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Current approaches to decreased sound tolerance disorders: A narrative review

Azalmış ses toleransı bozukluklarına yönelik güncel yaklaşımlar: Bir geleneksel derleme

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ABSTRACT

Decreased sound tolerance is a condition in which sensitivity to environmental sounds is increased. Hyperacusis, misophonia, and phonophobia are subtypes of this condition. Current literature continues to debate the definition, classification, mechanisms, and management strategies. Tests and self-report measures are available for assessment. Management strategies are based on counseling approaches, sound enrichment therapy, and psychological support. In this context, multimodal approaches increase the effectiveness of the rehabilitation process. Appropriate assessment and guidance of this group of patients, who are not sufficiently recognized despite being common in clinical practice, is of critical significance. The aim of this narrative review is to examine the current literature on disorders of decreased sound tolerance and discuss the definition, classification, mechanisms, and management strategies of these conditions.

Keywords: Counseling, hyperacusis, misophonia, sound enrichment, sound sensitivity.

ÖZ

Ses toleransında azalma, çevresel seslere karşı hassasiyetin arttığı bir durumdur. Hiperakuzi, mizofoni ve fonofobi bu durumun alt türleridir. Güncel literatürde tanımı, sınıflandırılması, mekanizmaları ve yönetim stratejileri tartışılmaya devam etmektedir. Değerlendirme için testler ve özbildirim ölçütleri mevcuttur. Yönetim stratejileri danışmanlık yaklaşımları, ses zenginleştirme terapisi ve psikolojik destek temelinde ilerlemektedir. Bu bağlamda, multimodal yaklaşımlar rehabilitasyon sürecinin etkinliğini artırmaktadır. Klinik pratiklerde yaygın görülmesine rağmen yeterince tanınmayan bu grup hastanın uygun şekilde değerlendirilmesi ve yönlendirilmesi kritik önem taşımaktadır. Bu geleneksel derlemenin amacı, azalmış ses toleransı bozuklukları üzerine mevcut literatürü incelemek ve bu durumların tanımını, sınıflandırılmasını, mekanizmalarını ve yönetim stratejilerini tartışmaktır.

Anahtar sözcükler: Danışmanlık, hiperakuzi, mizofoni, ses zenginleştirme, ses hassasiyeti.

Decreased sound tolerance (DST) is defined as an increased sensitivity to environmental sounds, which can negatively affect individuals' daily life. Hyperacusis, misophonia, and phonophobia are subtypes observed in individuals with DST. These disorders can lead to psychological, emotional, and physical disturbances. However, there is still considerable debate and uncertainty in the literature regarding the definitions, classifications, mechanisms, and management strategies for these disorders.[1-3] The lack of accepted criteria for distinguishing between these species and defining each one further complicates the field. Although these species present with similar symptoms, the etiology, triggers, and management approaches for each may differ. Decreased sound tolerance is often overlooked in assessments, resulting in individuals not being referred for appropriate treatment/therapy.

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This review aimed to summarize existing studies on DST disorders and examine the diagnosis, assessment and treatment modalities in this area. It is critical that individuals with DST are accurately recognized and appropriately referred. Given the existing gaps in the literature, this review aimed to contribute to the development of a more effective approach to identifying and treating sound tolerance disorders. Moreover, the effectiveness of multimodal treatment methods such as sound enrichment therapy, counseling approaches and psychological support has gained more importance in recent studies.[4-6] In this review, we discussed the use of these therapeutic approaches and how they can be adapted to individual treatment protocols and proposed solutions to the challenges encountered in clinical practice. It was also emphasized that professionals such as audiologists, otolaryngologists, psychologists, neurologists, neuroscientists, and occupational therapists who will be involved in the management of such disorders need to develop awareness. The collaboration of these professionals will make the treatment/therapy processes more effective and comprehensive. Given the prevalence of DST disorders, accurately recognizing and treating such patients is a great necessity in healthcare.

DECREASED SOUND TOLERANCE AND ITS TYPES

Decreased sound tolerance refers to a condition in which an individual's sensitivity to sounds in the environment increases. Different terms have been used in the literature to reflect specific parts of reduced sound tolerance. Some of these include increased sound awareness,[7] an abnormally strong response to moderate intensity sound, pathological auditory hypersensitivity, sound tolerance issues, increased auditory sensitivity, selected sound sensitivity, hyperacusis, and misophonia.[8-12]

Since the use of a large number of terms leads to confusion, a classification was made by two different researchers. Tyler et al.[3] accepted hyperacusis as an umbrella term and subcategorized it into loudness hyperacusis, annoyance hyperacusis, fear hyperacusis, and pain hyperacusis. These types may occur independently or in combination. In loudness hyperacusis, individuals are disturbed by the intensity of the sound, while in discomfort hyperacusis, intolerance to certain types of sound is observed regardless of the intensity of the sound. In fear hyperacusis, fear and avoidance behavior is observed mostly in anticipation of the arrival of the disturbing sounds. In pain hyperacusis, pain is felt at much lower sound intensity levels than expected (120 dB SPL).

Jastreboff and Jastreboff[13] mentioned the subclasses of hyperacusis, misophonia, and phonophobia. In hyperacusis, negative reactions to a sound depend solely on its physical properties (i.e., its spectrum and intensity). Misophonia occurs when there is an abnormally strong reaction to certain sounds that vary according to the individual. This reaction is not directly related to the physical properties of the sound. Although the exact causes of misophonia are unknown, it is thought to be a neurological condition associated with abnormalities in the way the brain processes auditory stimuli.[14,15]

Schröder et al.[16] argued that misophonia should be included in the obsessive-compulsive spectrum. Jastreboff and Jastreboff,[13] on the other hand, disagreed with Schröder et al.'s suggestion, arguing that mental pathology is rarely observed in misophonic patients. Kılıç et al.[17] and Alluşoğlu and Aksoy[18] also reported study results that support the need to classify misophonia as a separate psychiatric disorder. In a consensus on the definition of misophonia, it was reported that the scientific evidence was not sufficient to categorize misophonia as a medical[19] or psychiatric disorder.[16,19]

Phonophobia, on the other hand, is a specific subtype of misophonia and occurs when the patient's fear of sound is the dominant emotion.[13] It is an abnormally strong reaction by the autonomic and limbic system to a specific sound.[20] Phonophobia is recognized in clinical psychology and neurology, where it is treated in the same way as other types of sensory phobias as part of a chronic neurological disorder characterized by migraine-related symptoms and recurrent headaches.[13]

EPIDEMIOLOGY

Information on the prevalence of DST is not clear. There are inconsistencies as there is no consensus on terminology and how the diagnosis should be made. One study reported that 15.3% of 10,349 randomly selected subjects had DST.[21]

In the general population, hyperacusis affects at least 2% of individuals to varying degrees. The prevalence of hyperacusis has been observed to vary between 9% and 15%.[22] In a study on 536 university students, the prevalence of hyperacusis was 5.78%.[23]

In a study by Schröder et al.,[16] it was reported that approximately 20% of the general population suffered from misophonia symptoms. Another study

conducted by Wu et al.[24] showed that approximately 20% of university students experienced symptoms of misophonia. Kılıç et al.,[17] on the other hand, detected 7.7% misophonia according to the diagnostic criteria they developed in their study with 426 participants. In the same study, the rate of being significantly disturbed by at least one sound was 77.9%.

The prevalence of phonophobia has been reported between 21.3% in the USA and 16.8% in the UK.[25,26] It is frequently observed in patients with migraine and becomes more prominent as the severity and duration of the disease increases. One study reported that phonophobia was present in 25% of individuals with migraine, while another study found that 60% of individuals with tinnitus experienced phonophobia.[27] Fioretti et al.[28] stated that phonophobia alone is rarely observed.

Alluşoğlu and Aksoy[18] reported that hyperacusis and misophonia were most frequently observed together, with a prevalence of 18.9%, among the subtypes of DST in a study conducted with individuals with suspected DST who answered yes to the question, "Do environmental sounds disturb you?" This was followed by the coexistence of misophonia and phonophobia in 9.4%.

METHODS USED IN THE ASSESSMENT

Medical history, audiologic tests, self-report scales, psychoacoustic tests, and LDL measurements are used to diagnose DST. However, no universal procedure has been accepted.

Medical history

In the evaluation of DST, taking a medical history is important to learn about the patient's symptoms, triggers, and underlying diseases. The history is used to confirm the diagnosis, assess the severity of the disease, and determine appropriate treatment options.[29]

When taking a medical history, the patient is asked to describe their complaints. Detailed information is obtained about the sounds or environments to which the patient is exposed and the severity, duration, and frequency of symptoms. In addition, the patient is asked to describe the characteristics of the triggering sounds (e.g., loudness, intensity, frequency, and duration). In addition, the extent to which the symptoms interfere with the patient's daily activities, such as the impact on work or school performance, is also important.[17]

Factors affecting the patient's quality of life and psychological state are also assessed. These factors include stress, anxiety, depression, insomnia, and loss of functioning. The medical history includes information on previous illnesses, medications, and medical interventions.[30]

Scales

The Decreased Sound Tolerance Screening Scale and the Sound Sensitivity Symptoms Questionnaire were developed to screen for DST.[18,31] For the diagnosis of hyperacusis, the Khalfa Hyperacusis Questionnaire,[32] Multiple Activity Scale for hyperacusis,[33] the Self-Assessment Questionnaire on Hypersensitivity to Sound,[34] and the Hyperacusis Symptoms Inventory[35] are used for adults. The Hyperacusis Impact Questionnaire[31] was developed to assess the effects of hyperacusis. The Hyperacusis Handicap Questionnaire[36] and the Hyperacusis Assessment Questionnaire[37] have also been specifically developed to assess the presence of hyperacusis in the population with tinnitus. For the pediatric group, the Pediatric Hyperacusis Questionnaire Parent Form[38] and the Hyperacusis Scale for Children[39] are used.

In the assessment of misophonia, the Amsterdam Misophonia Scale,[16] the MisoQuest questionnaire,[40] the Misophonia Questionnaire,[24] and the Misophonia Assessment Questionnaire[41] are used. These tools aim to measure the severity, frequency, and emotional impact of symptoms and the impact of misophonia on quality of life and functioning.

There are no scales developed for phonophobia assessment. However, there is a phonophobia section in the Decreased Sound Tolerance Screening Scale.[18]

Tests

Psychoacoustic Test for Hyperacusis and Misophonia

Enzler et al.[42] developed a psychoacoustic test for the diagnosis of hyperacusis. In this test, patients are presented with a series of natural sounds and are asked to rate the sounds on a scale of 0 to 10 based on perceived loudness and discomfort. The advantages of the test are that it can be measured without disturbing hyperacusis patients by exposing them to very loud sounds and that it includes sounds from everyday life. It was thought that the test could be a more effective and reliable tool for the diagnosis of hyperacusis, particularly in individuals who have difficulty tolerating psychoacoustic tests containing artificial stimuli such as pure tones and narrowband sounds. Similarly, a psychoacoustic test was developed to be used in the diagnosis of misophonia.[43] The test may be an important tool for the measurement and treatment of symptoms of misophonia and may provide a basis for future research.

The loudness discomfort levels

The loudness discomfort level (LDL) is the highest sound level that a person can tolerate without discomfort or pain. It is measured in a frequency-specific manner, and frequencies between 125 and 8000 Hz are generally used.

The most common technique used in clinical settings to measure LDL is the Bekesy monitoring method. This method involves presenting the patient with a narrowband noise signal at a constant noise level and then increasing the noise level in small increments until the patient reports discomfort or pain. The noise level is then reduced until the patient no longer feels discomfort, and this level is recorded as LDL. Another commonly used method for measuring LDL is the Hughson-Westlake method. This method involves presenting the patient with a series of pure tone signals at a fixed level of intensity and then increasing the intensity level until the patient reports discomfort or pain. The intensity level is then decreased until the patient no longer feels discomfort, and this level is recorded as LDL. Due to its high test-retest reliability, the LDL can be considered a usable measure for monitoring and diagnosing patients.[44]

Dynamic range

Dynamic range is defined as the difference between the minimum and maximum sound levels a person can hear. In the presence of hyperacusis, the dynamic range is narrowed, which means that the patient can tolerate a smaller range of sound levels than normal.[30]

Several studies have shown that dynamic range measurement is a useful tool for the diagnosis of hyperacusis. For example, a study by Pienkoowski et al.[30] found that patients with hyperacusis had a significantly smaller dynamic range than control subjects. In addition, a study by Jastreboff and Jastreboff[45] proposed a method to diagnose hyperacusis based on the level of annoyance with sound and LDL measurement. The authors suggested that a decrease in dynamic range could be used as an indicator of hyperacusis. Assessment methods for hyperacusis and misophonia are given in Table 1.

DIAGNOSIS OF DECREASED SOUND TOLERANCE

It is critical to start by differentiating misophonia from hyperacusis. Although they have similar aspects and areas of involvement, their mechanisms and management strategies differ.[2]

There is disagreement about whether to use the LDL threshold or dynamic range to determine whether hyperacusis is present. Hyperacusis is reported as a dynamic range of less than 60 dB between the hearing threshold and LDL at the frequency of interest.[46] According to Jastreboff and Hazell,[47,48] the dynamic range in severe hyperacusis is between 25-40 dB.

Since many studies have reported that LDL is decreased in individuals with hyperacusis, LDL is used as a criterion for the diagnosis of hyperacusis.[49] There are studies that accept a finding in favor of hyperacusis when LDL is 90 dB and lower. Since the specific LDL threshold indicative of hyperacusis remains unclear, a group of researchers at the Third International Conference on Hyperacusis suggested that hyperacusis should be diagnosed when the minimum LDL is <77 dB and Khalfa Hyperacusis Questionnaire score is >22 dB.[49] In another study, the patient's statement, LDL, and the Khalfa Hyperacusis Questionnaire score were accepted as the criteria, and individuals with findings in favor of hyperacusis in two of the three criteria were considered to have hyperacusis.[42]

There is no definite criterion in the literature for the diagnosis of misophonia. However, in a study conducted with 543 individuals, diagnostic criteria were proposed by following the logic of psychiatric classification systems. Accordingly, the presence of at least one sound found to be moderately or very disturbing, emotional or physical reactions when exposed to the sound, and symptoms affecting daily life in certain areas and at certain rates were reported as criteria in the 50-item symptom list of misophonia.[17]

MANAGEMENT STRATEGIES

Decreased sound tolerance refers to a condition in which individuals have increased sensitivity to environmental sounds, often leading to discomfort and functional impairments in daily life. If the root cause of DST can be found, the first focus is on treating it. However, it is often not possible to get to the root cause or there is no known treatment. Rehabilitation methods are therefore used to reduce the individual's symptoms.

Counseling approaches

Counseling is important to inform individuals with DST and to manage psychological and emotional reactions. Since hyperacusis and misophonia are perceptual conditions, negative thoughts and emotional reactions in the limbic system that match the sounds can exacerbate symptoms. One of the main goals of

Tablo 1
Assessment methods for hyperacusis and misophonia

Assessment method	Description	For Hyperacusis	For Misophonia
Medical history	A medical history is taken to learn about the patient's symptoms, triggers, and underlying diseases, to assess severity, and determine appropriate treatments	✓	✓
Self-report tools			
Decreased Sound Tolerance Screening Scale	Screening tool for Decreased Sound Tolerance (DST)	✓	✓
Sound Sensitivity Symptoms Questionnaire	Developed to assess symptoms related to DST.	✓	✓
Khalfa Hyperacusis Questionnaire	For diagnosing hyperacusis.	✓	
Multiple Activity Scale for Hyperacusis	Used to assess the impact of hyperacusis on daily activities.	✓	
Self-Assessment Questionnaire on Hypersensitivity to Sound	Measures hypersensitivity to sound.	✓	
Inventory of Hyperacusis Symptoms	A psychometric tool designed to measure hyperacusis symptoms.	✓	
Hyperacusis Impact Questionnaire	Assesses the impact of hyperacusis on quality of life.	✓	
Hyperacusis Handicap Questionnaire	Developed for assessing the impact of hyperacusis, particularly in those with tinnitus.	✓	
Hyperacusis Assessment Questionnaire	Used for assessing hyperacusis in tinnitus patients.	✓	
Pediatric Hyperacusis Questionnaire	Tools for assessing hyperacusis in children.	✓	
Amsterdam Misophonia Scale	Diagnostic tool for assessing misophonia symptoms.		✓
MisoQuest Questionnaire	Developed to assess misophonia symptoms.		✓
Misophonia Questionnaire	Self-report tool to assess misophonia severity.		✓
Misophonia Assessment Questionnaire	A tool to assess misophonia symptoms and their impact on daily life.		✓
Tests			
Psychoacoustic Test for Hyperacusis	Involves rating natural sounds based on loudness and discomfort.	✓	
Psychoacoustic Test for Misophonia	Developed for diagnosing misophonia using everyday sounds.		✓
Loudness Discomfort Level (LDL)	The highest level of sound a person can tolerate without discomfort or pain.	✓	✓
Dynamic Range	The difference between the minimum and maximum sound levels a person can tolerate.	✓	

coping is to help individuals become more attuned to the sounds. There are several specialized methods used for this purpose. The methods are adapted from counseling protocols developed for tinnitus.

The counseling part of Tinnitus Retraining Therapy (TRT) aims to educate the patient about the role of the brain in the perception of hyperacusis and misophonia and how sounds become an issue when they are perceived as disturbing. Since it is based on a neurophysiological model, it emphasizes that the main problem is negative thoughts and coding about sounds.[20]

Hyperacusis Activities Treatment (HAT) involves holistic counseling that addresses thoughts and emotions, hearing and communication, sleep and concentration skills, and takes into account individual differences and needs.[50] It facilitates patient involvement by using a picture-based approach to counseling and provides comprehensive and structured information. Involving the patient in the process through assignments is emphasized to promote therapeutic outcomes and facilitate progress.

Cognitive behavioral therapy (CBT) is a psychological intervention that aims to alleviate anxiety by helping individuals change dysfunctional thoughts, beliefs, and safety-seeking behaviors. In the absence of treatment, CBT for decreased noise tolerance has been found beneficial in reducing the depressive and anxiety components of the disease.[15] Aazh et al.[4,51] reported significant reductions in patients' symptoms with a customized CBT program for hyperacusis, misophonia, and tinnitus.

Sound enrichment therapy

Sound enrichment therapy is used to retrain the brain to perceive everyday sounds. The aim of this therapy is to gradually and safely expose the patient to increasing levels of sound so that the experience of sound becomes more manageable. This process can help reduce overactivity in central auditory gain and increase tolerance to sound.[52,53]

There are many different types of sound therapy. Stimulus options include a variety of sounds such as broadband noise, modified tones, compound tones, modulated tones, musical sounds, and nature sounds. There are different opinions in the literature about which of these sounds is most appropriate for therapy. The sound therapy section of the HAT recommends continuous low intensity broadband noise for hyperacusis, while the use of recorded trigger sounds is recommended for misophonia.[30] In TRT, the aforementioned sound types for hyperacusis are selected individually. For misophonia, depending on the severity of the individual's symptoms, there is a wide spectrum from the background music of a favorite movie watched on television to the embedding of trigger sounds into music.[13]

Studies that support the use of a multimodal approach that includes various combinations of the mentioned methods for hyperacusis and misophonia stand out. Cherri et al.[54] proposed a protocol for hyperacusis that includes the combined use of structured counseling and sound therapy. Nolan et al.[55] reported reduced stress, psychological well-being, and accompanying distress in 268 patients they followed using an approach that included education about tinnitus and hyperacusis, relaxation, directed attention and music therapy, and the application of coping strategies and techniques. Tinnitus Retraining Therapy and HAT include a protocol that combines counseling and sound enrichment components. Hyperacusis Activities Treatment also uses relaxation exercises, breathing exercises, and meditation as supportive methods. In a randomized controlled trial, Formby et al.[52] emphasized that when counseling and sound therapy were used together, the benefit to patients was significantly higher than when counseling and sound therapy were used alone.

In conclusion, DST significantly impacts individuals' quality of life; however, it remains insufficiently recognized. The ambiguities surrounding its definition and classification complicate the accurate assessment of these disorders. Consequently, there is a pressing need for internationally accepted guidelines and consensus among professionals regarding DST. Comprehensive evaluation methods, including medical history, self-report scales, psychoacoustic tests, and LDL measurements, play a critical role in establishing an accurate diagnosis. Furthermore, therapeutic approaches should be enhanced through multimodal strategies, such as counseling, sound enrichment therapy, and psychological support.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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