

### 3.6.4 Category 3: hyperacusis without prolonged enhancement from sound exposure

*Because of the need for a different approach to hyperacusis from that for tinnitus, it is essential to establish the presence and extent of hyperacusis in each patient. This is achieved by measuring LDLs and making a detailed assessment of the patient's experience with environmental sounds to identify the potential contribution of misophonia to decreased sound tolerance. Approximately 40% of our patients have decreased sound tolerance. It is important to realize that the application of a protocol for management of tinnitus that disregards the presence of hyperacusis will not only fail to help the patient but may make the symptoms worse. Treatment for hyperacusis is required in about 25–30% of all patients.*

Patients in category 3 receive counseling focused on hyperacusis-related issues at the expense of information about tinnitus and they have sound therapy aimed at desensitization. It is essential to establish the extent of the hyperacusis component in decreased sound tolerance, since sound therapy will be determined by the extent of hyperacusis, disregarding misophonia, which is treated separately. The extent of hyperacusis is assessed by measuring LDLs and examining the patient's experience with environmental sounds. There is a continuum of distribution of average LDL values from equipment and legal limits (i.e., 120 dB hearing level) down to 20–30 dB hearing level in patients with severe hyperacusis and misophonia. Using an average LDL of 100 dB hearing level as the borderline for normality, about 40% of our patients exhibit decreased sound tolerance. As in the majority of patients, hyperacusis is accompanied by misophonia, all patients will receive counseling about both phenomena. This counseling is in addition to the non-specific counseling given to tinnitus patients. In those with dominant hyperacusis, and tinnitus being a secondary symptom, counseling focuses on hyperacusis-related issues at the expense of information about tinnitus, particularly the mechanisms involved in controlling the gain within the auditory pathways (control of the OHC system and modification of the sensitivity of neurons in the central auditory pathways; see Ch. 2 for details).

Hyperacusis is treated primarily by wearable sound generators, while misophonia requires special counseling and a separate treatment protocol.

These patients are taught that the auditory system, like all sensory systems, regulates its sensitivity on the basis of the average intensity of stimuli it receives. This means that in a very quiet environment we may become strongly aware of sounds that previously were inaudible, such as our heartbeat or sound produced by the movement of clothes over our body.

In the auditory system, this increased gain is achieved at two different levels. First, in the periphery, the sensitivity of the cochlea may be modified through the efferent system and the OHC, altering amplification within the cochlea. Second,

in the central auditory system, the sensitivity of auditory neurons can be modified to produce a high level of enhancement (amplification) of signals. There is a gradual transition from maximal activity of the cochlear amplifier (OHC) to passive transduction of the sound. In certain circumstances, the activities of this amplifier may be altered so that amplification is provided unnecessarily for higher levels of sound coming into the cochlea. In the central auditory system, a similar scenario might exist with inappropriate amplification of neural patterns of activity induced by moderate to high levels of sound.

Many patients with hyperacusis also experience the perception of sound distortion. This might result from neurons experiencing premature saturation of activity, resulting in “peak clipping” of the signal and perceived distortion of external sounds. Once a sufficient number of neurons reach this state of saturation, defense mechanisms are triggered and sounds are perceived as being uncomfortably loud, often with pain in the ear. As a part of this defense mechanism, the limbic and autonomic nervous systems will be activated in an effort to remove the person from the presence of the perceived excessive sound, or in an attempt to suppress its source. Reports of subjects who spent even a few minutes in a soundproof chamber clearly show that the perception of external sounds loudness is enhanced, presumably as a manifestation of increased gain within the auditory pathways.

Accordingly, mechanisms evoking abnormally high auditory gain might result in the emergence of tinnitus, as well as hyperacusis. Indeed, it is a common clinical experience that tinnitus and hyperacusis emerge around the same time. The two phenomena can, therefore, be viewed in some patients as two manifestations of the same internal mechanism.

**In category 3, temporary worsening of symptoms can occur after sound exposure, but never beyond a good night’s sleep.**

In categories 0–2, the symptoms of tinnitus are frequently worsened by exposure to sound for periods not exceeding a few hours. The same situation may happen for patients in category 3, and both tinnitus and hyperacusis might, therefore, exhibit worsening after sound exposure. While this has no effect on the proposed treatment or its outcome, this enhancement of symptoms may result in a worsening of misophonia, requiring specific counseling concerning the mechanisms of misophonia and the transient nature of the tinnitus increase. It is stressed that, even when the symptoms become worse as a result of sound exposure, this does not indicate new damage to the cochlea, as some patients believe. However, when enhanced hyperacusis or tinnitus in response to sound exposure persists after a good night’s sleep, other mechanisms are implicated, and a different treatment approach is needed, as described in the next section.

In the treatment of Category 3 patients, sound therapy is aimed primarily at desensitization of the auditory system to achieve attenuation or even removal of hyperacusis. The desensitization principle is explained to the patient as making the system more resistant to louder sounds by gradually introducing sound of increasing loudness. An analogy of desensitization may be explained in terms of sunburn. Immediate exposure to tropical sunshine when the skin is very pale will result in burnt skin, and possibly serious illness. However, sunburn can be avoided by gradually increased periods of exposure to the sun. Similarly, in hyperacusis, by gradually introducing carefully controlled sound, it is possible to desensitize the auditory system and achieve the same level of sound tolerance as present in the general population.

For this category of treatment, sound generators (or combination instruments where subjectively significant hearing loss is also present) are recommended. They are fitted binaurally using open ear-molds as described above. However, the initial sound levels are determined by the patient's annoyance level, which would depend on the extent of hyperacusis. Patients are advised to increase the sound level gradually, while keeping it always below that which could evoke annoyance. For pure hyperacusis, the sound is increased to the highest level that does not induce any annoyance or discomfort, or interfere with hearing. Many patients will experience an immediate symptomatic improvement in their sound tolerance when wearing the instruments. This should not be confused with the ultimate aim, which is to use desensitization to achieve normal tolerance to sound without the need for instruments. In this category, it is particularly important to use continuous not intermittent exposure to the sound, even at the expense of using lower sound levels. It is also important to keep close and frequent contact with the patient.

Some patients experience only hyperacusis and misophonia without tinnitus. Others may experience some tinnitus, which for them is not a significant problem, while suffering severely from hyperacusis. In this group, we can omit all the counseling relating to explanations of tinnitus and focus on the hyperacusis and misophonia. Furthermore, in these patients, it does not matter if the tinnitus is suppressed by the sound therapy. The comfortable listening level for sound from the instrument is the maximal sound level to be used.

**If both tinnitus and hyperacusis are present, the hyperacusis is treated first.**

When significant tinnitus is present, hyperacusis is still treated first and the sound level is determined by potential annoyance; additionally, patients are instructed to avoid suppression of tinnitus if possible. Being close to the "mixing point" is a secondary goal, attempted only after substantial improvement is noted in hyperacusis.