

## Internal Acoustic Channel Diameter in Sudden Sensorineural Hearing Loss

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### ABSTRACT

**Objective:** The purpose of our study was to determine the correlation between internal acoustic channel diameter and idiopathic sensorineural hearing loss.

**Material and Method:** We defined sudden sensorineural hearing loss according to the criteria of Wilson as a 30-dB sensorineural hearing loss occurring in at least three contiguous frequencies in less than 3 days. The internal acoustic channel diameter all of the patients was measured from three dimensional temporal CT scan.

**Results:** Of the 15 patients, 7 were male and 8 were female, ranging in age from 17 to 59 and the mean age was 39.6 years. The right ear was involved in 6 patients, and the left ear in 9. There was no statistically significant difference between the patients' affected and intact ears ( $p>0.05$ ). However, the mean diameter of affected side of the patients was narrower than those of healthy controls ( $p<0.05$ ).

**Conclusion:** When we compare our results with control group, we have shown that the diameter of the channel can be significantly related to sudden deafness. According to our data, a narrow channel can be a risk factor.

**Key Words:** Sudden sensorineural hearing loss, Internal acoustic channel, Three dimensional tomography.

### ÖZET

#### Ani İşitme Kaybında İnternal Akustik Kanal Çapı

**Amaç:** İdyopatik ani işitme kaybıyla internal akustik kanal çapı arasındaki ilişkinin ortaya konulması.

**Gereç ve Yöntem:** Wilson kriterlerine uygun olarak üç gün içerisinde oluşmuş, birbirini izleyen üç frekansta 30 dB işitme kaybı idiyopatik ani işitme kaybı olarak değerlendirildi. Hastaların internal akustik kanal çapları temporal bilgisayarlı tomografi yardımıyla internal akustik kanalın üç boyutlu görüntüsü elde edilerek ölçüldü.

**Bulgular:** Çalışmaya alınan 15 hastanın yedisi erkek sekizi kadındı. Yaş aralığı 17 ile 59 arasında değişmekte olup ortalama yaş 39,6 idi. Onbeş hastanın altısında sağ, dokuzunda sol kulak tutulmuştu. Hastaların işitme kaybı olan kulaklarıyla sağlam kulaklarının karşılaştırılmasında istatistiksel olarak anlamlı farklılık yoktu ( $p>0.05$ ). Ancak kontrol grubuyla karşılaştırıldığında etkilenen kulakta istatistiksel olarak anlamlı darlık tespit edildi ( $p<0.05$ ).

**Sonuç:** Bulgularımız kontrol grubuyla karşılaştırıldığında, idiyopatik ani işitme kaybı gelişen hastalarda internal akustik kanal çapının nispeten daha dar olduğunu ve bunun bir risk faktörü olabileceğini düşündürmektedir.

**Anahtar Kelimeler:** İdyopatik ani işitme kaybı, İnternal akustik kanal, Üç boyutlu tomografi.

Sudden Sensorineural Hearing Loss (SSNHL) is most commonly defined as a loss of at least 30 dB in 3 contiguous frequencies over a time course of 72 hours or fewer. The incidence is estimated at approximately 10 cases per 100,000 population (1). The pathogenesis of SSNHL is still not well understood.

Lack of knowledge about specific causes of Idiopathic Sensorineural Hearing Loss (ISHL) limits our ability to implement effective treatment. Although it is possible that a number of different pathologic processes result in sudden hearing loss, it is widely believed

that viral infection, cochlear membrane breaks, and vascular occlusion account for the majority of these cases. Of these, a viral etiology is thought to be most common (2, 3). Other causes such as syphilis, autoimmune diseases, perilymph fistula or multiple sclerosis must also be considered.

Schuknecht (4) argue in favor of a viral etiology on the basis of postmortem histopathologic studies of 12 patients with a history of ISHL. The most common pathology identified in their specimens, including atrophy of the organ of Corti and tectorial membrane, is

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similar to changes observed after known cases of viral labyrinthitis, particularly secondary to mumps and rubella. Further evidence for a viral etiology comes from serologic studies of patients with ISHL, showing a significantly increased rate of seroconversion for patients with sudden hearing loss as compared with controls (5).

Despite of all studies the pathogenesis of SSNHL is still not well understood. In most patients, however, we cannot identify the probable causes, and therefore idiopathic sudden sensorineural hearing loss is diagnosed. This essentially implies the importance of investigating risk factors for sudden deafness.

The purpose of our study was to determine the correlation between internal acoustic channel diameter and ISHL.

## MATERIAL AND METHOD

The study was approved by the local ethics committee of the department and carried out in accordance with the Firat University. We defined SSNHL according to the criteria of Wilson et al. as a 30-dB sensorineural hearing loss occurring in at least three contiguous frequencies in less than 3 days. The inclusion criteries were unilateral sudden hearing loss, hearing loss without a recognizable cause, no previous surgery affecting the ear, and no hearing loss in the affected ear in the past. Exclusion criteries were perilymphatic fistulas, acoustic trauma, acoustic tumors and Meniere's disease.

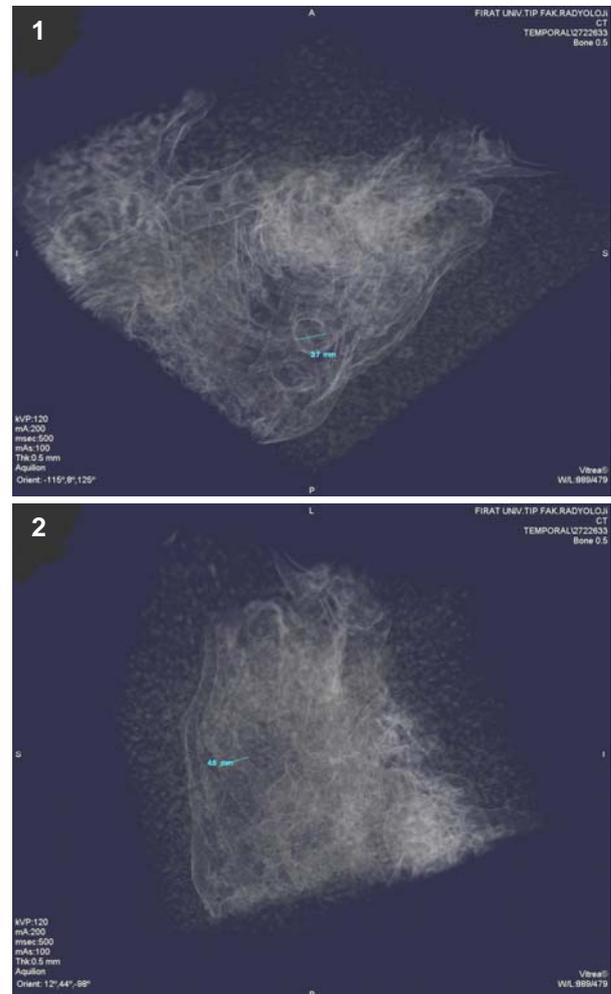
All patients were initially evaluated by physical examination, including blood pressure measurement; ear, nose, and throat examination; tonal and speech audiometry; stapedius reflex decay; and the following laboratory tests: hematocrit, prothrombin index, creatinine, glucose, cholesterol, triglycerides, thyroid-stimulating hormone and autoantibodies (AMA, SMA).

In addition the narrowest section of internal acoustic channel diameter all of the patients was measured from three dimensional temporal CT scan. The scanning conditions were: Tube current 200 mA, tube potential 120 kV, scanning time 0.5 s/scan, slice thickness 0.5 mm, and helical pitch 1 stac. The reconstitution function, FC81 was used as the algorithm for image reconstitution and an image-processing software (Aquilion 64, Toshiba) was used for preparation of reconstructed 3-D images. Mann Withney-U test is used for statistical analysis.

## RESULTS

Of the 15 patients, 7 were male and 8 were female, ranging in age from 17 to 59 and the mean age was 39.6 years. The right ear was involved in 6 patients, and the left ear in 9. The mean diameters were  $4.1 \pm 0.4$  mm in the patients with ISHL and  $4.4 \pm 0.4$  mm in those without ISHL whereas it was  $4.9 \pm 0.4$  mm in control

subjects (Figure1, 2). There was no statistically significant difference between the patients' affected and intact ears ( $p > 0.05$ ). However, the mean diameter of affected side of the patients was narrower than those of healthy controls ( $p < 0.05$ ). In addition the mean diameter of unaffected side of the patients was narrower than those of healthy controls ( $p < 0.05$ ).



**Figure 1, 2.** The narrowest section of internal acoustic channel diameter all of the patients was measured from three dimensional temporal CT scan

## DISCUSSION

Sudden Sensorineural Hearing Loss (SSNHL) is defined as a 30 dB loss over 3 continuous frequencies occurring in less than 3 days (6). If the reason is not clear the name of the disease becomes Idiopathic Sensorineural Hearing Loss (ISHL).

The etiology of the ISHL, is still unknown, what makes the topic still very controversial. In only 10% of the cases the cause can be found. One of the few emergencies in otology, the ISHL affects mostly those in their fourth decade of life, involving both the right and the left ears in equal proportions, and the 90% is unilateral (7, 8). The incidence is estimated at approxima-

tely 10 cases per 100,000 population (1). Because of the fact that the patients who had spontaneously remission did not seek help, the real incidence may be higher than thought. Several factors have been postulated to elicit the etiology of ISHL. The most recent studies concerning the possible causes of sudden hearing loss suggest vascular disorders, rupture of the inner ear membrane and autoimmune diseases; however, viral infections have received a great deal of attention in recent years (9). Little is known about the mechanism of sudden hearing loss.

Viruses can cause sudden hearing loss in an acute infection, however the latent form, and its possible reactivation have also been considered as explanations of the cochlear injury mechanism. Even though hearing loss can be explained by a blood viscosity change, experimental and clinical studies do not show any evidence of labyrinthine fibrosis and new bone formation, or labyrinthine membrane breaks. These findings are not in agreement with vascular and rupture membrane factors, respectively. Although acute viral infections may cause such damage, latent infections and their reactivation may also explain the lesion. The main latent viruses are part of the group of herpes virus: they are ubiquitous, bear strong neurotropism as characteristic; they not always cause symptoms (subclinical infection) and have complex relation with ISHL. The other viruses varicella-zoster (VZV), cytomegalovirus, influenza, parainfluenza A, B, C, mumps, measles, rubella, rhinovirus and the Epstein-Barr (10, 11). Almost all the SHL cases caused by virus are unilateral. The bilateral occurrence is rare. Depending on the viral agent, the hearing loss may present a certain pattern. For example, mumps courses with severe and irreversible HL, while HL caused by VZV is of low severity and reversible.

Although SSNHL is a well-recognized condition, no standard definition or treatment protocol has been accepted. Multiple factors have limited the ability to develop standard definition and treatment protocols for SSNHL. Limited understanding of the pathophysiology of this disease has as its consequence the lack of an effective treatment. It has become clear that this disorder is not the result of a single disease process. Confounding the issue is the high spontaneous recovery rate. Most studies report a spontaneous recovery in 45% to 65% of patients (12).

Steroids have become the most widely accepted treatment option for SSSL on the basis of their anti-inflammatory effect. Owing to the differences in the etiopathogenesis of SSSL, different therapeutic strate-

gies have been applied. These include steroids alone or combined with vasodilators, hyperbaric oxygen, inhaled carbogen, anticoagulants, antiviral, or even cytotoxic medications. Though some reports claim that their treatments were effective, there is no universal agreement on what is the "best" treatment protocol.

Several factors affect the prognosis directly. They include the age of the patient, the audiometric pattern of hearing loss, the presence or absence of vertigo, and the interval between the onset of SSNHL and the reception of treatment within 6 days (13). Age, time between onset and treatment, and audiogram type are shown to be significantly related to outcome. The best prognosis is in patients with midfrequency loss pattern, as reported in other studies. On the other hand prognosis is worse in children and over 60 years (14). Recently HSP70 has been an important marker in treatment and following of the disease (15).

In order to investigate risk factors for ISHL a lot of case-control study were done in past. Nakashima et al. (16) reported that those who ate many fresh vegetables were at a decreased risk for sudden deafness. If we look at the etiological factors of sudden deafness we can see that the disease is multifarious. So that the patient's own anatomical structure can be a risk factor for sudden deafness.

In the study by Weber et al. (17), it was demonstrated that steroid treatment improved the hearing via decreasing the suppression on edematous nerve in the internal acoustics channel, as showed by MRI. In this way, a narrow internal acoustic channel diameter can be a risk factor for sudden deafness theoretically. In the present study, there was no statistically significant difference between the patients' affected and unaffected ears ( $p > 0.05$ ). However, the mean diameter of affected side of the patients was narrower than those of healthy controls ( $p < 0.05$ ).

Anemia, disturbance of iron metabolism, smoking and drinking habits have been incriminated as risk factors of sudden deafness in previous studies. The purpose of our study was to determine the correlation between internal acoustic channel diameter and ISHL. When we compare our results with control group, we have shown that the diameter of the channel can be significantly related to sudden deafness. In addition, according to our data, a narrow channel can be a risk factor. On the other hand further prospective studies are needed to evaluate the risk factors about the disease.

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