**Components of decreased sound tolerance : hyperacusis, misophonia, phonophobia.**

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This report is an attempt to bring to your attention some important information related to decreased sound tolerance and it is based on a short paper (Jastreboff, MM and Jastreboff PJ, Hyperacusis, Audiology Online, June 2001, http://www.audiologyonline.com). In particular, as we recently proposed a new term "misophonia" and we would like to provide some explanation and justification for it (Jastreboff, PJ and Jastreboff, MM, Tinnitus and hyperacusis, In: *Otorhinolaryngology Head and Neck Surgery*, JJ Ballenger and JB Snow (eds), Singular, in press).

"My ears are painful when I am exposed to sound." "My ears are very sensitive to sounds." "I am afraid about my hearing." "When I am in a noisy surrounding I experience a troublesome sensation in my ears." These, and similar statements, are not unusual in the audiology or otolaryngology clinics. Terms such as "oversensitive hearing," "hyperacusis," "phonophobia," "recruitment," "dysacusis," and "auditory hyperesthesia," were used interchangeably (and incorrectly) to describe decreased sound tolerance, and discomfort or pain in the ears, associated with sound exposure.

Decreased sound tolerance includes more than one phenomenon. In the past, we have used two terms: Hyperacusis to describe patients experiencing discomfort to sound resulting from abnormally high activation of the auditory system. Phonophobia was used for patients expressing a fear of certain sounds, or all sounds and resulting from abnormal activation of the limbic and autonomic nervous systems.

We noticed, however, that many patients labeled as phonophobic are not really afraid of sound but simply disliked sound, and this aversive reaction in not related to the functioning of the auditory system. The use of "phobia" frequently caused a strong objection from patients due to the implied existence of a fear to sound, the existence of a phobia, and therefore a psychological basis for their problem. It is obvious that the negative reaction to a sound can be driven by various emotions, and not only by fear. The task was to find a term which would be sufficiently general to encompass these various emotions, while specific enough to describe the situation in an adequate manner. To describe this situation we decided to use dislike of, or aversion to sound. After reviewing various Latin and Greek prefixes, and consulting with a distinguished expert in classic Greek and Latin from Cambridge University UK, we selected the term "misophonia" which translates into " strong dislike (hate) of

sound". As such it is close to the patients' description of their symptoms and can encompass a variety of negative emotions generated by the sounds in question. .

Phonophobia is still a valid term, but describes a specific type of misophonia, when fear is the dominant emotion involved in the dislike of the sound. The majority of patients with decreased sound tolerance have misophonia, but only some of them are phonophobic. A common reason for phonophobia is the fear that sounds, frequently 'normal' environmental sound, may damage the ear, or make symptoms worse. This can result in patients spending much time and effort trying to avoid sound exposure Misophonic patients are simply disliking these sounds without necessarily fearing them, which are then creating negative emotional responses. We have already found the term misophonia to be very helpful in our clinical practice, reflecting more appropriately the real emotions involved in decreased sound tolerance.

Decreased sound tolerance can have an extremely strong impact on a patient's live. It can *prevent* people from entering louder environments, and from working and interacting socially. It can also prevent patients from enjoying a variety of life activities. In extreme cases, decreased sound tolerance can totally control a patient's life. In these cases, patients do not leave their homes. Their lives, and the lives of their families, are totally controlled by the issue of sound avoidance.

Clinical observations reveal that in many cases, decreased sound tolerance consists of more that one problem. It is not necessarily loud sounds, but even quiet sounds, which can cause discomfort. Decreased sound tolerance might reflect a physical discomfort, or can be related to a dislike or a fear of sound.

Our approach to decreased sound tolerance is based on neurophysiology. We indicate the neuronal systems which may be involved in decreased sound tolerance including the peripheral and central auditory systems, the limbic and the autonomic nervous systems. Consequently, we propose the following specific definitions.

*Hyperacusis* can be defined as an abnormally strong reaction to sound occurring within the auditory pathways. At the behavioral level, it is manifested by a patient experiencing physical discomfort as a result of exposure to sound (quiet, medium or loud). The same sound would not evoke a similar reaction in the average listener. The strength of the reaction is controlled by the physical characteristics of the sound, e.g., its spectrum and intensity.

*Misophonia* and *phonophobia* can be defined as abnormally strong reactions of the autonomic and limbic systems resulting from enhanced connections between the auditory and limbic systems. Importantly, misophonia and phonophobia do not involve a significant activation of the auditory system. At the behavioral level, patients have a negative attitude to sound (misophonia), or are afraid of sound (phonophobia). In cases of misophonia and phonophobia, the strength of the patient's reaction is only partially determined by the physical characteristics of the upsetting sound. It is also dependent on the patient's previous evaluation and recollection of the sound (e.g., sound as a potential threat, and/or the belief that the sound can be harmful), the patient's psychological profile and the context in which the sound is presented.

Please note that neither hyperacusis, nor misophonia nor phonophobia have any relation to hearing thresholds. Patients with hyperacusis, misophonia or phonophobia may have normal hearing, or they may be hearing impaired.

There is limited data available regarding the prevalence of decreased sound tolerance. Nonetheless, our research indicates that hyperacusis and tinnitus frequently co-exist in the same ear. Approximately 40% of tinnitus patients exhibit some degree of decreased sound tolerance, with 27% requiring specific treatment for hyperacusis. Conversely a study of 100 patients with hypersensitivity to sound showed that 86% of them suffered from tinnitus.

Therefore, based on clinical observation that approximately 27% of tinnitus patients required treatment for hyperacusis, considering that 86% of hyperacusis patients reported tinnitus, and accepting that about 4-5% of general population have clinically significant tinnitus, it is possible to extrapolate that significant hyperacusis probably exists in at least 1 - 1.5% of the general population.

In the majority of cases, the etiology of hyperacusis is unknown. Hyperacusis has been linked to sound exposure (particularly short, impulse noise), head injury, stress, and medications. The lack of strong epidemiological data, and the lack of an animal model for hyperacusis prevents us from proving the validity of any theory of the potential mechanisms responsible for hyperacusis.

Decreased sound tolerance can exist as an independent medical diagnosis, or may be associated with more complex problems. Medical conditions previously linked to decreased sound tolerance include: tinnitus, Bell's palsy, Lyme Disease, Williams Syndrome, Ramsay Hunt Syndrome, stapedectomy, perilymphatic fistula, head injury, migraine, depression, withdrawal from benzodiazepines, increased Cerebral Spinal Fluid (CSF) pressure and Addison's disease.

Most frequently, significantly decreased sound tolerance results from a combination of hyperacusis and misophonia/phonophobia. It is important to assess the presence and the extent of all these phenomena in each patient, as misophonia / phonophobia needs to be treated differently form hyperacusis.

While there is no clearly accepted consensus method for the evaluation of decreased sound tolerance, there appears to be general agreement that loudness discomfort levels (LDLs) provide a reasonable estimation of the problem. A detailed pre-test interview is needed with each patient to determine the relative contribution of hyperacusis, misophonia and phonophobia to decreased sound tolerance, reflected in decreased behavioral LDLs.

Regarding hyperacusis there are two, diametrically opposed treatment options. First, the most common approach to hyperacusis is to advise patients to avoid sound and use ear protection. This is based on the reasoning that because the patients became sensitive to sound this may indicate that they are more susceptible to sound exposure, and consequently need extra protection. Patients easily embrace this philosophy and start to protect their ears, even to the extent of using ear plugs in quiet environments. In our opinion this approach unfortunately makes the auditory system even more sensitive and further exacerbates hyperacusis.

The second approach involves the desensitization of patients by exposure to a variety of sounds. The desensitization approach has been promoted for some time with a variety of protocols and types of sounds utilized; such as the recommendation of using sound with certain frequencies removed, short exposures to moderately loud sound, or prolonged exposures to low level sounds. These treatments are not recommended and can make patients worse.

According to the principles of the neurophysiological model of tinnitus and decreased sound tolerance, our version of the desensitization approach is recommended and it is used as a part of Tinnitus Retraining Therapy.

Misophonic/phonophobic components cannot be removed by desensitization and a separate approach needs to be implemented. According the neurophysioogical model our approach involves proper counseling based on the model, and systematic exposure to sounds, associated with positive reinforcement (some pleasant situation) with gradually increasing sound levels .

Decreased sound tolerance, including hyperacusis, misophonia, and phonophobia, is a challenging topic to study, and a challenging symptom to treat. Many questions are unanswered; the etiology is not clear, neural mechanisms are speculative and treatments are not yet proven. Above all, the general recognition of decreased sound tolerance, as a problem requiring attention and proper treatment, should be considered a priority in the community for hearing professionals.

This paper was published in ITHS Newsletter 2 July 2001

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