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Neurootological Differentiations in Endogenous Tinnitus

Claus-F. Claussen[1] and Arti Pandey[2]

[1] *Neurootologisches Forschungsinstitut der 4-G-Forschung E.V., Bad Kissingen, Germany, and*
[2] *Ear, Nose, and Throat Department, CIMS Medical College, Bilaspur, Chhattisgarh, India*

Abstract: Vertigo and tinnitus are very frequent complaints. Often, we find multisensory syndromes combined with tinnitus, hearing impairment, vertigo, and nausea. From more than 10,000 cases, we evaluated 757 randomly selected neurootological patients suffering from endogenous tinnitus. First, we classified the 10,000 patients into those suffering from the basic tetrad of tinnitus forms: bruits, endogenous (maskable) tinnitus, exogenous (nonmaskable) tinnitus, and other syndromes such as the slow brainstem syndrome. Then, of all the endogenous tinnitus patients, we randomly selected our study sample (n = 757), and those patients underwent a complex neurosensory investigation, including neurootological history; classic audiometry; acoustic brainstem-evoked potentials; acoustic cortically evoked potentials; visually evoked potentials; electronystagmography of spontaneous, caloric, rotatory, and optokinetic nystagmus; and craniocorpography with several vestibulospinal tests. For this study, we primarily examined the historical findings. The statistical results demonstrate that tinnitus is interconnected to a multifactorial disease background with a broad spectrum of individual complaints. Finally, the topodiagnostics of the functional neurootometric analysis shows that this type of endogenous tinnitus constitutes decidedly more central than peripheral statoacoustic pathology.

Key Words: endogenous tinnitus; neurootometry; neurosensory investigations; statoacoustic system; tinnitus classification; tinnitus masking

Tinnitus is associated with the most important symptoms in neurootology besides vertigo, nausea, and hearing loss. In most cases, the origin of the tinnitus is not yet completely clear. However, what could be proved by various authors since 1985 is that endogenous tinnitus is significantly related to dysfunctions in the human temporal lobe (Brodmann area 41). Even though many irritating foci at different central nervous system levels are responsible for tinnitogenesis, only during the second half of the twentieth century have physicians had the tools to objectively discriminate at least four different kinds of tinnitus: bruits, maskable or endogenous tinnitus, nonmaskable or exogenous tinnitus, and delays and mismatches of data transfers within the statoacoustic pathways (i.e., slow brainstem syndrome).

Reprint requests: Claus-F. Claussen, MD, Kurhausstraße 12, D-97688 Bad Kissingen, Germany. Phone: (0049) (0)9 71-6 48 32; Fax: (0049) (0)9 71-6 86 37; E-mail: claussensolog@t-online.de

By questions and answers between doctors and tinnitus patients, the endogenous tinnitus can be clarified via the following dialog: *Q:* Where is your feeling of well-being maximized: in a busy and noisy environment or in a cave-like silence? *A:* I much prefer a busy and noisy environment. There I feel much better. Patients with a maskable or endogenous tinnitus prefer covering up their tinnitus by external sounds. In using masking procedures, three zones of tinnitus can be demarcated easily according to audiometric measurements within the hearing field: (1) low-tone tinnitus (at and below 750 Hz; Fig. 1); (2) middle-frequency tinnitus (1–2 kHz; Fig. 2); and (3) high-frequency tinnitus (>2–10 kHz or even 12 kHz; Fig. 3). The high-frequency tinnitus often develops close to the C5 dip and can be masked below the hearing threshold (see Fig. 3, right).

Since about 1985, via vestibular evoked potentials (VestEP) and brain electrical activity mapping (BEAM), the Würzburg Neurootology Group of Claussen et al. have detected that major groups of patients suffering from a maskable or endogenous tinnitus respond cortically in

a typical, reproducible, and measurable manner. The potentials are located around the upper gyrus of the temporal lobe (Brodmann area 41). We found typical shortenings in the latencies of the vestibular evoked quantitative electroencephalography (QEEG), an enlarged DC shift of the vestibular evoked QEEG, and typical cortical electrical burst expansion in three phases on the brain surface as shown by BEAM.

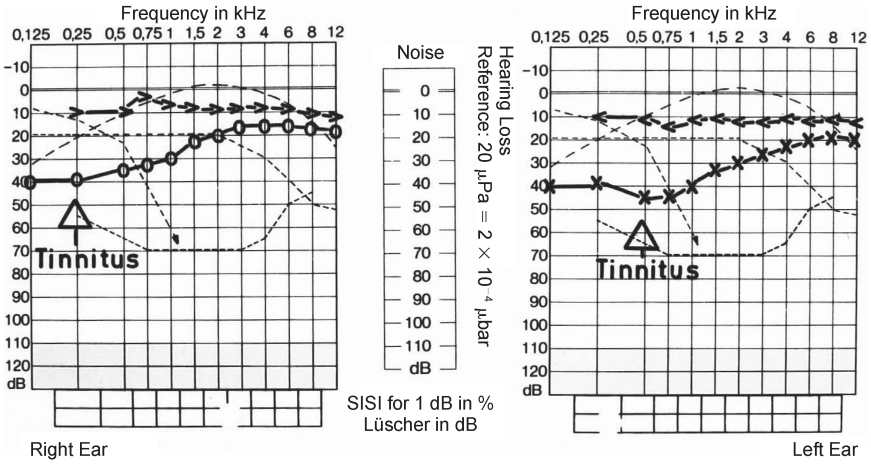


Figure 1. Low-tone tinnitus is more frequently found in Ménière's disease and some other cochleo-apical disorders.

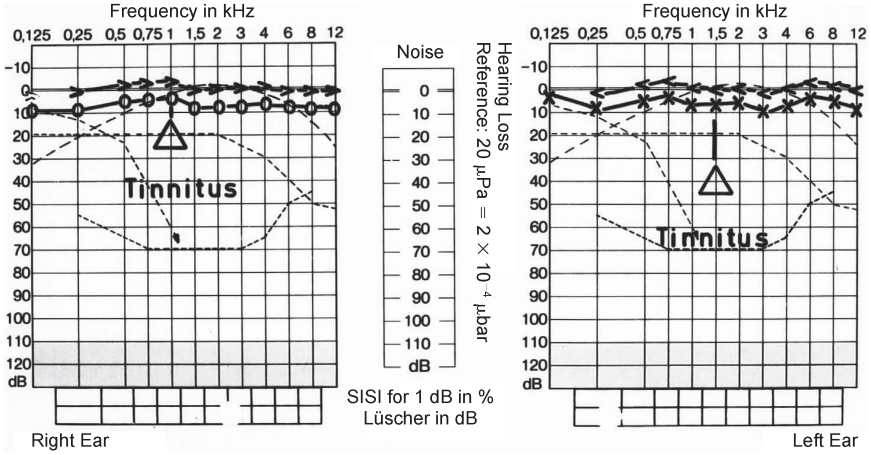


Figure 2. Middle-tone tinnitus more frequently occurs in diseases such as otosclerosis.

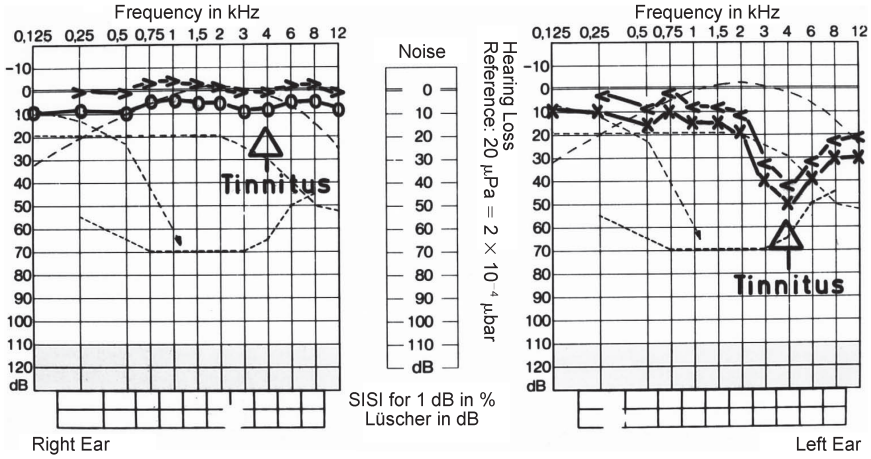


Figure 3. In the high-tone range, most frequently tinnitus is matched and related to such conditions as noise trauma, whiplash, head and skull trauma, cardiovascular failures, stress, and toxic events, including pharmaceutical use, nicotine or drug abuse, and acoustic neuromas.

PATIENTS AND METHODS

For this study, we randomly selected a sample of 757 patients suffering from an endogenous tinnitus according to the tetrad of tinnitus differentiation described. Owing to the size of the workload, we limited ours efforts to constructing a sample from those 757 patients randomly selected from a major group of neurootological patients (we process more than 10,000 files of neurootological patients, many of whom suffer from one or another type of tinnitus). We administered a full spectrum of neuro-otometric testing to all 757 patients; the investigation protocol for thorough data analysis (more than 500 parameters) included five procedures. First we recorded a thorough neurootological history with a systematic preprinted history scheme of Neurootologisches Anamneseschema Claussen (Neurootological History Scheme). Next, we examined all the patients otologically, including bilateral microscopical inspection of the outer ear, ear canal, and tympanic membrane.

We followed with a thorough audiometric investigation to obtain measurements of the hearing threshold, the acoustic discomfort threshold, the calculation of the acoustic dynamics, tinnitus masking, impedanciometry, and stapedial muscle reflexes. We then conducted objective and quantitative electrophysiological measurements of the acoustic pathways via otoacoustic emissions, acoustic brainstem-evoked potentials, and acoustic late or cortical evoked potentials.

As the majority of our patients also complained of vertigo and nausea, we conducted an extensive equilibriometric investigation with polygraphic electronystagmography (Claussen butterfly graph); the bilateral vestibular ocular per- and postrotatory test with the Claussen rotatory intensity-damping test scheme; retino-ocular tests with the pendular ocular eye-tracking test; and monocular recording of the eye movements with closed eyes. Other additional equilibriometric tests were complementary.

In assessing the vestibulospinal pathways, we regularly applied craniocorpography (CCG) in the form of ultrasonographic computed craniocorpography (UCCCG). We performed vestibulospinal recording of the CCG with the Romberg standing test and the Unterberger-Fukuda stepping test using USCCG and the human space trail. Additionally, we could have employed other vestibulospinal tests (e.g., the neck flexion-extension rotation test or the longitudinal lateral-vertical head-sliding test).

The test results from our analyses helped us to demonstrate that these 757 patients were suffering from an endogenous tinnitus. However, for this study, we present the broad spectrum of subjective complaints as reported by the patients with a broad variety of findings. After all the files of the patients were transferred into digital lists and nets of digital data, we could select the various groups of complaints to derive a representative statistic. This study describes the subjective pathology associated with the entire sample.

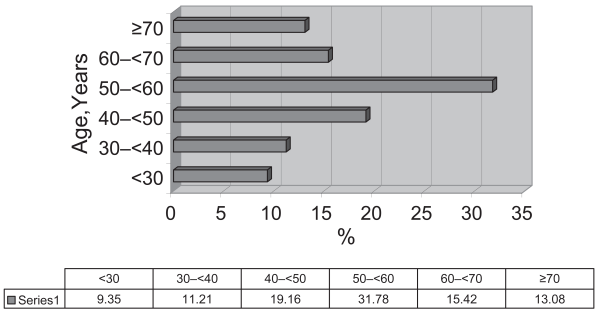


Figure 4. Age group distribution.

RESULTS

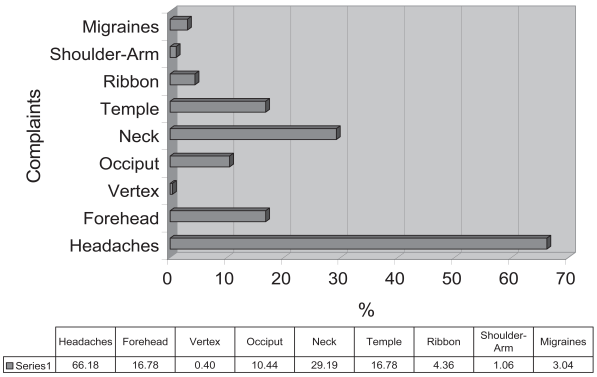
At the Neurootological Research Institute at Bad Kissingen, we recorded statistics from our 757 patients suffering from an endogenous tinnitus. This group included 470 male (62.09%) and 287 female (37.91%) patients. The average age of the sample was 52.40 years (standard deviation [SD], 13.89 years). Figure 4 displays the age distribution for our total sample. The weight of those in the sample was averaged at 75.66 kg (SD, 14.04 kg). The average height of our sample was 171.63 cm (SD, 8.71 cm) and the body mass index of the total sample amounted to 25.81 (SD, 3.95). The average systolic blood pressure stood at 130.28 mm Hg (SD, 19.72 mm Hg), and the average diastolic blood pressure averaged to 77.64 mm Hg (SD, 12.05 mm Hg).

We display the audiometric locations of optimal maskability in Table 1. As shown, tinnitus is more evident in the left ear than in the right ear. The majority were suffering from a high-tone tinnitus. As the sum of all the tinnitus spots being masked amounts to 141.74%, we were able to derive that nearly one-half of the sample suffered from a bilateral maskable tinnitus. The statistical chart (Fig. 5) shows that 66.18% of the entire sample were suffering from headaches. Headaches in the neck

Table 1. Statistical Analysis of Audiometric Masking Experiments of Tinnitus in 757 Patients with Endogenous Tinnitus

Tinnitus	No. (%)	Mean (Hz)	SD (Hz)	Mean (dB)	SD (dB)
Right ear	66.97	3,531.84	2,772.85	49.22	21.23
Left ear	74.77	3,291.97	2,651.68	47.24	20.44

dB = loudness; Hz = pitch; SD = standard deviation.



	Headaches	Forehead	Vertex	Occiput	Neck	Temple	Ribbon	Shoulder-Arm	Migraines
Series1	66.18	16.78	0.40	10.44	29.19	16.78	4.36	1.06	3.04

Figure 5. Headache complaints.

were the most frequent (29.19%), followed, with equal frequency, by headaches at the temple (16.78%) and above the forehead (16.78%).

All the tinnitus locations where we matched a tinnitus were then summed. This is shown for instance, in Figures 6 and 7, wherein the typical tinnitus phenomena are matched on different hearing zones in the audiograms of the right and left sides. There can also be overlap within the same side.

Of our 757 patients, 68.16% complained of decreased performance. Figure 7 shows the complaints of dysfunction of vigilance. Most frequently, we found insomnia in 51.52%, followed by susceptibility (39.10%) and daze (27.34%). In evaluating the complaints of mood disorders (Fig. 8), we found lower occurrence rates, with no more than 3.17% cases of depression. We also analyzed the complaints of vegetative symptoms (Fig. 9). The leading symptom here was nausea (96.95%), followed by retching (7.79%) and vomiting (7.13%). The latter symptoms occurred chiefly in relation to vertigo complaints from our patients.

Figure 10 describes the complaints of vertigo. The most frequent symptoms are uncertainty (55.09%), swaying (51.20%), and dizziness (50.59%). All three symptoms pertained to more than half of our sample. The symptoms of psychic vertigo are rather rare: similar to a lifting feeling (0.66%) or claustrophobia (0.53%). We also evaluated the complaints of vertigo-triggering mechanisms (Fig. 11). The most frequent trigger for releasing a vertigo attack was bending (35.80%), followed by getting up (12.68%). In 7.27%, only changing the posture of the body released a vertigo attack.

After exploring the vertigo mechanisms, we analyzed the different sensations in hearing distortion in our patient sample (Fig. 12). The most frequent quality of tinnitus distortion reported was a whizzing sound in either ear or in both (54.02%). A total of 18.49% reported a sizzling sound in the right ear, and 17.97% described it in the left ear. This was followed by a buzzing sound in 9.25%

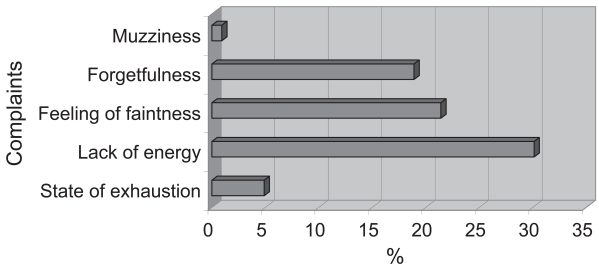
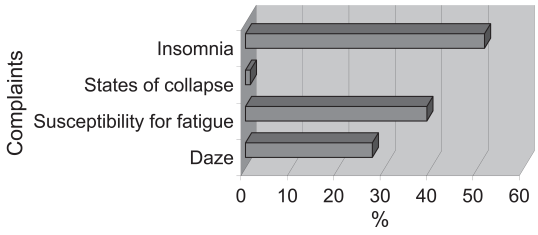
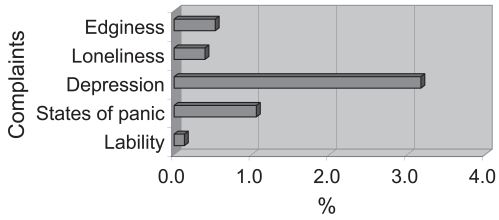


Figure 6. Complaints of decreased performance (total, 68.16%).



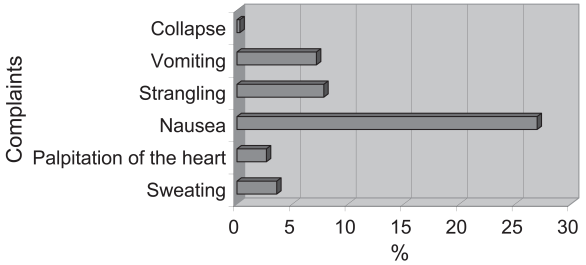
	Daze	Susceptibility for fatigue	States of collapse	Insomnia
Series1	27.34	39.10	1.06	51.52

Figure 7. Complaints of dysfunction of vigilance.



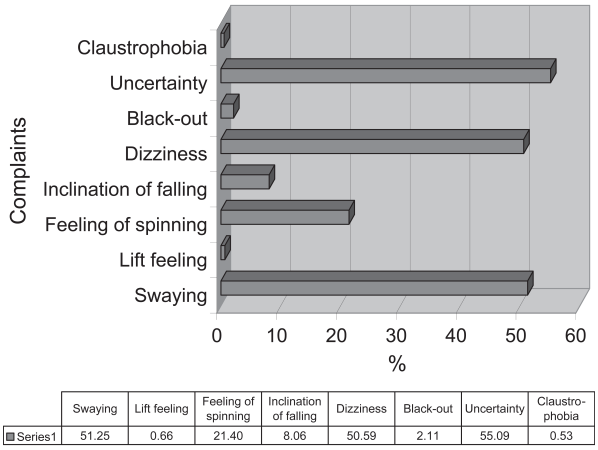
	Lability	States of panic	Depression	Loneliness	Edginess
Series1	0.13	1.06	3.17	0.40	0.53

Figure 8. Complaints of mood disorders.



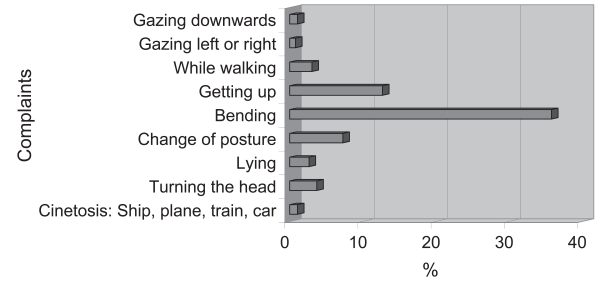
	Sweating	Palpitation of the heart	Nausea	Strangling	Vomiting	Collapse
Series1	3.57	2.64	26.95	7.79	7.13	0.26

Figure 9. Complaints of vegetative symptoms.



	Swaying	Lift feeling	Feeling of spinning	Inclination of falling	Dizziness	Black-out	Uncertainty	Claustro-phobia
Series1	51.25	0.66	21.40	8.06	50.59	2.11	55.09	0.53

Figure 10. Complaints of vertigo.



	Cinetosis: Ship, plane, train, car	Turning the head	Lying	Change of posture	Bending	Getting up	While walking	Gazing left or right	Gazing downwards
Series1	1.06	3.70	2.64	7.27	35.80	12.68	3.04	0.79	1.06

Figure 11. Complaints of vertigo triggers.

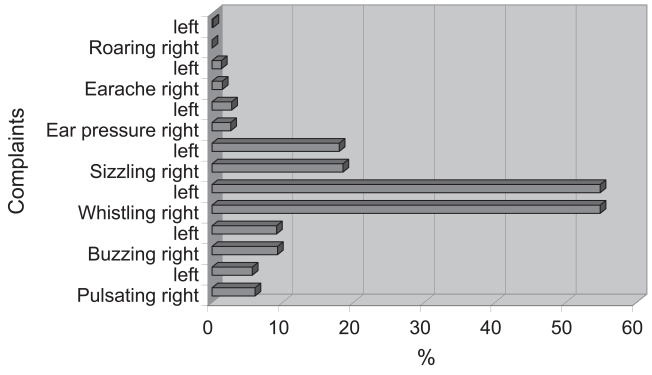
(in the right ear) and 9.11% (in the left ear). Pulsating tinnitus existed in the right ear in 6.08% and in the left ear in 5.68%. Only 0.13% of our patients described a subjective roaring sound in the left ear, whereas none attributed it to right ear.

In our analysis of duration of tinnitus symptoms (Fig. 13), the majority reported that their tinnitus had existed for years (80.45%); 4.89% reported a new-onset tinnitus with a duration of only weeks, and 1.19% complained of a very-long-lasting tinnitus enduring for more than decades.

When we asked our patients about the duration of the average single tinnitus seizure, the great majority (86.53%) reported that their tinnitus was constantly present, and 36.59% reported that their tinnitus fluctuated. Additionally, 13.87% reported that the intensity of their tinnitus was changeable. Only very few patients reported specific periods of the day in which they hear only the tinnitus: in the morning (0.53%), in the evening (1.19%), and during the night (1.45%). No patient reported a tinnitus occurring only at noon (Fig. 14).

Figure 15 demonstrates that the great majority of our patients experienced decreased hearing in tandem with their tinnitus (right ear, 98.94%; left ear, 98.02%). Additionally, we asked our patients whether they were using a hearing aid. The answers with respect to this question (Fig. 16) were positive in only a few cases (i.e., hearing aid in the right ear, 2.25%; hearing aid in the left ear, 1.45%).

Figure 17 displays responses to our question about visual disorders in our 757 patients. Most frequently, the patients reported that they wore eye glasses (74.50%). Oscillopsias occurred in the right eye (28.27%) and in the left eye (27.74%). This indicates a rather high incidence rate of ocular motility disturbances. Double vision occurred in 1.72% and moving bodies—so-called *mouches volantes*—in the right eye in 9.25% and in the left eye in 9.11%. The group experiencing *mouches volantes* also may account for a certain number of complaints about ocular movement disorders (e.g., oscillopsia). The rates of glaucoma (1.06% in the right eye and 1.06% in the left eye) and cataract (1.06% in the right eye and 0.92% in the left eye) were rather low in light of the age distribution of our patients.

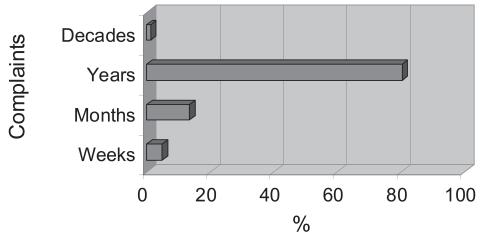


	Pulsating right	left	Buzzing right	left	Whistling right	left	Sizzling right	left	Ear pressure right	left	Earache right	left	Roaring right	left
Series1	6.08	5.68	9.25	9.11	54.82	54.82	18.49	17.97	2.64	2.77	1.45	1.32	0.00	0.13

Figure 12. Complaints of various noises in the ear.

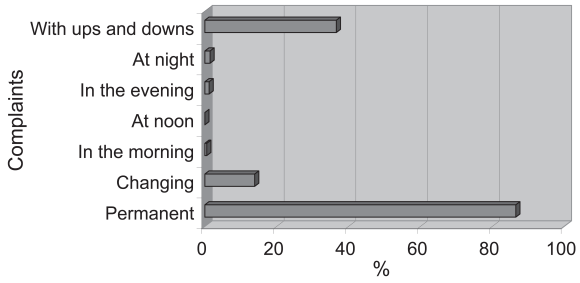
As shown in Figure 18 (analysis of the rate of smell disorders), 6.47% complained of a reduced smell capacity (e.g., hyposmia) in the right nostril, and 5.42% spoke of decrease in the left nostril. Regarding distortion of the sense of the smell (e.g., kakosmia), 0.13% described it in the right nostril and 0.13% in the left nostril. Only 0.26% reported perceptual distortions of smell (e.g., parosmia) in both sides of the nose, and 0.66% described total loss of smell in both sides of the nose.

In evaluating the complaints of distorted or absent taste (Fig. 19), we found that 13.70% complained of a reduction in taste sensitivity; 0.40% complained of a



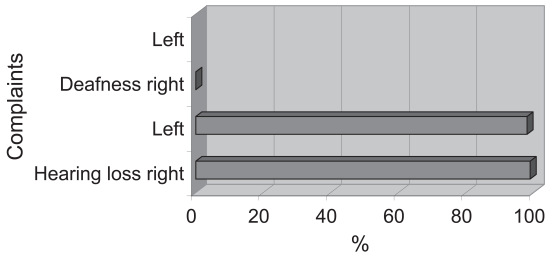
	Weeks	Months	Years	Decades
Series1	4.89	13.47	80.45	1.19

Figure 13. Complaints of tinnitus duration.



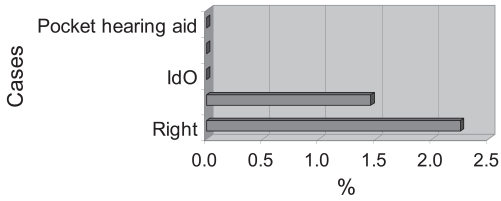
	Permanent	Changing	In the morning	At noon	In the evening	At night	With ups and downs
Series1	86.53	13.87	0.53	0.00	1.19	1.45	36.59

Figure 14. Complaints of tinnitus seizure duration.



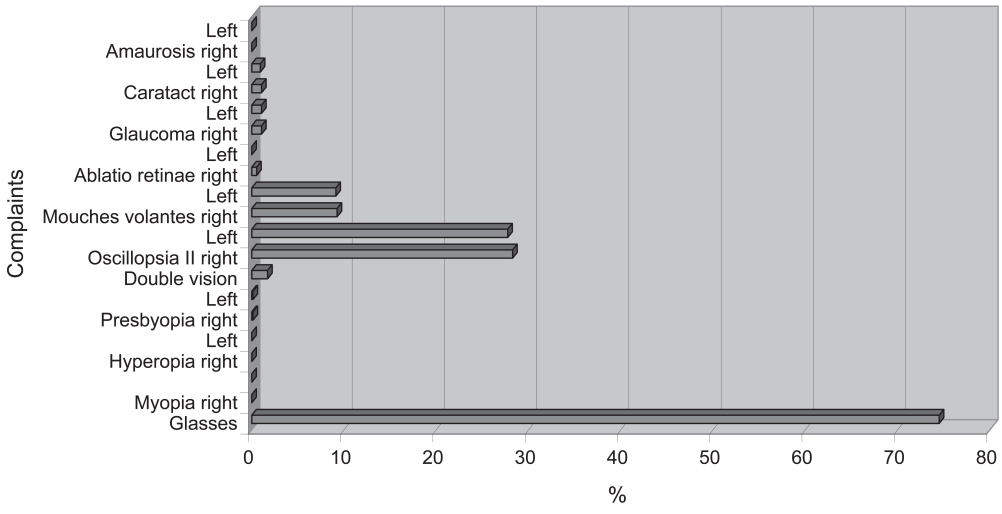
	Hearing loss right	Left	Deafness right	Left
Series1	98.94	98.02	0.00	

Figure 15. Complaints of decreased hearing.



	Right	Left	IdO	HdO	Pocket hearing aid
Series1	2.25	1.45	0.00	0.00	0.00

Figure 16. Number of patients using hearing aids.



	Glasses	Myopia right		Hyperopia right	Left	Presbyopia right	Left	Double vision	Oscillopsia II right	Left	Mouches volantes right	Left	Ablatio retinae right	Left	Glaucoma right	Left	Caratact right	Left	Amaurosis right	Left
Series1	74.50	0.00	0.00	0.00	0.00	0.13	0.13	1.72	28.27	27.74	9.25	9.11	0.53	0.00	1.06	1.06	1.06	0.92	0.00	0.00

Figure 17. Complaints of visual disorders.

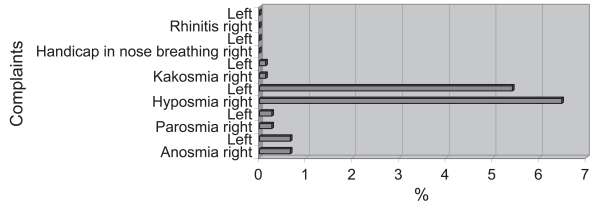
complete loss of taste, and 0.26% spoke of a distorted quality of taste (parageusia).

Figure 20 shows our analysis of trigeminal nerve complaints: Although no patient reported trigeminal nerve disorders, the medical investigators found such disorders by direct inspection relative to patients' obtained medical history. Of our patients, 0.53% displayed facial nerve disorders. Figure 21 demonstrates a specific differentiation with respect to facial nerve paralysis cases. In that respect, we found that 0.26% were suffering from a peripheral facial nerve paralysis and only 0.13% from a central facial nerve paralysis.

The special set of questions regarding our patients' history dealt with specific neurological disorders (Fig. 22). We found that a smaller number of patients reported some important neurological disorders (e.g., paresthesias, 1.19%; paralysis, 0.53%; apoplexia, 0.66%; and epilepsia, 0.26%). However, no patient reported Parkinson's disease or tumor.

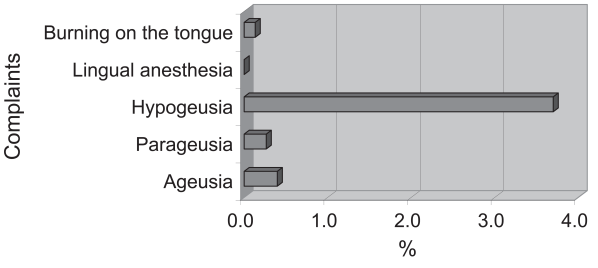
Evaluation of the responses to questions about orthopedic disorders (Fig. 23) reveals that 4.62% of patients with endogenous tinnitus reported cervical disturbances, and 0.66% spoke of a discus problem. No one reported rheumatic disorders or artificial joint problems.

Very well known is that after head and neck trauma, many patients complain of various types of tinnitus. Therefore, we prepared a specific, detailed analysis of the background of head and neck trauma (Fig. 24). The majority of patients (consistent through all age groups) reported so-called whiplash-related tinnitus problems after a car accident. They also reported posttraumatic complaints of whiplash injury (also consistent through all the age groups but especially frequent in the age group 30–40 years). Car accidents and whiplash occur



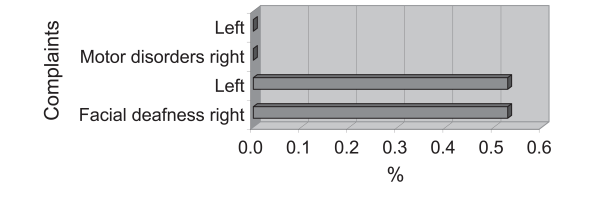
	Anosmia right	Left	Parosmia right	Left	Hyposmia right	Left	Kakosmia right	Left	Handicap in nose	Left	Rhinitis right	Left
Series1	0.66	0.66	0.26	0.26	6.47	5.42	0.13	0.13	0.00	0.00	0.00	0.00

Figure 18. Complaints of smell disorders.



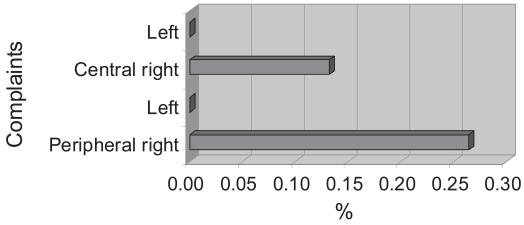
	Ageusia	Parageusia	Hypogeusia	Lingual anesthesia	Burning on the tongue
Series1	0.40	0.26	3.70	0.00	0.13

Figure 19. Complaints of taste disorders.



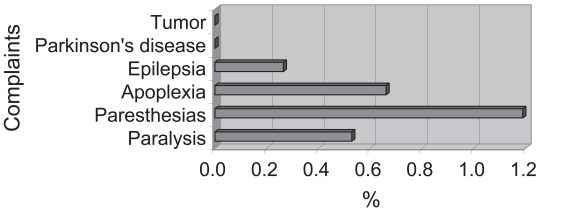
	Facial deafness	Left	Motor disorders	Left
Series1	0.53	0.53	0.00	0.00

Figure 20. Trigeminal nerve complaints.



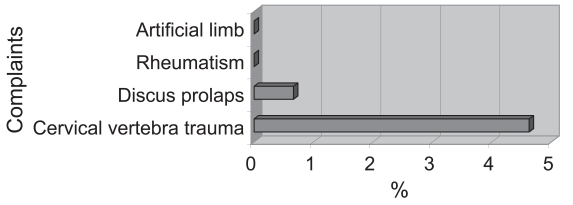
	Peripheral right	Left	Central right	Left
Series1	0.26	0.00	0.13	0.00

Figure 21. Complaints of facial paresis.



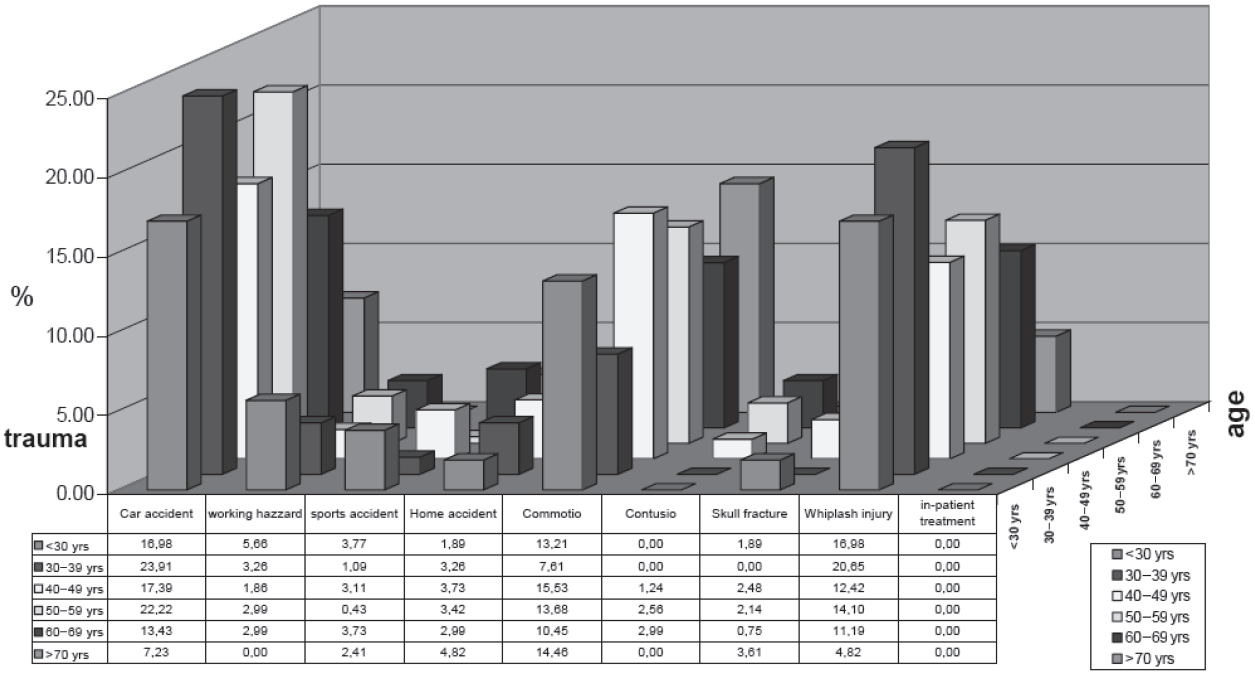
	Paralysis	Paresthesia	Apoplexia	Epilepsia	Parkinson's	Tumor
Series1	0.53	1.19	0.66	0.26	0.00	0.00

Figure 22. Complaints of neurological disorders.



	Cervical vertebra	Discus prolaps	Rheumatism	Artificial limb
Series1	4.62	0.66	0.00	0.00

Figure 23. Complaints of orthopedic disorders.



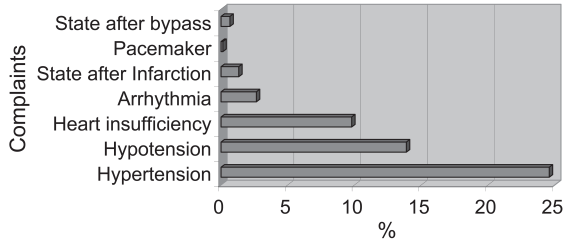
	Car accident	working hazzard	sports accident	Home accident	Commotio	Contusio	Skull fracture	Whiplash injury	in-patient treatment
<30 yrs	16,98	5,66	3,77	1,89	13,21	0,00	1,89	16,98	0,00
30–39 yrs	23,91	3,26	1,09	3,26	7,61	0,00	0,00	20,65	0,00
40–49 yrs	17,39	1,86	3,11	3,73	15,53	1,24	2,48	12,42	0,00
50–59 yrs	22,22	2,99	0,43	3,42	13,68	2,56	2,14	14,10	0,00
60–69 yrs	13,43	2,99	3,73	2,99	10,45	2,99	0,75	11,19	0,00
>70 yrs	7,23	0,00	2,41	4,82	14,46	0,00	3,61	4,82	0,00

Figure 24. Pattern of head and neck trauma.

more frequently in the younger age groups, whereas reports of cerebral concussions are more frequent in the old-age group (>70 years).

Cardiovascular diseases were very important background disorders for our neurootological patients. The results of our analyses of these complaints are reported in Figure 25. Most frequently, our tinnitus patients complained about hypertension (24.57%), followed by hypotension (13.87%). Heart insufficiency played a role in 9.87% of patients, cardiac arrhythmias in 2.64%, a state after cardial bypass in 1.32%, and a pacemaker in 0.13%. The state after myocardial infarction was found in 0.66%.

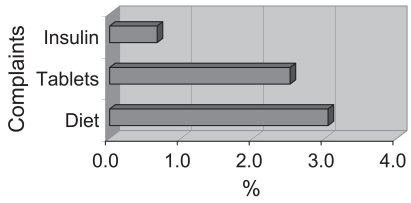
We also questioned our patients about diabetes mellitus and categorized these cases with respect to their therapy. Figure 26 shows that 3.04% suffered from a diabetes mellitus treatable only by diet, 2.51% treatable with tablets, and 0.66% treatable with insulin.



	Hypertension	Hypotension	Heart insufficiency	Arrhythmia	State after Infarction	Pacemaker	State after bypass
Series1	24.57	13.87	9.78	2.64	1.32	0.13	0.66

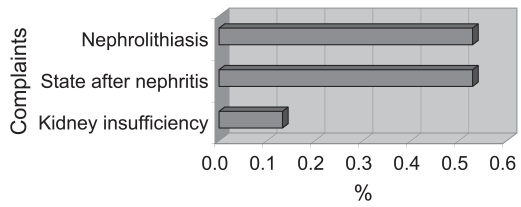
Figure 25. Complaints of cardiovascular disorders.

Figure 27 shows the percentages of answers to questions about kidney disorders: 0.13% suffering from kidney insufficiency, 0.53% from a state after nephritis, and 0.53% from nephrolithiasis. In Figure 28, we summarize our analysis of gastroenteral disorders. The occurrence rate was low: stomach complaints, 1.59%; intestinal disorders, 0.26%; and pancreas disorders, 0.26%.



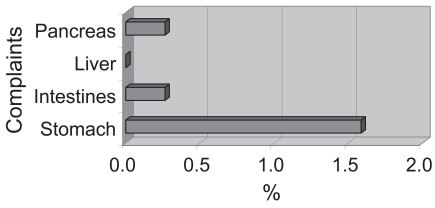
	Diet	Tablets	Insulin
Series1	3.04	2.51	0.66

Figure 26. Complaints of diabetes mellitus.



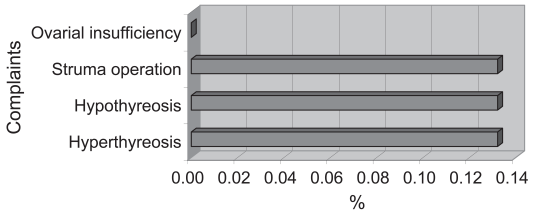
	Kidney insufficiency	State after nephritis	Nephrolithiasis
Series1	0.13	0.53	0.53

Figure 27. Complaints of kidney disorders.



	Stomach	Intestines	Liver	Pancreas
Series1	1.59	0.26	0.00	0.26

Figure 28. Complaints of gastroenteral disorders.



	Hyperthyreosis	Hypothyreosis	Struma operation	Ovarial insufficiency
Series1	0.13	0.13	0.13	0.00

Figure 29. Complaints of hormonal disorders.

Finally, we investigated the complaints of specific hormonal disorders (Fig. 29). Hyperthyroidism was found in 0.13%, hypothyreosis in 0.13%, and a struma in 0.13%. No patient complained of ovarian hormonal dysfunctions.

CONCLUSIONS

For this study, we randomly selected 757 tinnitus patients who reported that they felt better in a noisy environment. (In such cases, we could mask the tinnitus by means of audiometric masking procedures.) After we identified a focus of dysfunction in the temporal lobe of tinnitus patients (Brodmann area 41) by VestEP and BEAM since 1985, we started to separate our major samples of tinnitus patients into smaller groups according to content. We easily designated a group of patients who demonstrate a genuine objective sound in the head as experiencing bruits. We separated them from others suffering from a maskable or endogenous tinnitus. Significantly different from the group identified as having endogenous tinnitus are the behavior and the sensation of those with exogenous tinnitus or nonmaskable tinnitus, who find relief in a completely silent environment. Finally, via our complex neurootometric tests, we demonstrated slowing deregulations in the statoacoustic pathways. We called patients in this group the "slow brainstem syndrome group."

The question underlying this study is whether tinnitus is a monosymptomatic disease or is bound into a complex spectrum of complaints within a multisensory disorder. Our search presented us with a great amount of data (more than 500 parameters per case), which we transferred into a digital version of the databank to preserve the anonymity of this sample of patients. All 757 cases fulfilled our criteria for being classified as endogenous tinnitus. Surprisingly, in our study, the genders were not equally distributed. We found approximately two-thirds to be male (62.09%) and only one third to be female (37.91%).

The average age seen in our sample reflected the average age found in most of our studies of neurootological patients: They are living in the second half of their lives (average age, 52.40 years; SD, 13.89 years). The other identification indicators (weight, height, body mass index, and average systolic and diastolic blood pressure) lie within the expected range of this sample taken for Germany. In age distribution, however, we also found approximately 10% younger than age 30 and a maximum number at 50–60 years (31.78%; see Fig. 4).

Our analyses of our group of 757 cases of endogenous tinnitus revealed high incidences of accompanying symptoms: for example, headache (66.18%; Fig. 5); subjective feeling of decreased daily performance (68.16%; see Fig. 6); and various disturbances of their vigilance, including 51.52% reporting insomnia (see Fig. 7). However, the complaints about mood disorders were not very prevalent (see Fig. 8). Patients' vertigo complaints (Fig. 10) specifically pointed to swaying vertigo, dizziness, and uncertainty. Each of these symptoms occurred in more than one-half of our sample (for details, see Fig. 10).

We found a high incidence rate (35.80%) of typical vertigo trigger mechanisms (e.g., bending down). For vegetative symptoms, such as the occurrence of nausea in perhaps one of four patients, see Figure 9.

We saw a very varied picture in the subjective descriptions of the quality of tinnitus sensations. Even though the majority of our patients reported a whizzing tinnitus sound (54.82%), we also recorded descriptions of a sizzling sensation (18.49% in the right ear, 17.97% in the left ear); a buzzing sound (9.25% in the right ear, 9.11% in the left ear); and a pulsation (6.08% in the right ear, 5.68% in the left ear). Additionally, sensations such as ear pressure (2.64% in the right ear, 2.77% in the left ear) and earache (1.45% in the right ear, 1.32% in the left ear) showed that the sensations differ from case to case. The frequently reported sensation of a roaring in the right or the left ear occurred in only 0.13% (left ear) in our sample. The majority of our patients described their tinnitus as lasting from one to several years (as seen in Fig. 13). A tinnitus duration of decades was rare. However, we also found some cases (4.89%) of a new-onset tinnitus that lasted only weeks.

A total of 86.53% of our patients reported that their tinnitus was permanent (see Fig. 14). However, 13.87%

additionally described their tinnitus as changing in quality and quantity, and 36.59% said that the tinnitus occurred in "ups and downs" (a wave pattern): That is, even though there is a permanent tinnitus, it can change, rolling up and down.

Subjective hearing loss (Fig. 15) was reported by nearly all our patients (98.94% for the right ear and 98.02% for the left ear). However, hearing aids were used in only a few cases (see Fig. 16). Aside from hearing complaints, the patients also reported visual disorders (see Fig. 17). In such cases, the visual acuity problems were corrected most frequently by use of eye glasses (74.50%). Obvious, however, is that more than one-fourth of our patients suffered from central optomotor problems, which we described as oscillopsias (28.27% in the right eye, 27.74% in the left eye).

We also found smell disturbances (6.47% in the right nostril and 5.42% in the left nostril; see Fig. 18) accompanied by other distortions of the sense of smell. Complaints about taste disorders (see Fig. 20) were significantly less numerous than those for smell. We found that 3.70% of patients complained about a reduced acuity in their taste (hypogeusia). We heard no complaints about trigeminal disorders; however, we found both peripheral and central facial nerve paresis, though in a small number (see Fig. 21). Astonishingly, even the number of occurrences of basic neurological disorders (paralysis, paresthesias, apoplexies, epilepsia, Parkinson's disease, and brain tumors) was very low (as shown in Fig. 22).

Of background disorders, various cardiovascular diseases showed a high occurrence rate (Fig. 25). Diabetic patients in our sample, however, accounted for a rather low 5–6%. Kidney disorders (Fig. 27) and gastroenteral disorders (Fig. 28) played a minor role in our sample, as was evident for the major hormonal diseases (Fig. 29). Background disorders mirrored the important role of cardiovascular diseases and the traumatic mechanism of the cervicocerebral traumas (e.g., whiplash). Clearly, a typical interrelation of tinnitus with a single major disease group is highly unlikely.

All in all, we must conclude that our evaluations in studying our 757 cases demonstrate that the spectrum of subjective complaints is very complex and individually mingled. Acoustic, vestibular, and behavioral and psychosomatic symptoms are intertwined and seemingly interact with one another. In future, this must be taken into consideration in developing a spectrum of therapeutic procedures not only in the field of pharmacotherapy but in psychotherapy and physiotherapy and in applying such physical measures as magnetotherapy.

Overall, our evaluation of 757 patients with endogenous tinnitus posits that the most important accompanying general diseases are cardiovascular. However, more than twice as many patients suffered from hypotension as from hypertension. We found diabetes mellitus more frequently in the group with the exogenous or unmaskable tinnitus, whereas hyperlipidemia was reported twice as often in the group with endogenous or maskable tinnitus as in those with the unmaskable type.

From all these patterns of interactive complaints, we also must conclude that endogenous tinnitus points to a "cybernetopathia" deriving from dysfunctions at various points of the statoacoustic and interrelated supportive neurosensory pathways. In a subsequent publication, we will deal with the outcome of the objective and quantitative measurements in audiology, equilibriometry, and the like in our group of 757 cases of endogenous tinnitus.

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