed for maximum benefit is dependent on the date of the onset of hearing loss to the fitting of hearing aids. Further, it depends on the magnitude of hearing loss as well as the age and the intellectual and emotional status of the patient.

The use of high-performance hearing aids has a very positive affect on signal processing by the hearing aid user. The authors are aware also that when high-performance hearing aids are used binaurally, there is greater acceptance of binaural use. High-performance hearing aids are usually multichannel, multi-programmable, and, since 1996, DSP.

Sometimes a dilemma arises: Established conventional wisdom dictates that when a hearing loss exceeds certain accepted boundaries, the patient is no longer a candidate for binaural hearing. As logical as this may sound, there are times when accepted dogma must be abandoned and empirical evidence accepted. For example, let’s assume that there is a 20-dB difference between ears. The deficit in each ear is sufficient to warrant amplification. In the past, the poorer ear would not have been a candidate for hearing aid use. Throwing caution to the wind, the audiologist fits the poorer ear only to discover that the patient has perceived some benefit, even though certain fitting criteria have not been met. Do audiologists counsel the patient that, although benefit has been realized, he or she is not a candidate for binaural amplification?

What Constitutes a Successful Fitting for Patients with Bilateral Asymmetric Hearing Loss?

This is a very difficult question to answer. One concludes that a general consensus is absent among members of the audiologic community. There are those who adhere to a policy suggesting that when the difference between ears is at a certain magnitude, only the better ear is to receive amplification. Others may use word recognition scores to determine acceptance or rejection of amplification. Still others may use real-ear measurement to determine if the prescribed gain can be reached.

One can appreciate the absolute adherence to a clinical discipline in the performance of hearing aid assessment and amplification. However, such a restrictive discipline could deny amplification to those who may benefit even though there is a bilateral asymmetric hearing loss. What some may fail to realize is that objective criteria, though useful, are not infallible indicators of acceptance, benefit, and satisfaction. Hosford-Dunn and Huch (2000) suggest that
more thought should be given to the merits of benefit, acceptance, and satisfaction. They suggest that these are mutually exclusive terms. That is, one does not include either of the others. Certainly, there can be measured benefit from hearing aid use, but the patient fails to accept the benefit gained. Conversely, the patient may find the instruments to be satisfactory, but there is little evidence of clinical benefit. Lastly, the patient may accept the instruments, although neither satisfaction nor benefit has been realized. We feel that, with the advances in hearing aid technology and the wide variety of response characteristics that are now possible, it may be prudent to take a somewhat more critical look at rules governing the fitting of asymmetric hearing loss.

From a technical perspective, it is now possible to offer a much lower compression threshold. Such is made possible by DSP. For example, there is a DSP hearing aid produced by a Danish company that has a 20-dB compression threshold and a compression ratio approximating 1:1. The advantage of a low compression threshold is that of permitting the patient to hear more of his or her acoustic environment. The advantage of having a 1:1 compression ratio is that of limiting spectral smearing (Kuk, 1998).

**Single versus Multiple-Channel Hearing Instruments with Various Processing Schemes**

There is no universal agreement relating to the use of single- or multiple-channel hearing instruments to meet the acoustic needs of patients with hearing loss. Further, there is no common consensus among audiologists about whether single or multiple channels are to be utilized in the fitting of asymmetric hearing loss. If multiple channels are to be utilized in the fitting of asymmetric hearing loss, how many channels are needed to accomplish optimal results? We feel strongly that multiple channel instruments are the most appropriate instruments of choice. The fly in the electroacoustic ointment is that of determining the “best” instruments. The clinical task is one of deciding on the type of signal processing carried out in each channel. Should the processing be analog or should it be DSP?

Since 1996, much attention has been directed toward the value of DSP as the hearing aid system of choice. This is so because many more parameters of signal manipulation are available to audiologists. This statement is not to suggest that all DSP hearing aids incorporate the same number of algorithms; quite the contrary. As a matter of fact, no two DSP performance characteristics, regardless of the manufacturer, perform the exact same functions.

This is not the forum for discussing the relative merits of one DSP system over another. Suffice it to say, however, that we feel that multiple-channel DSP hearing aids provide the best hope of assisting patients with bilateral asymmetric hearing loss. The advantages seem rather straightforward, because each channel is independent with its own DSP function. Within limits, the frequency-gain characteristics within each channel can be tailored to more closely approximate the acoustic needs of the patient.

To use intelligently the latest DSP technology for asymmetric hearing loss, one must abandon thought processes associated with analog technology and its attendant limitations. This is not to imply that high-performance, nonlinear analog systems are not effective in meeting acoustic needs, but rather that DSP systems offer more in terms of signal manipulation. The appropriate fitting of hearing aids to asymmetric hearing loss is something more than improvement in word recognition in a controlled acoustic environment. Other issues such as audibility, comfort, reduced fatigue, loudness growth, and cosmetic appeal have important roles to play in the benefit and acceptance of hearing aids.

Through the use of DSP, if one can adequately compensate for the hearing loss—usually the poorer ear in cases of asymmetric hearing loss—one may achieve a level of performance not possible with analog systems. If one continues to rely on dicta that suggest
that amplification of the poorer ear is contraindicated, one may have done a disservice to the patient. This statement does not condemn the use of analog technology in managing asymmetric hearing loss, but rather questions the wisdom of making clinical decisions without first experimenting with amplification for the poorer ear. The experimentation, however, does not necessarily involve assessing word recognition, but rather involves the patient in the process of determining need.

Reformatting the Auditory Image

It is common knowledge among audiologists that it takes time for a new auditory image to be formed following the fitting of hearing aids (Barford, 1979; Goldberg, 1988). That is, for most individuals using amplification for the first time, there is a significant difference between what the person is hearing without hearing aids and with hearing aids. For some, the change in the aided acoustic input that is now audible is very different from that which is audible without the hearing aids. This mismatch between what the person is used to hearing and what she or he may experience with hearing aids often results in rejection of the hearing aids. Appropriate patient counseling, however, offers an explanation of what the patient expects to experience. This is a significant step in fitting bilateral asymmetric hearing losses. Often, the poorer ear has been deprived of audible sound for a number of years and the audiologist is somewhat hesitant to even experiment with amplification to the poorer ear.

One would argue that if sound can be made audible to the poorer ear, it may provide enough information to determine if the patient is a candidate for binaural hearing. In the process of determining candidacy, the audiologist may rely, in part, on word recognition scores, difference in hearing level between ears, and MCL and ULL measures. One would advise, nonetheless, that these objective measures are not the sole indicators of potential benefit.

As mentioned earlier, although there is no consensus, it may take 4 to 6 weeks (or longer) to form a new auditory image. Unfortunately, for those with bilateral asymmetric hearing loss, the audiologist may terminate the fitting of the hearing aids for the poorer ear if improvement is not present during the initial fitting process. If such restrictive action is taken, the patient may be denied the opportunity to adapt to the new auditory image. If one relies on word recognition scores to determine benefit from amplification to the poorer ear, it may be a clinical error of judgment. Word recognition scores may not be the most sensitive indicators to make a final clinical decision, relative to benefit.

With the advent of DSP and the advantages thereof, perhaps audiologists have arrived at a point when emphasis needs to be given to more subjective measures that assist in the fitting process. There are a number of subjective questionnaires that contribute to the optimal fitting of hearing aid systems. Some of the most familiar ones include the Abbreviated Profile of Hearing Aid Benefit (APHAB; Cox, 1995a), the Client Oriented Scale of Improvement (COSI; Dillon et al, 1997), and Satisfaction with Amplification in Daily Living (SADL; Cox and Alexander, 1997). Hosford-Dunn and Huch (2000) present a more definitive analysis of a host of outcome measures that may be associated with successful hearing aid outcomes. They state, "Electroacoustic adjustments that optimize aided benefit do not predict how well a patient will react to amplification in daily life. Acceptance depends on other factors besides hearing aid fitting parameters and should be measured according to more than just whether the aid was returned for credit or sold" (p. 468).

Assessing Binaural Performance for Asymmetric Loss

The binaural advantage for those with asymmetric hearing loss may be difficult to confirm in a sound field (Cox and Alexander, 1991; Danhauer et al, 1991; Mueller et al, 1991, 1998). One would assume that the head shadow effect and binaural squelch affecting discrimination are two essential elements that should enhance one's ability to
achieve greater word recognition scores in both quiet and noise. Showing marked benefit for those with bilateral asymmetric hearing loss is even more challenging. When the noise and speech are spatially separated, however, there may be as much as a 12-dB improvement in the SNR (Dirks and Wilson, 1980). Obviously, when the noise and speech emanate from the same azimuth, there is little or no binaural advantage.

The question arises as to whether or not bilateral asymmetric hearing loss can perform in the same manner as symmetric hearing loss in the sound field. Given the advances in hearing aid technology, especially DSP, should symmetry for patients with asymmetric hearing be approximated by manipulating several electroacoustic parameters affecting the output of the hearing aid? If that is possible, then more credence could be given to the fitting of bilateral asymmetric hearing loss.

It is generally held by audiologists that word recognition scores in a “quiet” sound field yield higher percentages than word recognition scores in noise. We feel that aided bilateral symmetric hearing loss will achieve better word recognition scores in a sound field than will be evident for aided bilateral asymmetric hearing loss. The issue that needs to be determined is whether the magnitude of difference in word recognition scores would be significantly different after the patient has adapted to a new auditory image. Further, if there is only minimal improvement in word recognition scores after a period of use, is that tantamount to rejecting binaural amplification, or must one look at other factors determining benefit, acceptance, and satisfaction? These measures have been discussed earlier in this chapter.

The Role of Counseling in Fitting Asymmetric Hearing Loss

Sweetow (1999) states, “Successful fitting of hearing aids is a process, not a single event. It begins with the initial case history and diagnostic testing and does not end until after the patient has received proper orientation and long term rehabilitation training” (p. xi). Nothing is more important in the fitting and the subsequent patient management process than effective counseling. This is especially true when fitting hearing aids for patients with bilateral asymmetric hearing loss. There are several reasons why counseling is important and essential. Initial counseling of the patient is that of reviewing the advantages and limitations of binaural amplification. Depending on the magnitude of the loss and the threshold difference between the better and the poorer ear, the patient needs to know what the probability is that some benefit will be achieved. One must remember that the patient really wants to know both the advantages and the disadvantages of amplification. It is critical that the patient has trust in the audiologist dispensing the hearing aids. Trust in the audiologist can be translated into accepting the information offered and increasing the probability that the patient will benefit from binaural hearing aid use. The greater the magnitude of the hearing loss between the better ear and the poorer ear, the greater the need for a well-structured patient management protocol.

An appropriate management approach would be to review the anticipated benefits and the limitations imposed by the asymmetry. It is critical that the patient is made aware of those factors contributing to successful use as well as factors contributing to unsuccessful use of hearing aids.

Sweetow (1999) has provided us with a very workable definition of counseling:

Counseling is the gathering of data through careful listening, the conveying of information, and the making of adjustments in one’s strategies based on that knowledge. It is generally a lot simpler to present information than it is to obtain it. Humans tend to have a harder time listening than they do speaking. Perhaps that is the reason why we have only one mouth. We expect our hearing-aid wearing patients to listen twice as much as we speak (even without being taught to do so), yet many of us have not mastered this critical skill. [p. 3]
It would seem that a dialog must be generated between the audiologist and the patient. We would suggest that some type of patient-centered approach be initiated, which involves understanding the patient’s needs, being empathetic to those needs, and assessing whether the patient’s needs are met through the judicial use of amplification. The patient needs to know what is being recommended and why. Further, audiologists need to know the patient’s perception of expected benefit and whether benefit can be reasonably achieved.

Counseling takes on a very important role when applied to those patients with bilateral asymmetric hearing loss. Unlike some other hearing aid users, the task of demonstrating benefit may be more difficult. Both the patient and the audiologist need to be aware that only limited benefit might be gained. Goals need to be established and agreed upon. Some of those goals include expected word recognition benefit in quiet and in a variety of environmental backgrounds, and the subjective analysis of determining whether sufficient benefit has been received to warrant purchase of the hearing aids.

Counseling is not an overnight experience, nor can benefit reasonably be achieved in a short period of time (the reader is referred to that section of this chapter dealing with auditory image). Realistic goals based on a definitive span of time (8 weeks) need to be set. Some questions need to be answered: (1) At what level are aided sounds audible? (2) At what aided presentation level can the patient recognize monosyllabic words in quiet and in noise? (3) At what output level are aided signals too loud (i.e., OSPL90)?

Based on an analysis of the patient’s preferences, an audiologist can begin to fine-tune the electroacoustic responses of the patient’s hearing aids. These changes may very well offer a means of determining whether or not further fine-tuning would be helpful. To make meaningful changes in the hearing aid response, the patient should take a few days to assess the need for change. The experienced audiologist should provide the patient with a list of things to do, relative to assessing benefit. Such a list may include, but is not limited to, the following:

1. Under what environmental conditions are sounds audible to the aided, poorer ear?
2. Under what environmental conditions are sounds inaudible to the aided poorer ear?
3. Under what environmental conditions does the poorer aided ear contribute to the understanding of connected discourse?
4. Is the hearing aid that is fitted to the poorer ear comfortable?
5. Is the hearing aid that is fitted to the poorer ear uncomfortable?
6. How many hours a day do you wear both hearing aids?
7. If you do not wear both hearing aids, what is the reason for taking off the hearing aid fitted to the poorer ear?
8. On a scale of 1 through 5 (“1” being no benefit at all and “5” being a great deal of benefit) how would you rate the benefit received from wearing both hearing aids?
9. Using the same scale as in question 8, how would you rate your ability to understand speech?
10. Using the same scale as in question 8, what is the overall rating you would give to the advantages offered by wearing both hearing aids?

We have stressed the need for the patient’s subjective preferences to be taken into account for the purpose of making changes in the initial fitting. This reasoning is rather straightforward. In the first instance, the patient is learning to recognize sounds that have not been audible for years. To incorporate these new sounds into a unified auditory image is necessary before the absolute advantage of amplification can be accurately assessed. Other areas of analysis may include proper fit of the hearing aids, fatigue induced by the hearing aid following a period of use, cosmetic acceptance, and whether listening with a monaural instrument fitted to the better ear is superior to
binaural hearing aids. If patients can faithfully describe their experiences to the audiologist, appropriate changes in the hearing aid response can be made.

Optimally, the dialog between patient and audiologist will result in a satisfactory outcome: the patient has high regard for the audiologist and the audiologist has met the acoustic needs (within limits) of the patient. Patients’ ability to report their experiences as a result of their bilateral asymmetric hearing loss contribute to the correct instrument selection and fitting process.

Even if it has been determined that amplifying the poorer ear provides no benefit, two positive outcomes are evident. First, the patient maintains a high regard for the professionalism and the care displayed by the audiologist. Second, the audiologist has the satisfaction of knowing that every effort was made to improve performance with binaural amplification. There are other intangible benefits as well. The patient will not hesitate to recommend the audiologist to other potential patients, even though the fitting of binaural hearing aids was not successful.

The audiologist did what he or she thought best, even though a hearing aid fitted to the poorer ear provided little if any benefit. Further, asymmetric hearing loss poses problems not encountered with other types of hearing loss. If there is any moral emerging from all of this speculation, it is this: It is not important whether audiologists do a successful fitting; it is important that audiologists know that they did their best, based on current knowledge and the state of technologic advances.

Summary and Conclusions

Fitting binaurally for patients with bilateral asymmetric hearing loss presents clinical challenges to the audiologist. There is no general consensus as to what can and should be accomplished in prescribing amplification for those patients with asymmetric hearing loss. For some audiologists, if some preordained performance criteria are not met in the presence of asymmetric hearing loss, then binaural amplification is not recommended. For example, if the interaural threshold difference is greater than 15 dB at 500, 1000, and 2000 Hz, or if there is a difference in word recognition of 8% or less, binaural amplification may not be recommended. Such rigid criteria are no longer appropriate or tenable in view of the technologic advances made in hearing aid design and performance. As illustrated by the several cases in this chapter, these restrictive taboos are to be questioned because many patients with asymmetric hearing loss can benefit from binaural amplification, even though traditional criteria for binaural candidacy were not met.

This chapter has offered suggestions for the fitting of binaural amplification for asymmetric hearing loss. We do not suggest that all patients with asymmetric hearing loss are amenable to binaural amplification. Rather, most patients with asymmetric loss should be evaluated and the determination of benefit should be made following a trial period of hearing aid use. Further, we do not question the use of CROS or BICROS hearing aids. There is no doubt that the use of such hearing aid configurations has been of some benefit to those unable to benefit from binaural amplification. In the final analysis, we encourage clinical curiosity and experimentation. One should question established protocols dictating the use of hearing aid devices. Although most accepted criteria for assessing and fitting hearing aids will meet the challenge, consider the valuable experienced gained when some do not. Not only has the audiologist gained clinical insight in meeting amplification needs, but the hearing loss patient may be better served in meeting electroacoustic needs.

Audiologists should be quick to accept change or modification in fitting philosophy if sufficient data are presented that challenge traditional practices regarding the decisions about hearing aids and their benefit. The willingness to question and the desire to change in light of new and compelling
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