A Hearing Aid System for Fluctuating Hearing Loss Due to Meniere's Disease: A Case Study

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A Hearing Aid System for Fluctuating Hearing Loss Due to Meniere's Disease: A Case Study

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This article presents a case study of a client with Meniere's disease who was successfully fitted with hearing aids in spite of his fluctuating hearing loss. The selected hearing instruments had a portable-programmer that allowed the client to measure his own hearing and to program his own hearing aids at home. It shows the hearing fluctuation, as measured by the client three times a day, over a period of time, as well as different audiograms performed in the clinic by the audiologist. This study demonstrates the feasibility of training a client with fluctuating hearing loss to reliably measure his own hearing levels and program his hearing aids to enhance the level of satisfaction with amplification.

Hearing aids may be very difficult to fit to clients with Meniere's disease due to the unpredictable fluctuation of hearing levels. Described in 1861 by Prosper Meniere, the disease that carries his name is characterised by a combination of hearing loss, ear fullness, tinnitus and vertigo (Paparella & Sajjadi, 1999). Meniere's disease is a very disruptive condition that affects the individual's social, family and working lives (Stewart & Stewart, 1999). The unpredictability of the symptoms of dizziness and hearing fluctuation generates an overall sense of insecurity, leading individuals to withdrawal from social contact and in many instances to take forced retirement. The fluctuation of hearing and tinnitus levels in patients with Meniere's disease is well accepted in the literature (Gibson, 1999; Matijsen et al., 2001). The fluctuation is usually more detrimental in the second stage of the disease.

Kumagami et al. (1982) classified Meniere's disease into three stages, and the hearing loss varies according to each stage. Stage 1 is when there is a low-frequency sensorineural hearing loss fluctuating from a mild to moderate (25–50 dB) loss, recovering to normal thresholds. Stage 2 is when there is a fluctuating sensorineural hearing loss from mild to moderate. The audiogram presents a change in configuration as the hearing fluctuates. Stage 3, also called the 'burnt out' stage, is when the hearing no longer fluctuates and the attacks of vertigo subside. The hearing loss is generally a flat-moderate to severe (60–80 dB) and with poor speech-recognition scores.

Very little has been found in the literature regarding the fitting of hearing aids in hearing losses due to Meniere's disease. A recent Medline search showed only four publications which covered the topic over the past 40 years. Miller and Niemoeller (1967) discussed the evaluation and hearing aid fitting process to a Meniere's patient, emphasising the need to improve signal to noise ratio by means of 'detachable' hearing-aid microphones to be placed on the talker's lips to help with 'poor speech discrimination'. Johnson and House (1979) raised the difficulties of fitting hearing aids for Meniere's

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disease due to the limited tolerance for amplification caused by narrow dynamic range, poor speech discrimination and fluctuating hearing loss. Hood (1980) discussed the importance of considering recruitment curves when prescribing hearing-aid gain for Meniere's disease. In 1995 Koefoed-Nielsen and Courtois pointed out that in most audiology clinics, hearing aids are not considered an option for clients with Meniere's disease. The reasons for this are usually attributed to poor speech-recognition scores in the ear with Meniere's disease, unilateral hearing loss, fluctuation in the hearing and recruitment. They conducted a study, fitting hearing aids in a series of 43 patients with Meniere's disease and found that 27 of these patients obtained some benefit from amplification.

McNeill et al. (2002) found that in the third stage of the disease ('burnt-out' stage) the fitting of a hearing aid is usually quite successful, despite many professionals in the field still not considering this possibility. Their survey of 25 ENT specialists showed that patients presenting with a moderate-to-severe hearing loss, as in the third stage of Meniere's disease, are discouraged from trying amplification, based on the usually poor speech-recognition scores obtained on standard audiological assessment. Our clinical experience shows that after acclimatisation with a successfully fitted hearing aid, this population develops a significant improvement in speech recognition.

During the first and second stages, the attacks of vertigo are the most disturbing symptoms of Meniere's disease. The hearing loss becomes a problem from the second stage, but most patients with Meniere's disease are again discouraged by medical professionals from trying amplification, based on their poor speech-recognition scores. Furthermore, in many instances, the hearing loss at this stage is overlooked because of the severity of the symptoms of dizziness (McNeill, 1999).

It is also not always possible to determine straight away the stage of Meniere's disease a client is going through. Several audiograms may be necessary to establish any existing hearing fluctuation.

Whenever present, the loss of hearing warrants amplification, but the fluctuation of the hearing levels makes it very challenging to fit a suitable hearing aid. The hearing usually fluctuates in different degrees at different frequency bands, making it difficult and sometimes even impossible to adjust the hearing aid to a comfortable level by means of a volume control from a conventional hearing aid.

Anecdotally, multiple-memory programmable hearing aids have been found to be more appropriate in some cases (McNeill, 1999). The author has been working with a large number of Meniere's disease clients for over 15 years and the clinical experience shows that in many instances it has not been possible to find a pattern in the variation of the hearing levels during conventional clinical testing. This means that even the most sophisticated multiple memory hearing aids may provide little benefit.

In some cases, the author's attempts to program different memories in a hearing aid to cater for the fluctuation in hearing have been frustrated by the impossibility of establishing a pattern of variation from several audiograms performed at different sessions. The final result has been that many individuals in the second stage of Meniere's disease give up on hearing aids after numerous visits to the audiology clinic, in spite of their genuine need for amplification.

In recent times, Widex released a hearing aid, which seems to be a solution to this problem. The Senso Diva hearing aid comes with a portable programmer (SP3) designed for the clinician to program the hearing aid in replacement of a computer. This device provides the possibility of measuring the hearing levels in up to 14 different frequency bands in situ and uses these measurements to automatically program the hearing aid for a given hearing loss.

After many years of frustrating attempts to fit different hearing aids in individuals with fluctuating hearing losses due to Meniere's

disease, the author decided to try the Senso Diva. A case study, using one client with fluctuating hearing loss, showed very encouraging results and is described below.

METHOD

A male client, aged 51, diagnosed by an otologist as being in the second stage of Meniere's disease with bilateral sensorineural hearing loss, was selected for this study. This client had tried hearing aids in the past with limited success, attributed to his fluctuating hearing levels. Audiograms performed at the clinic on four different occasions over a period of 6 weeks had shown fluctuations in the right-hearing levels while the left hearing remained fairly stable (Figure 1). This client was initially fitted with bilateral behind-the-ear multiple-memory digital hearing aids with a remote control. Three different memories were programmed using the proprietor's fitting algorithm for three different audiograms. The client could access the different memories by using the remote control. The volume could also be adjusted in a 6 dB range on each of the three programs. The remote control could only access the right hearing aid, as the hearing did not fluctuate in the left ear.

The difficulty encountered with these hearing aids was that the client reported that he had not been able to find the appropriate program for his hearing levels most of the time. He reported hearing clearly through the hearing aids some days and then they would lose clarity and or become too loud. Changing the programs and adjusting the volume was very confusing and achieved minimal success. The end result was that he would remove the right-hearing aid, relying exclusively on the left aid most of the time. Unilateral amplification, however, would not achieve satisfactory outcomes at business meetings and social situations, mostly because of head shadow effect and signal-to-noise ratio issues.

This client was finally fitted with bilateral Senso Divas behind-the-ear hearing aids (SD-9M). These aids were fitted with a custom-hard acrylic, nonvented, skeleton ear mould. The fitting protocol was based on the Widex proprietor's procedure, using the Sensogram. The Sensogram is an in situ method for hearing threshold measurements and hearing-aid fitting. It takes into account the acoustic properties of the ear — the amplification algorithm of the Senso Diva hearing aid is based on this data. The Sensogram can be performed through a computer using the Compass software via the HiPro or the Noah Link. It can also be performed by means of the SP3, which is a portable programmer designed for the clinician to fit Widex

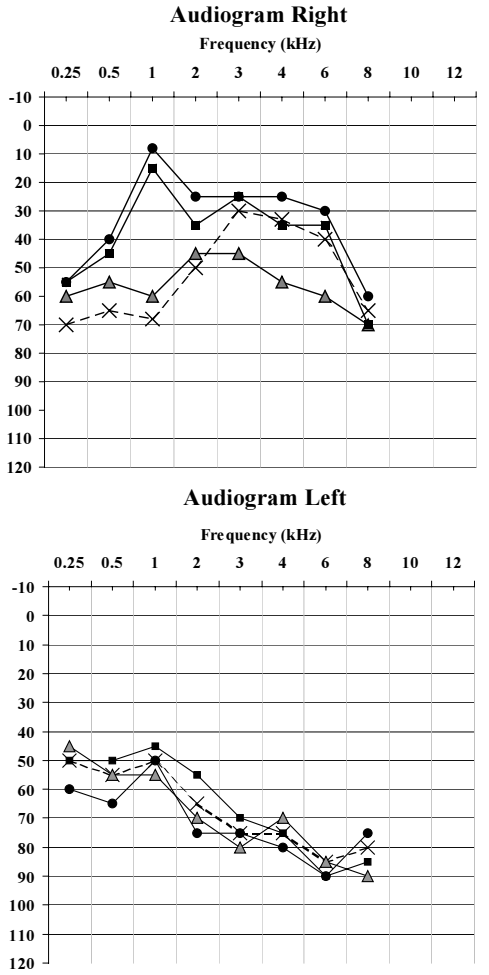

FIGURE 1
Air conduction thresholds measured at different dates.

hearing aids when a computer is not available. The Sensogram is measured with the hearing aid in the ear, connected via a programming cable to either the HiPro or Noah Link when using the computer, or directly to the SP3.

In this case the audiologist performed an expanded Sensogram via the HiPro measuring the hearing thresholds at 13 frequency bands followed by the 'feedback test' as prescribed by the Widex fitting protocol. The Widex Compass software automatically programmed the hearing aids based on these two measurements. The 'expanded sensogram' (measuring 13 frequency bands) was selected instead of the 'basic sensogram' (measuring only 4 bands), as the authors experience showed differences of up to 15 dB in the intermediate frequency bands calculated by the software as opposed to the measured sensogram.

The client was then introduced to the SP3 device. He was taught how to connect the hearing aid and to perform his own 'expanded sensogram'. The client's ability to carry out this procedure was checked in the clinic by asking him to repeat the measurements made by the audiologist earlier in the session.

The SP3 programmer was then given to the client, who was instructed to perform his sensogram and to program his own hearing aids at home three times a day for a period of 8 weeks. Feedback test was not part of the protocol for home measurements as the audiologist had already performed it. According to proprietor's instructions the feedback test only needs to be repeated if feedback issues arise. In this case, only the audiologist in the clinic would carry out a feedback test.

The client was asked to measure his sensogram in a quiet environment and whenever possible to use the same location each time. Such measurement automatically programs the hearing aid for the hearing levels at the time. He was also given a table and asked to write down his hearing thresholds as measured through the sensogram. (Table 1). The procedure takes no longer than 15 minutes.

Abbreviated Profile of Hearing Aid Benefit (APHAB) questionnaire was used to measure hearing aid outcome (Cox & Alexander, 1995). The questionnaire was administered on the fitting date and 6 months after.

RESULTS

Table 1 shows an example of the results of three different sensograms measured by the client over the period of 1 day. The hearing fluctuation presented here shows that a conventional hearing aid with a volume control could not be suitably adjusted for this client. A multimemory device had been previously tried with frustrating results. The different Sensogram results, as displayed in Table 1, indicate the difficulty in establishing a pattern in the hearing fluctuation. This may explain the difficulties of programming useful memories in his previous multimemory hearing aids.

Test–retest reliability for this particular client could be indirectly assessed, based on the repeatability of the sensograms of the left ear which did not show any significant fluctuation in different audiograms measured by the audiologist in the clinic. It is a reasonable assumption that his right-ear measurements were as reliable as those recorded for the left.

The client reported great satisfaction with the new devices and with his ability to adjust the hearing aid according to when his hearing fluctuation occurs. He has been using these devices for over 12 months now and is very pleased with the results. He reports taking the SP3 to work with him every day and reprogramming his hearing aids every time he notices a change in his hearing. He expressed feeling more in control of his problem and more confident. He also expressed a greater understanding of his hearing as a consequence of measuring his thresholds and programming his hearing aids to adjust for the fluctuation.

APHAB questionnaire (Table 2), which assesses hearing-aid benefits in four categories, showed an improvement of 60% in

TABLE 1
Table Given to Participants of the Hearing Aid Trial

Study: Hearing aids for fluctuating hearing loss Name: _____

Audiologist: Celene McNeill

Please use the tables below to record your hearing levels measured 3 times a day, every day for a period of 8 weeks in a quiet room using the SP3 programmer as instructed.

12 Jan 8.00am	250 Hz	350 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3200 Hz	4000 Hz	6000 Hz
Right ear	45	40	40	35	20	10	15	25	30	25	35	35	40
Left ear	60	65	55	45	45	45	45	55	65	65	80	80	80

12 Jan 6.45pm	250 Hz	350 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3200 Hz	4000 Hz	6000 Hz
Right ear	50	45	45	40	30	25	15	25	25	25	30	35	40
Left ear	45	55	50	50	45	45	45	60	65	70	80	80	80

12 Jan 8.30pm	250 Hz	350 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3200 Hz	4000 Hz	6000 Hz
Right ear	50	45	45	40	30	20	15	25	25	25	30	35	40
Left ear	50	60	55	55	50	45	50	60	65	65	80	80	80

13 Jan 9.00pm	250 Hz	350 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3200 Hz	4000 Hz	6000 Hz
Right ear	55	50	45	40	25	10	15	20	20	15	25	30	30
Left ear	55	60	50	45	45	45	45	55	60	70	80	80	80

13 Jan 12.30pm	250 Hz	350 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3200 Hz	4000 Hz	6000 Hz
Right ear	55	45	45	35	20	10	15	20	25	20	30	35	35
Left ear	60	60	55	50	45	45	45	50	60	70	75	80	80

13 Jan 8.15pm	250 Hz	350 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3200 Hz	4000 Hz	6000 Hz
Right ear	50	50	50	45	40	30	15	25	25	20	25	30	30
Left ear	55	60	55	50	45	40	45	55	60	70	80	80	80

13 Feb 9.15am	250 Hz	350 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3200 Hz	4000 Hz	6000 Hz
Right ear	60	55	55	55	50	50	50	50	40	25	35	35	40
Left ear	55	60	55	45	45	45	45	55	60	70	80	80	80

13 Feb 3.00pm	250 Hz	350 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3200 Hz	4000 Hz	6000 Hz
Right ear	50	50	50	50	40	25	20	25	25	30	50	55	55
Left ear	45	55	50	50	45	45	45	55	60	70	80	80	80

13 Feb 10.00pm	250 Hz	350 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3200 Hz	4000 Hz	6000 Hz
Right ear	60	55	55	55	55	55	50	45	35	25	40	40	45
Left ear	60	65	60	50	50	50	50	60	65	70	80	80	80

14 Feb 5.00pm	250 Hz	350 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3200 Hz	4000 Hz	6000 Hz
Right ear	60	55	55	55	55	55	50	50	40	30	40	45	50
Left ear	55	60	55	50	50	45	45	60	60	65	80	80	80

14 Feb 10.30pm	250 Hz	350 Hz	500 Hz	630 Hz	800 Hz	1000 Hz	1250 Hz	1600 Hz	2000 Hz	2500 Hz	3200 Hz	4000 Hz	6000 Hz
Right ear	60	55	55	50	50	50	45	40	35	30	40	45	45
Left ear	55	60	55	50	50	45	45	60	60	65	80	80	80

TABLE 2
Abbreviated Profile of Hearing Aid Benefit

	EC	RV	BN	AV
Unaided	68%	71%	79%	33%
Aided	8%	29%	27%	8%
Benefit	60%	42%	52%	25%

Note: EC: Ease of communication; RV: Reverberation; BN: Background noise; AV: Aversiveness to sound.

'ease of communication', 63% in 'reverberation', 52% in 'background noise' and 31% in 'aversiveness to sound'. These results, combined with the client's informal report, indicate the benefits and satisfaction with the hearing aids.

DISCUSSION

It would not have been possible to assess the extent of the hearing fluctuation of this client using routine audiological assessments. The fluctuation observed, based on his own measurements, showed more variation than we could have predicted based on audiograms performed in the clinic.

The possibility of allowing clients to program their own hearing aids has been the subject of considerable debate. Our experience with Meniere's disease for more than 15 years is that this was the first time that a fully satisfactory result was obtained from hearing aids. We have spent many clinical hours in the past retesting the hearing and reprogramming the hearing aids of clients with fluctuating hearing loss due to Meniere's disease, with limited success. The client would leave the clinic with the hearing aid programmed to provide the desirable match to the prescribed gain and very happy with the results but would return a few days later totally dissatisfied with the amplification, as the hearing had changed.

This new system empowers the clients with Meniere's disease to control their hearing aids to suit their hearing levels as it fluctuates. We find that this sense of control over their hearing also helps to reduce their stress levels, which is also detrimental to the other symptoms of Meniere's disease.

This study has demonstrated the feasibility of training a client to use a portable programmer to reliably measure his own hearing levels and program his hearing aids. These results and the enhanced level of satisfaction with amplification for this client with fluctuating hearing loss have prompted further research. We currently have 25 clients with fluctuating hearing loss due to endolymphatic hydrops, as in Meniere's disease, who have been fitted with this system. Initial results are encouraging. Publication of this expanded study will follow in the near future.

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