

## Beyond the Basic Test Battery: The Tinnitus Assessment

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### Bio:

Paula Schwartz, Au.D, is the owner of Audiology Concepts and the Tinnitus and Hyperacusis Clinic in Edina, Minnesota. Dr. Schwartz's 24-year background as an audiologist includes working as a trainer and sales representative for Ensoniq Corp. and clinical audiologist in private practice. She started her own private practice, Audiology Concepts, in 2002. With an 8-year-old son with tinnitus and a passion for tinnitus, Dr. Schwartz added the Tinnitus and Hyperacusis Clinic in 2005. The clinic serves patients throughout the Midwest, Canada and Europe.



### Kindling/Reactive Tinnitus:

An extreme condition in which a person's tinnitus is exacerbated after exposure to mild or moderate levels of sound. This increase in tinnitus tends to last for more than a day.

### Misophonia and Phonophobia:

Sound tolerance problems in which persons have a fear of a particular sound (misophonia) or a strong dislike of a particular sound (phonophobia), which is most often present at a mild to moderate level. These two conditions are caused by an abnormal limbic or emotional reaction.

## Terminology

### Tinnitus:

Phantom auditory perception or any sound generated within the head.

### Decreased Sound Tolerance:

Loudness discomfort levels between 70dB and 90dB HL, in the presence of normal hearing or a mild hearing loss.

### Hyperacusis:

Loudness discomfort levels of less than 70 to 75dB HL, in the presence of normal hearing. This is decreased sound tolerance at its most extreme—this level of reduced sound tolerance is extremely debilitating in everyday life.

## Introduction

The hearing healthcare industry is taking a renewed interest in the assessment and management of the tinnitus patient. The arsenal of treatment tools available is expanding and therefore it is important for the professional to provide detailed audiological assessment to best determine management strategies. The following discussion reviews the additional testing required beyond the basic battery of hearing tests to manage the patient with tinnitus and/or reduced sound sensitivity.

## Case History

A detailed case history is paramount in identifying the primary issues which can intermingle between hearing loss, reduced sound tolerance, tinnitus, misophonia, phonophobia and psychological issues. Questionnaires such as the Tinnitus Reaction Questionnaire (TRQ; Wilson, et al., 1991) are useful for evaluating tinnitus as a problem and the specific areas affected for that person. Beyond case history and patient questionnaires, the following discussion pertains to additional testing that may be helpful in the counseling and management of the patient with tinnitus and/or hyperacusis.

## The Basic Evaluation

Tinnitus is a symptom, not a disease. A full medical evaluation is essential to exclude, or otherwise treat, any underlying tinnitus-related pathology. The basic audiological evaluation (pure tone testing, speech reception thresholds, speech discrimination testing and tympanometry) is necessary to determine basic hearing status and plays an obvious role in the recommendations of hearing aids. For the tinnitus patient, an exception to the basic audiological evaluation is the testing of acoustic reflexes. Acoustic reflex testing is not recommended as part of the basic evaluation of the tinnitus patient because acoustic reflex stimuli may be louder than some of these patients can tolerate. Up to 30% of patients require specific treatment for hyperacusis and/or reduced sound sensitivity. Acoustic reflex testing can set up a level of distrust between the patient and clinician.

## Extended high frequency threshold testing

Threshold testing of 250–8000 Hz is standard audiological testing procedure; however, the tinnitus assessment should include threshold testing at the non-standard frequencies of 10,000 Hz, 12,500 Hz and possibly 14,000 Hz. For persons with normal hearing through 8000 Hz, there is generally hearing loss in the higher frequencies which can

be helpful in the counseling of the tinnitus patient based on the neurophysiological model of tinnitus. The main idea of the neurophysiological model of tinnitus is that a number of systems in the brain are involved in the phenomenon of tinnitus. These systems include the auditory system, the limbic system and the autonomic nervous system (Jastreboff & Hazell, 2004).

### High Frequency Assessment Protocol:

The procedure for finding extended high frequency thresholds is the same as the procedure for threshold determinations for 250–8000 Hz.

## Loudness Discomfort Level Testing

In the tinnitus assessment, it is important to assume that some misophonia and/or hyperacusis exist so as not to over-stimulate the patient and avoid enhancing misophonia. Case history and loudness discomfort level testing indicate the effects of hyperacusis, reduced sound sensitivity, and misophonia. Jastreboff and Hazell (2004) recommend starting Loudness Discomfort Level (LDL) testing with the patient's most comfortable level for running speech and increase the level in 2.5-dB steps if hyperacusis is a concern. Extended high-frequency LDL testing is particularly important when evaluating a hyperacusis patient who complains of sensitivity or discomfort to very high frequency sounds, such as silverware or children's voices. LDLs may very well be within normal limits at frequencies through 8000 Hz, but reduced at the extended high frequencies.

### Loudness Discomfort Levels Assessment Protocol:

LDL testing should be done with an intermittent tone presented no faster than one per second to allow time for patient response. LDLs should then be obtained at all frequencies in which threshold data were obtained (typically 250–12500 Hz). The specific instructions should be consistent and repeatable with all patients, such as “We want to get past ‘too loud’ to where it would actually be uncomfortable;” “This is not an endurance test;” “I will stop immediately when you tell me that it is enough;” “Try

to hold on as long as possible;” “This test cannot do any permanent damage to your hearing or permanently make your tinnitus worse” (Jastreboff & Hazell, 2004). The Neuromonics Tinnitus Treatment loudness measurement protocol has response options on paper, reflecting a 9-point ascending scale. The printed options are: **Very Soft, Soft, Comfortable but Slightly Soft, Comfortable, Comfortable but Slightly Loud, Loud but OK, Uncomfortably Loud, Extremely Uncomfortable, and Painfully Loud** (Neuromonics Tinnitus Treatment Clinician’s Guidelines). The continuously presented intermittent tones should be slowly and consistently increased in 5-dB steps until the patient indicates that the tone has become uncomfortably loud. At that point, the level should be decreased by 10 dB, and then increased again in 2-dB steps until the uncomfortably loud level is determined. Test all frequencies, including 10,000 and 12,500 Hz.

## Measurements of Tinnitus Pitch and Loudness Matching

According to Jastreboff and Hazell (2004), tinnitus pitch and loudness matching show no relationship to severity of tinnitus, its diagnosis, or the outcome of treatment. These measurements, however, do reveal changes related to the habituation of the perception of tinnitus and help with counseling the patient.

### Pitch Matching Assessment Protocol\*:

Pitch matching has little usefulness unless residual inhibition is being tested. The pitch-matching results indicate the frequency of narrow band noise that should be used to monitor residual inhibition. Use pure tones for pitch matching if the tinnitus is tonal; use narrowband noise for pitch matching if the tinnitus is broad. Test the non-tinnitus ear if the tinnitus is unilateral. The instructions to the patient may be as follows: “I want to find the approximate pitch of your tinnitus. This is how sharp or flat it sounds, not its loudness. I will present two tones and say ‘1...2’. Listen to both and then tell me which is closer to your tinnitus.” Start with a continuous tone and present at 10 dB SL for 2-3 seconds. Present a comparison of two tones. The patient can either verbally report back

which tone is closest to his/her tinnitus or use his/her index finger to indicate tone 1 or tone 2. Progressively reduce the difference between the sounds until the patient feels that the tone is closest to their tinnitus. The patient is reminded that it will not be an exact match but a close approximation. It is often found that the pitch of the tinnitus is found close to a frequency at which the hearing loss slopes.

### Loudness Balance Assessment Protocol:

Loudness matching has no relevance to tinnitus severity; however, the monitoring of the loudness of the tinnitus throughout treatment does exhibit changes in the habituation of perception of the tinnitus. Instructions to the patient: “Now that we have found the approximate pitch of your tinnitus, I want to get an idea of its loudness. Press the button when you first hear the sound. I will continue to gradually increase the level of the sound. I want you to press the button a second time when my sound is equally as loud as your tinnitus.” Using the same type of tone at the pitch-matched frequency in the ear contralateral to the primary tinnitus, slowly increase the sound until the patient indicates that it is the same loudness as the tinnitus. Repeat this procedure twice and average the second and third results. Report the average level in dB SL.

### Broad Band Noise Minimal Suppression Level (BBN MSL)\*:

Changes in BBN MSL can be linked to treatment outcomes. Tinnitus treatment aims to affect the plasticity of the auditory pathways, detuning neuronal networks from tinnitus detection (Jastreboff & Hazell, 2004). So, changes noted in the BBN MSL reflect the reduced sound levels needed to suppress the tinnitus. Instructions to the patient: “I want to find out how much noise is needed to just cover up or mask your tinnitus. I am going to make the noise gradually louder and I want you to press the button when you judge it is just covering up your tinnitus.” Presentation is in the ipsilateral ear if the tinnitus is unilateral. Starting at threshold, increase the volume of the noise until the patient indicates that the noise is masking the tinnitus. Repeat again. The average of the two results is reported in dB SL.

*\*Described according to Neuromonics Tinnitus Treatment Clinician’s Guidelines.*

## Narrow Band Noise Minimum Masking Level Assessment Protocol (NBN MML):

Use the same protocol as BBN MSL, only use narrow band noise at the tinnitus pitch-matched frequency.

## Residual Inhibition Assessment Protocol\*:

Residual inhibition is the change in tinnitus loudness after exposure to sound, typically for one minute at 10 dB above NBN MML at the pitch-matched frequency of the tinnitus. Residual inhibition reflects the rebound effect in which the activity of neurons decreases below the level of spontaneous activity after a period of strong stimulation (Jastreboff & Hazell, 2004). Present NBN at 65 to 75 dB HL at the pitch-matched frequency of the tinnitus for 60 seconds. Instructions to patient: “I am going to put some noise in both ears for a minute or so. You do not have to do anything. Just sit back and relax. When I turn the sound off, I’d like you to focus on your tinnitus for a short period of time and report back to me if you notice any change in your tinnitus. Does it remain the same? Does it change pitch? Does it change loudness? Does it reduce in volume or go away for a period of time?” There is conflicting opinion on the usefulness of residual inhibition testing, as described by Feldman (1971). However, the potential therapeutic benefit of doing such a test following LDLs should be considered. Neuromonics suggests that partial or complete residual inhibition is an excellent prognostic indicator for candidacy of the Neuromonics Tinnitus Treatment in that their tinnitus can be affected by sound (Neuromonics Tinnitus Treatment Clinician’s Guidelines). There is also a risk of increasing the tinnitus as a result of the residual inhibition test. If the tinnitus increases in volume, there should be concern of kindling/reactive tinnitus or winding up of the tinnitus.

## Conclusion

There are additional tests required in the assessment of the patient with tinnitus and/or hyperacusis beyond the basic audiological test battery. Going beyond the basic test battery is necessary to not only obtain thresholds above 8000 Hz, but to determine sound tolerances and misophonia involvements.

## References

*Feldman, H. (1971). Homolateral and contralateral masking of tinnitus by noise-bands and by pure tones. Audiology, 10, 138-144.*

*Jastreboff, P.J. & Hazell, J.W.P. (2004). Tinnitus Retraining Therapy. University of Cambridge.*

*Neuromonics Tinnitus Treatment Clinician’s Guidelines*

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*\*Described according to Neuromonics Tinnitus Treatment Clinician’s Guidelines.*

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