Algorithm for the Diagnostic & Therapeutic Management of Tinnitus

TRI Tinnitus Clinic Network


The information contained herein is based on careful literature research, performed in August 2008 and further updated since then.

If specific diagnostic or therapeutic procedures are not mentioned, no clear evidence for their use has been found. ► Evidence Levels

This flowchart should not be considered as a "final version" but rather as "work in progress". It is intended to be a "living document" and thus the quality and actuality of the flowchart will depend on your feedback. Please send your comments and suggestions to the following e-mail address:

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The authors will be very grateful for all kinds of feedback.

We hope that the TRI Flowchart for Patient Management will contribute to a better diagnosis and treatment of the many tinnitus patients worldwide, who seek help.

► Start Flowchart

No responsibility is assumed for any injury and/or damage to persons or property as a matter of product liability, negligence or otherwise, or from any use or operation of any methods, products, instructions or ideas contained in the material herein. Because of rapid advances in the medical sciences, in particular, independent verification of diagnoses and treatment should be made.

17/01/2011
**Clinical examination**
- Otoscopy
- Cranio-mandibular & neck examination
- Auscultations

**Audiological measurements**
- Audiometry
- Psychophysical measurements
- Tympanometry
- Tubal impedance-manometry
- Distortion product OAE

**History**
Self-performed questionnaires
- Tinnitus Handicap Inventory
- Tinnitus Questionnaire
- Case History Questionnaire
- Tinnitus Severity Grading (E.Biesinger)

**Audiological measurements**
- BAEP
- EEG
- OAE
- MRI
- VEMP
- Electrocochleography
- Lumbar puncture

**Clinical examination**
- MRI
- BAEP
- Blood test
- OAE
- MRI
- Furosemide test
- Lumbar puncture
- RI
- MVI
- N VII
- N VIII
- Basilar impression
- Depression
- Anx. disorder
- Insomnia
- Somatoform disorder
- Suicidality

**Counseling**
- Cran. + cerv. CT/MRI
- BAEP
- EEG
- Echo doppler
- Neck exam
- Psych. exam

**Neuromodulation**
- Disorders
- Neck
- TMJ

**Specialized neuro-/otologist**

**Abbreviations:**
- BAEP = Brainstem auditory evoked potential
- BIH = Benign intracranial hypertension
- MVC = Microvascular compression
- OAE = Otoacoustic emissions
- PTSD = Posttraumatic stress disorder
- SOL = Space occupying lesion
- TMJ = Temporomandibular joint
- VEMP = Vestibular evoked myogenic potential

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Evidence Levels

Level I: Evidence obtained from at least one properly designed randomized controlled trial.

Level II-1: Evidence obtained from well-designed controlled trials without randomization.

Level II-2: Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one center or research group.

Level II-3: Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled trials might also be regarded as this type of evidence.

Level III: Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Questionnaires & History

Indication and short description
- Taking a case history is essential in all tinnitus patients. Items, that should be assessed, were agreed in a consensus at the first TRI meeting in Regensburg 2006 (document available at [www.tinnitusresearch.org](http://www.tinnitusresearch.org)).

- For assessment of tinnitus severity and psychiatric comorbidity (depression, anxiety) standardized questionnaires should be used.

Diagnostic value
- A detailed patient history is essential for differential diagnosis.
- Tinnitus Questionnaires help to identify tinnitus severity and urgency of treatment, however limitations should be considered.

Literature
Clinical otorhinolaryngological examination

Indication

All tinnitus patients should be clinically examined by a specialised medical doctor

Short description

- Otoscopy/Microscopy: external auditory canal diseases, integrity of tympanic membrane, infections, middle ear effusion, chronic otitis media, cholesteatoma should be ruled out. If pulsatile tinnitus, see for effusion or vascular mass in middle ear (glomus). Check out movement of TM while breathing (patulous Eustachian tube)
- Rhinoscopy, oropharyngoscopy is highly recommended in all patients. Consider flexible or rigid endoscopy in some cases to rule out a nasopharyngeal mass
- Neck digital examination to rule out compressive masses
- Examination of cranial nerves (associated lesions)
- Tuning fork testing, vestibular assessment

Diagnostic value

Identifying abnormalities of the cochleovestibular system and the Head and Neck, which can present tinnitus as primary complaint

Literature

Clinical examination - Auscultations

Indication
Pulsatile tinnitus

Short description
- Auscultation of the neck, both sides
- Auscultation of the neck after pressure to the jugular vein (if possible with ultrasound control)
- Auscultation of the area surrounding the pinna (mastoid area, temporal area, temporomandibular joint area)
- Auscultation of the orbicular area

Diagnostic value
- Murmurs in the neck could be related to carotid diseases.
- Murmurs in the temporal or mastoid area could be related to arteriovenous fistula or malformation
- Murmurs in the orbital region could be related to carotid-cavernous fistulas

Literature
Audiological measurements

The Audiological assessment is based on the following exams:

► Pure Tone Audiometrical measurements
► Psychophysical audiometrical measurements (Tinnitus matching)
► Tympanometry, stapedius reflex
► Tubal impedance-manometry
► Distortion Product Otoacoustic Emission DPOAE

Literature

London, Hamilton (chap. 16)
Audiometrical measurements

Pure tone audiometry 125-16,000 Hz in audiometric boot

Indication
- Standard tests used to detect hearing problems in middle and inner ear

Diagnostic value
- Useful for DD of different forms of hearing pathologies
- Useful in counseling
- Potentially useful in monitoring outcomes
- Mandatory in setting hearing aids

Literature

R Tyler et al. (2008) American Journal of Audiology,
Clinical Guidelines, Chap. 11
Audiological measurements: Psychophysical measurements

► Pitch and loudness matching
► Minimum masking level (MML)
► Residual inhibition (RI)
► Loudness Discomfort Testing (LDL - Loudness growth)

Indication
- Standard tests used to characterise subjective description of tinnitus in all patients

Diagnostic value
- Useful in counseling (Pitch, loudness, Residual inhibition)
- Potentially useful in monitoring outcomes (MML)
- Useful in setting hearing aids (LDL)

Literature

Pitch matching - Short description

One suggested method.

**A two alternative forced choice method**
- Two tones choose best match
- Example
  - 1 vs 2 kHz chooses 2 kHz
  - 2 vs 3 kHz chooses 3 kHz
  - 3 vs 4 kHz chooses 3 kHz
  - Check for “octave confusion” 3 vs 6 kHz
  - Should be undertaken at levels close to pitch match

Loudness matching - Short description

One suggested method.

At tinnitus pitch
- Determine auditory threshold
- Ascending increase in tone until subject reports external tone of equal loudness to tinnitus
- Most meaningful dB SL (sensation level) = dB HL(match) - dB HL(threshold)

Minimum masking level (MML) - Short description

One suggested method.

Minimum masking level
- NBN or BBN
- Record threshold to sound
- Record Lowest level which covers tinnitus
- Difference is MML

Residual Inhibition (RI) - Short description

One suggested method.

**Residual inhibition**
- MML + 10 dB
- Apply for 60 seconds
- "How does your tinnitus sound?"
- Record partial or full RI

Loudness Growth - Short description

One suggested method.

Contour Test (IHAFF)
- Uncomfortably loud (= LDL)
- Loud, but O.K.
- Comfortable, but slightly loud
- Comfortable
- Comfortable, but slightly soft
- Soft
- Very Soft

Rating of sounds preferably tones
For setting MPO of hearing aids
For describing loudness tolerance

Audiological measurements: Tympanometry, stapedius reflex

**Indication**
Differential diagnosis of middle ear pathology

**Short description**
- Refer to Literature below for procedure.
- For better accuracy use manual driven instruments, always print the graphs. Stapedius reflex measure should be performed carefully to avoid worsening of tinnitus and after LDL if LDL doesn't indicate any major tolerance problem. Source of clear indications in case of clin. susp. of conductive hearing loss.

**Diagnostic value**
- Detection of surgical or medical curable tinnitus
- Middle ear problems detection,
- Otosclerosis detection,
- Olivecochlear bundle problems detection

**Literature**
Audiological measurements: Tubal impedance-manometry

**Indication**
Tubaric functionality test, very frequently this test can show air retaining in middle ear with moderate increase of transmission hearing loss and possible tinnitus increase.

**Short description**
Use tympanometric measure as evidence of eustachian tube function

**Diagnostic value**
for the diagnosis of middle ear dysfunction

**Literature**
Audiological measurements: DPOAE (following NP tinnitus constant + hearing loss - SN)

Short description (suggested method)
- High resolution DPOAE mode (8-10 pp/oct) is required in order to have a clear view of also minor OHC problem
- Tech. specs. high-definition DPOAE: L1/L2=65/55; f2/f1=1.22; f2 range: 1-8 kHz; 10 pp/octave

Diagnostic value
- Objective test of cochlear status,
- Assessment of outer hair cell function,
- Indication of suspected early stage hydrops (even if not proof with evidence),
- Important information for counselling (indication of cochlear damage as tinnitus trigger)

Literature
Pulsatile tinnitus - arterial

Diagnostic criteria
- Heart beat synchronous pulsations
- Can disappear on manual compression of carotid artery in neck
- Can sometimes be perceived by auscultation

Differential diagnosis
- Atherosclerotic disease (carotid, subclavian)
- Dural arteriovenous fistulas
- Carotid-cavernous fistula
- Aneurysm (giant)
- Fibromuscular dysplasia of carotid artery
- Carotid artery dissection
- Aberrant internal carotid artery
- Hyperdynamic states (Anemia, thyrotoxicosis, pregnancy)
- Hypertension
- Internal auditory canal vascular loops
- Glomus jugulare tumor
- Benign intracranial hypertension

Literature
Pulsatile tinnitus - venous

**Diagnostic criteria**
- Venous hum
- Can disappear on jugular vein compression
  (if possible with ultrasound control)

**Differential diagnosis**
- Benign intracranial hypertension (BIH)
- Sigmoid or jugular diverticulum
- High jugular bulb
- Transverse or sigmoid stenosis
- Condylar vein abnormalities

**Literature**


Tinnitus - paroxysmal

Diagnostic criteria

Paroxysmally occurring tinnitus

Differential diagnosis

OBJECTIVE PAROXYSMAL TINNITUS:
- Palatal and middle-ear myoclonus,
- TMJ alterations (synchrony with joint movements)

SUBJECTIVE PAROXYSMAL TINNITUS:
- Cerebellopontine angle alterations (meningioma, arachnoid cyst, vascular compression…)
- Epilepsy
- Auditory hallucinations
- Migraine/aura (basilar)
- Phantom sensations without evidence of cortical or auditory system dysfunction.

Literature


From this slide on, tinnitus stands for non-pulsatile tinnitus.
Tinnitus – constant + hearing loss - conductive

**Diagnostic criteria**

- Otoscopy
- Pure tone audiometry/Tuning fork testing
- Stapedius reflexes /Tympanometry
- Tubal manometry for a perforated or closed tympanum
- Star reflex
- CT Scan of the temporal Bone/X Ray of the Skull (Schüller)

**Differential diagnosis**

- Ear Wax
- Acute otitis media
- Otitis media with effusion
- Chronic otitis media
- Cholesteatoma
- Otosclerosis
- Ossicular chain trauma
- Ossicular malformations
- External or middle ear cancer

**Literature**


Tinnitus – constant + hearing loss – sensory neural

Diagnostic criteria:
- Audiometry: SNHL
- Metz Test (stapedial reflex): positive if recruitment
- Otoacoustic emissions, Distortion products
- Auditory Brainstem Responses
- MRI Posterior Fossa (with gadolinium contrast)
- Blood test for metabolic and immunology:
  - Hemogram, Zinc
  - FTA for oto-syphilis
  - Glucose. If Meniere's disease: 5h-curve on glucose and insulin
  - If Autoimmune Inner Ear Disease: GSV, Immunoglobulines, Complement factors, ANA, Rheumatoid Factor, Immunophenotype, Western blot for heat shock protein-70

Differential diagnosis:
- Acoustic trauma
- Otologic / temporal bone trauma
- Sudden deafness
- Barotrauma
- Labyrinthitis (bacterial, viral, tuberculosis, fungical)
- Idiopathic hearing loss
- Auditory neuropathy / dis-synchrony
- Central auditory processing disorders

- Genetic tests
- Stapedius (reflex and thresholds) / Tympanometry/Reflex Decay test
- Fistula searching
- CT Scan of the temporal Bone
- MRI and/or BAEP – if unilateral or asymmetric hypoacousia

Literature

17/01/2011
Tinnitus – constant + vertigo

Diagnostic criteria
- Tonal audiometry (bone and air conduction)
- Tympanometry (Stapedius reflexes and thresholds)
- Decay reflex test
- Fistula searching
- MRI and/or BAEP - if hypoacusia and/or tinnitus are unilateral and/or asymmetric
- Clinical Vestibular Examination: nystagmus, axial and segmentary deviation's searching, Fukuda-test, study of the cranial nerves
- if needed: instrumental Vestibular Examination: e.g. oculomotricity, spontaneous and provoked nystagmus, Head shaking test, Kinetic and Caloric tests, Subjective vertical test, high frequency vibratory stimulation, Positional vertigo and nystagmus searching

Differential diagnosis
- Ménière’s disease
- VIII cranial nerve tumor-Cholesteatoma
- Labyrinthitis (viral,bactérial..)
- Cochlear otosclerosis-central auditory and/or vestibular disorders

Literature
Tinnitus – constant + headache

Diagnostic criteria / differential diagnosis
- Bilateral (more frequently)/unilateral tinnitus accompanying constant headache as a somatosensory symptom of tension-type headache. (Typically constant dull, moderate headache without nausea, vomiting, photo / sonophobia; frequently tinnitus lateralisation corresponds to headache lateralization)
- Tinnitus and constant headache in benign intracranial hypertension
- The headache is usually holocranial, dull and constant, increase with the Valsalva maneuver and is associated with papillodema in the neurological examination

Literature
Tinnitus – constant + psychiatric

Diagnostic criteria
- Suspicion of psychiatric comorbidity:
  - Symptoms of depression, anxiety, OCD, somatoform disorders, posttraumatic stress disorder, psychosis or dementia in the first consultation
  - Suspicion of psychiatric comorbidity especially with high scores in tinnitus questionnaires (grade III or IV according to Biesinger; TQ > 47; THI > 37),
  - In case of suspicion of psychiatric disorder further diagnostic evaluation by a specialist (psychiatrist, clinical psychologist)

Differential diagnosis
  depression, anxiety, somatoform disorders, OCD, posttraumatic stress disorder, psychosis or dementia

Literature
Langguth et al. (2007) Prog Brain Res.;166:221-5
Unterrainer et al. (2003) *Experiencing tinnitus: which factors are important for perceived severity of the symptom?* Int Tin J;9(2):130-3
Tinnitus – constant + somatosensory – neck
Constant tinnitus and modulation induced by neck movements

Diagnostic criteria

On physical exam (tests should be performed in a silent environment):
A. Immediate tinnitus changes during active neck movements (with or without resistance):
   - forward / backward
   - rotation
   - lateralization

B. Immediate tinnitus changes during passive muscular palpation:
   - sternocleidomastoid
   - trapezius
   - suboccipital

Observations:
   - the modulation can occur with or without concomitant pain
   - both increases and decreases in loudness reinforce the somatosensory involvement, but the decreases seem to have better prognostic to cure/improve tinnitus after muscular manipulation

Literature

Tinnitus – constant + somatosensory – TMJ
Constant tinnitus and modulation induced by temporomandibular joint movements

Diagnostic criteria

On physical exam (tests should be performed in a silent environment):
A. Immediate tinnitus changes during active jaw movements (with or without resistance):
   - Opening / closing
   - Forward / backward
   - Lateralization
B. Immediate tinnitus changes during passive muscular palpation:
   - Masseter
   - Temporalis
   - Pterygoid (controversial)
   - Immediate tinnitus changes during the fatigue test (close teeth with spatula between them in anterior, left and right positions for one minute)

Observations:
The modulation can occur with or without concomitant pain

Literature

17/01/2011
Hyperacusis

Diagnostic criteria

- Decreased sound tolerance test (GÜF, Nelting 03)
- Loudness Disconfort Levels
- Efferent system test with Otoacoustic Emissions
- Auditory Brainstem Responses
- MRI Posterior Fossa

Differential diagnosis

- Peripheral disorders:
  - Cochleopathy: - Hyperactivity of external ciliary cells (?)
    - Ménière’s disease. Endolymphatic hydrops
    - Perylymphatic istula
    - Sudden deafness
    - Acoustic trauma
    - Otosclerosis
  - After surgery: - After stapedotomy / stapedectomy
    - After tympanic tube placement
    - After wax extraction
  - Stapedial reflex disorder: - Ramsay-Hunt Sdr.
    - Facial nerve paralysis
    - Muscular Disorders: - Miastenia gravis

- Central disorders:
  - Migraine
  - Depression. Postraumatic stress sdr.
  - Craneo-encephalic trauma
  - Lyme disease
  - Williams sdr.
  - Benzodiacepine abscence sdr.
  - Chronic fatige sdr.
  - Tay-Sachs sdr (gangliosidosis 2)
  - Multiple sclerosis
  - Benign intracranial hypertension sdr.

Literature

Nelting M, Rienhoff NK, Hesse G, Lamparter U (2002) [The assessment of subjective distress related to hyperacusis with a self-rating questionnaire on hypersensitivity to sound.] [Article in German]Laryngorhinootologie; 81: 32-4

**Post traumatic tinnitus**

**Diagnostic criteria**
tinnitus starting or worsening after noise-, ear-, head-, neck- or emotional trauma
A potential relationship between tinnitus and a traumatic event should be considered, if tinnitus begins or worsens within 3 months after the trauma event. In case of pulsatile tinnitus, immediate diagnostic workup for vascular pathologies (especially carotid dissection) necessary.

**Differential diagnosis**
tinnitus starting incidentally after traumatic event, not causally related with the trauma

**Further diagnostic steps**

- Noise trauma
  - OAE, BAEP, MRI

- Ear trauma
  - OAE, BAEP, MRI

- Head trauma
  - Cran. MRI, EEG, BAEP

- Neck trauma
  - Cerv. MRI, cran. MRI, Duplex sonography
  - Funct. Neck exam.

- Emotional trauma
  - Psychiatric exam.

**NOTE:** In case that Post traumatic Tinnitus manifest as pulsatile tinnitus, follow the diagnostic path detailed on ▶ slide 2.
Post traumatic tinnitus

Non-pulsatile tinnitus
  - Otological
    • Temporal bone fracture: in 50% tinnitus develops (Chen 2001)
    • Labyrinthine concussion: tinnitus common (Balogh 1998)
    • Ossicular chain disruption: associated with fracture in 15% (Wennmo 1993)
    • Perilymphatic fistula: in 61-76% tinnitus develops (Glasscock 1992)
    • Barotrauma: in 66-88% of blast injuries tinnitus develops (Mrena 2004, Persaud 2003)
    • Noise trauma: induces high pitched whistling tinnitus (Nicolas-Puel 2006)
  - Psychological
    • PTSD: in 50% tinnitus is present (Hinton 2006)
  - Cervical
    • Neck trauma associated

Pulsatile tinnitus
  - AV fistula: can develop after days, weeks or years (D’Alise 1997, Freckman 1981)
  - Caroticocavernous fistula: most common, in 3.8% of skull base fractures, in 8.3% of middle fossa fractures (Liang 2007)

Literature
Cardiovascular examination

Indication
- Suspicion of a cardio-vascular origin and/or modulation of the tinnitus modulation or disappearance of the tinnitus on some body, head or neck positions. In these cases the tinnitus can be induced or modulated by a neck hemodynamic problem in static or dynamic conditions
- Carotid or vertebral dissection such as unilateral neck pain or headache, face numbness, Horner’s syndrome, transitory ischemic attacks etc.

Short description
- Blood pressure (evtl. lying and upright), cardiac and neck auscultation, electrocardiography, echocardiography
- Echo-Doppler of neck vessels. Measurement of flows, resistances and thickness of the Intima. Search of an arterial-venous fistula, atheroma plates, stenoses and vascular loops, dissection vessels

Diagnostic value
Tinnitus related to arterial hypertension or hypotension, cardiac rhythm abnormalities, ischemia, heart décompensation hemodynamic and vascularization
Proof or exclusion of neck vessel disorders
pathologies of neck vessels such as Arterial-venous fistula, arterial stenoses, vascular loops, and dissection vessels can manifest as tinnitus

Evidence level / Literature
Diagnostic clues in pulsatile tinnitus (somatosounds)
Tinnitus caused by traumatic posterior auricular artery--internal jugular vein fistula.
Angiography

Indication
- Pulsatile tinnitus evaluation with/without occlusion testing and embolization
- Very careful indication, If possible less invasive techniques

Short description
- Insertion via Seldinger technique of contrast in arterial or venous circulation
- Dilate a balloon and verify if tinnitus improves
- Embolize vascular anomalies

Diagnostic value
- Retrieve arterial and venous vascular anomalies
- Perform occlusion tests
- Embolize

Remark: 0.1% risk of permanent neurological deficit

Literature
**Indication**
Pulsatile tinnitus evaluation, preferable compared to Angiography

**Short description**
- MRI with or without gadolineum contrast
- Without contrast
  - Flow based MRA: TOF (time of flight) or phase-contrast MRA
  - True FISP and bTFE (based on different signal properties of blood)
- Contrast based: gadolineum

**Diagnostic value**
- Retrieve arterial and venous vascular anomalies

**Literature**
**EEG (following tinnitus paroxysmal)**

**Indication**
- Paroxysmal bilateral/unilateral tinnitus (especially with further signs of seizures)
- especially indicated in Paroxysmal tinnitus with consciousness disturbance, progressive pitch or complex sounds and with variable periods between episodes

**Short description**
Standard EEG, eventually with provocation (flashlight, hyperventilation)

**Diagnostic value**
- epileptic focus in temporal or temporal with secondary generalization
- Video-EEG demostrative if tinnitus coexists with temporal lobe discharges

**Literature**
<table>
<thead>
<tr>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any paroxysmal tinnitus without any evidence of extracranial/intracranial disorder proved</td>
</tr>
</tbody>
</table>

**Short description**

MRI shows cerebellopontine angle disorders, cortical ectopias, TMJ disorders,

**Diagnostic value**

- Cerebellopontine angle disorders (arachnoid cyst, vascular malformations, Brain tumours, Arnold-Chiari)
- Microvascular compression
- Cortical ectopias
- TMJ disorders
- indirect signs of benign intracranial hypertension
- indirect signs of liquoral hypotension

**Literature**


17/01/2011
**BAEP (following tinnitus paroxysmal)**

**Indication**
- In paroxysmal tinnitus indicated for screening of nerve compression only, if MRI not available or not possible (e.g. patient with pacemaker)
- Functional and structural assessment of the auditory pathways up to the inf. colliculus
- In case of microvascular compression indicated as prognostic marker

**Short description**
- Peak Ili correlates with tinnitus
- IPL I-IIIi with hearing loss at tinnitus frequency
- IPL III-Vc with compensation (unpublished data)

**Diagnostic value**
- Only valuable for MVC as more compressions are seen on MRI than symptomatic
- Patients should be surgically decompressed before IPL I-III prolongs

**Literature**
- De Ridder D (2007)
MRI (following tinnitus constant + hearing loss - SN)

**Indication**
Exclude possible treatable causes of tinnitus, especially in unilateral hearing loss:

**Short description**
- T1, T2, CISS, Flair, etc
- With and without contrast

**Diagnostic value**
- Microvasc. compression (MVC)
- Canal dehiscence
- N VIII tumor
- Chiari
- Space occupying lesions (SOL)
- Cerebrovascular accident (CVA)

**Literature**

17/01/2011
BAEP (following tinnitus constant + hearing loss - SN)

**Indication**
Screening tool for acoustic nerve pathology, in case that MRI is not available see ► **slide 36**

**Short description**
- BAEP at high intensities while identifying the first 5 waves of the Brain Stem, the variations of inter-waves and inter-auricular conduction, appreciation of the correlation between the objective thresholds to the CLICK and the data of the tonal audiogram.

**Diagnostic value**
If pathologic, MRI has to be performed)

**Literature**
MRI (following tinnitus constant + vertigo)

Indication
Uni- or bilateral symmetric or asymmetric tinnitus associated with an unbalance or a vertigo.

Short description
MRI on the whole of brain
A location in the sagittal plan in T1: petro-occipital joint
A diffusion sequence: Recent AVC
FLAIR and CISS sequence
following sequences are centered on the posterior fossa
T2 volume: neuroma
T1 Volume with injection: neuroma, arterial or venous vascular anomalies
Angiography (ARM): arteries.

Diagnostic value
Neuroma, arterial or venous vascular anomalies, petro-occipital joint anomalies, recent Stroke, MVC

Literature
BAEP (following tinnitus constant + vertigo)

**Indication**

for screening of auditory nerve pathology in uni- or bilateral symmetric or asymmetric tinnitus associated with an unbalance or a vertigo, only if MRI is not available see ► slide 36.

**Short description**

BAEP at high intensities while identifying the first 5 waves of the Brain Stem, the variations of inter waves and inter auricular conduction, appreciation of the good correlation between the objective thresholds to the CLICK and the data of the tonal audiogram. Sometimes it is interesting to modify the recurrence or the polarity of the CLICK for a better extraction of the wave I. Ratio of the I and V waves amplitudes, appreciation of some labiality of the wave V and dysmorphism of the complex IV-V (Multiple scleroses).

**Diagnostic value:**

If BAEP is pathologic, MRI has to be performed (Acoustic neuroma, dissociated Ménière, multiple scleroses, Brain stem tumoral or vascular pathologies...)

**Literature**

**ECoG (following tinnitus constant + vertigo)**

**Indication**
ECoG is a sensitive measure for endolymphatic hydrops and can be indicated in doubtful cases of unilateral tinnitus and vertigo, to differentiate endo-or retrocochlear origin.

**Short description**
Installation of a transtympanic electrode on the headland to assess a cochlear potential that can compare to the wave 1 of the BAEP while CLICKS stimulation. The ECoG potential has 3 main components, the Cochlear Microphonism (CM), summation potential (SP) and Compound Action Potential (CAP). It can be registered with transtympanic, tympanic or extratympanic electrodes thus representing a more or less invasive procedure.

**Diagnostic value**
sensitive indicator for endolymphatic hydrops

**Literature**
Aran, J-M (1968) Assisent of non-invasive electrocochleography
MRI (following tinnitus constant + headache)

**Indication**
- Tinnitus + Headache
- Worsening during Valsalva, bending over or reclining (positional)

**Short description**
Often associated with pulsatile component

**Diagnostic value**
- Space occupying lesion (tumor, arachnoid cyst, abscess…)
- Chiari Malformation
- Benign Intracranial Hypertension
- Spontaneous intracranial hypotension

**Literature**
....
Furosemide test (following tinnitus constant + headache)

**Indication**
Suspicion of benign intracranial hypertension (BIH)

**Short description**
- Furosemide per os or IV (40 to 80 mg morning) for 3-10 days (Cave: control of electrolytes)
- Tinnitus reduction after furosemide application

**Diagnostic value**
- Positive test could potentially indicate raised pressure

**Literature**
LP (following tinnitus constant + headache)

**Indication**
Patients with suspected BIH responding to furosemide

**Short description**
- Perform LP in lateral decubitus
- Measure opening pressure
- Evacuate 40 cc

**Diagnostic value**
If tinnitus improves on LP, ventriculoperitoneal shunt can be considered

**Literature**
**Psych Exam (following tinnitus constant + psychiatric)**

**Indication**
- Severe tinnitus often accompanied by psychiatric comorbidity (e.g. depression, anxiety disorder, insomnia, somatoforme disorder)\(^1\)
- Psychiatric consultation indicated in case of decompensated tinnitus (grade III or IV according to Biesinger; TQ > 47, THI > 37), history of psychiatric disease or suspicion of psychiatric disease based on the first consultation.
- A helpful guide for screening can be found here:
  www.aafp.org/afp/981101ap/carlat.html

  Immediate referral to a psychiatrist in case of suicidality

**Short description**
- Psychiatric interview
- Psychometric evaluation if necessary

**Diagnostic value**
Diagnosis of comorbid psychiatric diseases (depression, anxiety disorder, insomnia, somatoforme disorder)

**Literature**
Screening form psychiatric comorbidity - One suggested method.

Screening questions for depressive episodes:
• during the past month have you often been bothered by feeling down, depressed, or hopeless?
• during the past month have you often been bothered by little interest or pleasure in doing things?
If „yes“ to one of these questions, further diagnosis by psychiatrist is indicated


Screening questions for anxiety disorders:
1. Have you, on more than one occasion, had spells or attacks when you suddenly felt anxious, frightened, uncomfortable or uneasy, even in situations where most people would not feel that way? Did the spells surge to a peak, within 10 minutes of starting? Code YES only if the spells peak within 10 minutes.
2. Do you feel anxious or uneasy in places or situations where you might have a panic attack or panic-like symptoms, or where help might not be available or escape might be difficult: like being in a crowd, standing in a line (queue), when you are away from home or alone at home, or when crossing a bridge, traveling in a bus, train or car?
3. In the past month were you fearful or embarrassed being watched, being the focus of attention, or fearful of being humiliated? This includes things like speaking in public, eating in public or with others, writing while someone watches, or being in social situations.
4. In the past month have you been bothered by recurrent thoughts, impulses, or images that were unwanted, distasteful, inappropriate, intrusive, or distressing? (e.g., the idea that you were dirty, contaminated or had germs, or fear of contaminating others, or fear of harming someone even though you didn’t want to, or fearing you would act on some impulse, or fear or superstitions that you would be responsible for things going wrong, or obsessions with sexual thoughts, images or impulses, or hoarding, collecting, or religious obsessions.)

Interpretation:
If “Yes” to 1.: suspicion of panic disorder
If “Yes” to 2.: suspicion of agoraphobia
If “Yes” to 3.: suspicion of social phobia
If “Yes” to 4.: suspicion of specific phobia

Literature:
**Indication**
Tinnitus modulation during movements involving the TMJ and/or tinnitus in the presence of classical signs and symptoms of TMD (pain in the chewing muscles and/or jaw joint, limited movement or locking of the jaw, radiating pain in the face, neck or shoulders, painful clicking, popping or grating sounds in the jaw joint when opening or closing the mouth, headache, earache, dizziness, aural fullness)

**Short description**
- MRI, CT scan or X ray, being the first the more detailed exam.
- However, anamnesis plus clinical examination might be enough in many cases.

**Diagnostic value**
Bony problems of TMJ may justify the presence of the pain and the maintainance of muscular problems (although they may occur isolated) and are seldom reversed with treatment, unless they have surgical indication.

**Literature**
Neck Imaging (following tinnitus constant + somatosensory)

**Indication**
Tinnitus modulation during movements involving the neck and/or tinnitus in the presence of pain in the neck

**Short description**
- MRI, CT or X-Ray with flexion & extension of the neck
- Bone scintilography

**Diagnostic value**
- rectification of the natural curvature indicates muscular tension
- most bony diseases (osteophits, arthrosis, spondylosis, etc) may justify the pain and the maintainance of muscular problems (although they may occur isolated)

**CAVE:** imaging is essential before manual manipulation

**Literature**
Suicidality

Diagnostic criteria

- Risk of Suicidality may be increased in chronic tinnitus patients, especially with comorbid depressive disorder.
- Warning signs may be severe depressed mood, which can not be modulated; social withdrawal; suicide thoughts or suicidal behaviour
- Severeness of suicidality should be explored by asking the patient about potential thoughts of committing suicide or if he/she is having concrete plans
- Cave: Mentioning potential suicidality does not increase the risk of committing suicide

Treatment recommendation

- In case of suicidality: immediate referral to a psychiatrist, in-patient treatment, benzodiazepines (Level III)

Literature:

Guidelines for Identification, Assessment and Treatment planning of Suicidality, (http://www.rmf.harvard.edu/files/documents/suicideAs.pdf)

17/01/2011
Suicidality

In case of suspected suicidality, careful exploration is necessary. The most effective approach for assessing suicidal ideation is to ask first about passive suicidal ideation. This sensitive area may be introduced with the question, "In the past month did you think that you would be better off dead or wish you were dead?"

Screening questions:

<table>
<thead>
<tr>
<th>C. SUICIDALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the past month did you:</td>
</tr>
<tr>
<td>C1 Think you would be better off dead or wish you were dead?</td>
</tr>
<tr>
<td>C2 Want to harm yourself?</td>
</tr>
<tr>
<td>C3 Think about suicide?</td>
</tr>
<tr>
<td>C4 Have a suicide plan?</td>
</tr>
<tr>
<td>C5 Attempt suicide?</td>
</tr>
<tr>
<td>C6 In your lifetime: Did you ever make a suicide attempt?</td>
</tr>
</tbody>
</table>

Is at least 1 of the above coded Yes?

If Yes, add the total number of points for the answers (C1-C6) checked Yes and specify the level of suicide risk as follows:

- 1-5 points Low
- 6-9 points Moderate
- >10 points High
Arteriovenous malformation

Diagnostic criteria
Arterial pulsatile tinnitus

Short description
- Dilated arteries and veins with dysplastic vessels
- Bleeding risk of 2-4% per year
- Demonstrated by MRI, MRA, Angiography

Treatment recommendation
- Embolization in multiple stages
- Surgical resection if intractable to embolization

Literature
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Sinus thrombosis

Diagnostic criteria
- Bilateral/unilateral tinnitus of acute/subacute onset with signs/symptoms of sinus venous thrombosis: headache, papilledema, seizures
- MRI with venous MRI angiography, venous CT angiography
- further diagnosis for detecting the etiology (Blood test etc.)

Treatment recommendation
- Acute treatment with intravenous heparine for 10-14 days (aiming at a PTT of 60-80 s) (I)
- alternatively low molecular heparine (IIA)
- oral anticoagulation for 3-6 months (INR 2-3)(I)
  surgical treatment and antibiotic treatment in case of local infection (I)
- osmotherapeutic treatment in case of increased intracranial pressure (IIB)
- antiepileptic drugs if needed

Literature
Aneurysm

Diagnostic criteria
- Tinnitus with or without history of sudden severe headache
- Aneurysm very rare in pulsatile tinnitus (1/84 pulsatile tinnitus patients)
- esp. petrous ICA aneurysms present with tinnitus

Treatment recommendation
Clipping, coiling, wrapping, trapping or observation, depending on size, localisation, history of bleeding of other aneurysms, patient age (IIB)

Literature
Glomus Tumor

Diagnostic criteria
- = paraganglioma = chemodectoma
- Women (6:1) with hearing loss and pulsatile tinnitus
- Four different kinds (carotid body, glomus jugulare, glomus tympanicum, glomus intravagale)
- Unilateral
- Benign (<10 % with lymph node involvement or distant spread)
- Grow < 2 cm / 5 year
- Otoscopy
- MRI-angio + CT scan

Treatment recommendation
- Surgical removal
- follow or embolize
- irradiation

Literature
Carotid Stenosis

**Diagnostic criteria**
Tinnitus related with significant ipsilateral or contralateral carotid stenosis
Causal relationship is difficult to judge; treatment recommendations are independent from a possible causal relationship

**Diagnostic procedures**
Carotid eco-duplex, MRI with vascular MRI, angiography

**Treatment recommendation**
- Symptomatic carotid stenosis more than 70%: carotid angioplasty (contralateral Concomitant stenosis, age >65 years, vascular risk factors, etc) or endarterectomy
- clopidogrel, statins and antihypertensive drugs (without tinnitus as an adverse Effect) (I)
- Tinnitus could persist after treatment

**Literature**
Benign intracranial Hypertension

Diagnostic criteria
- = pseudotumor cerebri
- Most frequent cause of pulsatile tinnitus
- Obese (11-90%) women (2-8:1) with headache (94-99%),
- Blurry vision (48-68%) and pulsatile tinnitus (60%)
- Venous hum disappears on compressing ipsilateral jugular vene
- CT scan is normal (sometimes slit ventricles or empty sella)
- Papiledema
- LP > 20 cm H2O
- Exclude endocrinological pathologies & evaluate medication use

Remark: some patients have LP<20cm water, no papiledema
(= idiopathic intracranial hypertension without papilledema in chronic daily headache)

Treatment recommendation
Weight loss, Lasix, Diamox, VP shunt

Literature

17/01/2011
High Jugular Bulb

**Diagnostic criteria**
- Venous hum
- Jugular venous compression
- Bending over, reclining
- MRI CT angio

**Treatment recommendation**
- Ligation of the jugular vein
- Surgical jugular bulb lowering

**Literature**
**Chiari**

**Diagnostic criteria**
- 7-10% have tinnitus: non-pulsatile & pulsatile
- Sensorineural hearing loss (3%)
- Associated symptoms: occipital headache (70%), weakness (56%) and numbness (52%), torticollis, hypertension, heart rhythm disturbances, sleep apnea, hiccups, trouble swallowing, hemifacial spasm, trigeminal neuroalgia
- can be associated with basilar impression
- 100 % III-V prolongation
- 36 % I-III prolongation
- MRI

**Pulsatile tinnitus**
- Venous humm
- Cause = ICP / Hydrocephalus
- Worse on bending over
- Disappears on ipsilateral jugular -vene compression
- Hearing improves on jugular vene compression (masking)
- No BAEP changes

**Non-Pulsatile tinnitus**
- Intermittent
- BAEP changes in 75 %
- 100 % III-V prolongation
- 36 % I-III prolongation
- MRI

**Treatment recommendation**
Posterior fossa decompression

**Literature**

17/01/2011
Epilepsy

 Diagnostic criteria
 - Paroxysmal NP tinnitus as a isolated symptom or more frequently with disturbance of consciousness, progressive pitch, complex sounds
 - Cortical irritative focus with EEG
 - Video-EEG can demonstrate tinnitus coexistence with cortical temporal lobe discharges

 Treatment recommendation
 - Antiepileptic drugs (Level I)
 - BZDs (Level I)

 Literature
Microvascular compression

Diagnostic criteria
Symptoms associated with MVC n VIII – (VII)
1. Intermittent paroxysmal spells of unilateral tinnitus lasting only seconds
2. Associated ipsilateral symptoms
   - Facial nerve: cryptogenic or overt HFS
   - Intermediate nerve: otalgia with or without deep prosopalgesia (geniculate neuralgia) or feeling of pressure in the ear
   - Vestibular nerve: vertiginous spells: short lasting, optokinetiely induced
   - Cochlear nerve: frequency specific hearing loss
3. positive MRI for vascular compression
4. positive brainstem auditory evoked potential, using Moller’s criteria

Typical evolution: spells more frequent, intermittent periods shorter, finally constant

Classification

**Possible CVCS**: initially intermittent unilateral tinnitus spells without associated symptoms.

**Probable CVCS**: possible CVCS with high resolution heavily T2 weighted CISS images) or abnormal ABR

**Definite CVCS**: associated symptoms (otalgia, vertigo or hemifacial spasms) or MRI demonstrating vascular compression of cochleovestibular nerve (using: probable CVCS with associated symptoms and/or abnormal ABR and/or abnormal MRI

**Certain CVCS**: definite CVCS which is surgically proven

Treatment recommendation
- If < 4 years, peak II absent, IPL I-III nl, no hearing loss: surgical decompression
- If vertebral artery, decompress
- If > 4 years poor results

Literature
De Ridder D (2007)
Otosclerosis

Diagnostic criteria
- Presence of same disease in the family (30% cases)
- No signs of chronic otitis media (normal tympanic membrane, normal ET exploration, normal or hyper-pneumatized X Ray Schueller)
- Clearly negative RINNE test, WEBER towards affected side
  -- Conductive or combined hearing loss (Some cases of cochlear otosclerosis present sensorineural hearing loss)
- Loss of stapedius reflex
  -- Some cases require CT to rule out ossicular malformations or superior semicircular canal dehiscence
- some cases of cochlear otosclerosis require MRI to rule out acoustic neuroma

Treatment recommendation
- Wait and see, if mild hearing loss (Rinne positive)
- Stapedotomy / stapedectomy only to improve the hearing (improvement of Tinnitus unpredictable)
- Hearing aid fitting
- Tinnitus instrument (hearing aid + noise generator)

Literature
Evidence II-2:
Oliveira CA (2007) How does stapes surgery influence severe disabling tinnitus in otosclerosis patients?
  Adv Otorhinolaryngol. 65:343-7
Evidence III:

17/01/2011
Middle Ear Dysplasia

Diagnostic criteria
- Clinical report of familiar cases
- Presence of other craniofacial malformations
- Otoscopy: Absence of tympanic membrane or malformation of the malleus, external ear malformation (stenosis or atresia of external ear canal)
- Tuning fork: negative RINNE test, WEBER towards the affected side
- Conductive or combined hearing loss
- CT scan to confirm the ossicle malformation
- MRI to rule out inner ear / VIII cranial nerve malformations
- Exploratory tympanotomy in selected cases

Treatment recommendation
- Surgery: Tympanoplasty, Plastic reconstruction of the outer ear
- Hearing aid fitting, consider implantable hearing aid
- BAHA
- CI

Literature
Chronic and acute Otitis media

Diagnostic criteria
- Clinical report of recurrent ear infections
- Presence of effusion, otorrhea, adhesion or perforation of the tympanic membrane, tympanosclerosis, cholesteatoma in otoscopy
- Presence of signs of previous surgery (mastoid cavity, scars)
- Tuning fork testing: negative RINNE test, WEBER towards the affected side
- Conductive or combined hearing loss
- If no perforation of tympanic membrane, flat tympanogram?
- Nasopharyngoscopy: Mass? Adenoid tissue?
- CT scan of temporal bone, Schueller X Ray for extension of cholesteatoma and pneumatization of the mastoid bone

Treatment recommendation
- Acute treatment: antibiotics (local and systemic), Myringotomy with or without tube insertion
- Chronic: Antibiotics, Tympmonic tubes, tympanoplasty, mastoidectomy
- Open hearing aid fitting. Risk of otorrhea
- BAHA, implantable hearing aids with round window application of the soundbridge

Literature
Eustachian Tube dysfunction

Diagnostic criteria
- Clinical report of ear and respiratory infections
- Clinical report of nasal breath dysfunction
- Presence of effusion, adhesion or perforation of the ear drum in otoscopy
- Tuning fork: negative RINNE test, WEBER towards the affected side
- Conductive hearing loss
- Tympanometry towards negative or plain curves
- Eustachian tube examination altered.
- Nasopharyngoscopy, searching for mass or adenoid tissue
- CT or MRI scan in selected cases

Treatment recommendation
- Acute treatment: antibiotics, corticosteroids, antihistaminics, oximetazoline pseudoephedrine, mucolytics
- Surgery: Tympanic tubes (temporal, permanent/t-tube).
  Some cases adenoidectomy, septum and turbinates surgery
- Hearing aid fitting.
- Training of tubal function (e.g. valsalva, blowing balloons)

Literature

17/01/2011
Ménière

Diagnostic criteria
Unilateral SN hypoacusia prevailing on the low frequencies or with a plate, associated with a low frequency tinnitus which worsens while crisis. Feeling of auricular fullness and a gyratory vertigo during several hours accompanied by nauseas, vomiting and sometimes diarrhea.

Treatment recommendation
Vertigo - Palliative medical treatment: 1st day of the crisis: 1 intra-venous injection of 40cc Hypertonic serum to 30%, followed by 2 injections of an amount every 6 hours. 2nd and 3rd days: 1 IV injection morning and evening + corticoid therapy: 1mg/Kg during 5 days + symptomatic treatment of the nausées+ Benzodiazepine. Between crises :Betahistine 16 mg/j, and especially relaxation therapy.

In the event of instability, it’s necessary to propose vestibular rehabilitation (VR) if the compensation is not completely realised.

Chemical intratympanic treatment: chemical destruction of the reached vestibule + VR

Curative surgical treatment: vestibular neurotomy + VR

Tinnitus: relieving, sound therapy – masking or MP3, sometimes - prosthesis for a less fluctuating deafness

Literature
Endolympathic hydrops

Diagnostic criteria
- Clinical report of unilateral or bilateral SN hearing loss prevailing on the low frequencies or with a plate, associated with a low frequency tinnitus which worsens while crisis. Feeling of auricular fullness, sound hypersensitivity and recruitment.
- Audiometric findings of SN hearing loss
- OAE /DP can be useful in the initial stage of the disease, when the audiometry can be normal
- Electrocochleography and glicerol tests, can be useful too.

Treatment recommendation
- Oral, intravenous corticosteroids for acute debut or acute crisis of the disease
- Intratympanic corticosteroids when:
  - Severe or profound acute hearing loss
  - Many acute crisis that need systemic corticosteroids frequently (3 or 4 crisis /year)
  - No corticoid recommendation due to systemic diseases (diabetes, tuberculosis, immuno deficiencies..)
- Low salt diet + Increase water intake (2,5liters/day)
- Diuretics (hidrochlohtiazide, azetazolamide)
- Betahistine, trimetazidine, pirazetam
- Sound therapy – masking or MP3, sometimes - prosthesis for a less fluctuating deafness
- Glucosé hyper à 30%:IV 20 cc 3/J the first day
  ----------- 1/J the 3 days after

Literature

17/01/2011
**Superior Canal Dehiscence**

**Diagnostic criteria**

- Clinical findings: vertigo or oscillopsia induced by loud sound or changes in middle ear / intracranial pressure (valsalva maneuver)
- Eye movements during vertigo typically aligne with the plane of the dehiscent SSC (vertical and torsional component)
- Conductive hearing loss, hyperacusis, autophony, tinnitus
- Tuning fork: WEBER towards the affected side
- Audiometry: air-bone gap, even with normal air conduction thresholds (bone conduction thresholds less than 0)
- Intact acoustic reflex responses
- Usually normal function in caloric testing
- VEMP (vestibular-evoked myogenic potentials): lower threshold for VEMP response
- High-resolution temporal bone CT scan (coronal view important)

**Treatment recommendation**

- Avoidance of the sound and pressure stimuli that cause symptoms
- Surgery: Resurfacing of superior canal through a middle fossa approach (III)
- Hearing aid fitting (Risk of vertigo when using the hearing aid)

**Literature**

Laryngoscope 115:1717-1727

Clin Otolaryngol 30, 9-15
N VIII tumor

Diagnostic criteria
- High pitched tinnitus (ringing or steam from a kettle)
- 60-85% of patients have tinnitus
- The smaller the tumor the more tinnitus
- Hearing loss (98%, 1-14% sudden)-desequilibrium (67%)-headache (32%)
- Facial numbness (29%) & weakness (10%)
- MRI, (BAEP)

Treatment recommendation
- Radiosurgery or microscopic surgery
  40 - 50% tinnitus disappears with surgery
  40-50% develop tinnitus
  almost no improvement with radiosurgery
- Wait & see

Literature
Baguley (2005)
Acute Noise Trauma

Diagnostic criteria
- Notch in the audiometry typically at 3- 4 kHz
- DPOAE temporary or permanently disappeared at a specific frequency

Treatment recommendation:
- Avoidance of further noise trauma (III)
- Steroids (start within 3weeks), (systemic, transtympanic) (III)
- hyperbaric O2 (start within 6 weeks) (III)
- Antioxidants as treatment of acoustic trauma (III)
- Sound enrichment / hearing aid (III)

Literature:
Chronic sensorineural hearing loss

**Diagnostic criteria**
Audiometry, Progressive, bilateral, sensorineural or mixed hearing loss

**Treatment recommendation**
- No causal treatment of hearing loss possible,
- Hearing Aids (Level II-2)
- Cochlear Implant (Level II-2)

**Literature**
Evidence level III:

Evidence level II 2:
Acute hearing loss

**Diagnostic criteria**
Acute, unilateral, sensorineural hearing loss

**Differential diagnosis**
- viral or vascular attacks, neuroma, beginning Ménière,
- Sound traumatism, cochlear barotraumatism, fracture of the temporal bone

**Therapeutic recommendation:** urgency!
- Hyperbaric oxygen-therapy + vasodilators + corticoids
- Carbogen Inhalation
- Perfusion of vasodilators and corticoids
- Intratympanic corticosteroids as a rescue treatment after systemic
- corticosteroids or as the initial treatment
- Surgical exploration?

**Literature:**


17/01/2011
Space occupying lesion (SOL)

**Diagnostic criteria**
- Tinnitus: non-pulsatile or venous hum
- Hearing loss, desequilibrium, other cranial nerve related symptoms
- ICP increase: Headache (morning, valsalva), nausea, vomiting, papiledema
- Space occupying lesion in the MRI

**Treatment recommendation**
- Surgical removal
- Biopsy +gamma knife or chemo+/- XR-therapy
- Marsupialisation if arachnoid cyst

**Level II-3**

**Literature**
Depression

Diagnostic criteria / characteristic features

- Depressed mood, reduction of energy, activity, interest, concentration, self-esteem- and self confidence
- No changes from day to day or due to circumstances
- Psychomotor retardation, agitation, loss of appetite, weight loss, and loss of libido
- Sleep disturbances
- Suicidality is a frequent symptom of depression and needs always to be specifically addressed (> see slide suicidality)
- Duration of 2 weeks or more

Treatment recommendation

- Pharmacotherapy with standard antidepressants (Evidence Level I)
- Choice of antidepressants according to symptomatology and comorbitity (Evidence Level I)
- Newer antidepressants have lower risk of pharmacological interactions, especially important in older patients with polypharmacy (Evidence Level I)
- If loss of energy, activity and interest are main symptoms, first choice may be SSRIs (e.g. citalopram, sertralin) or dual acting drugs (Venlakaxine, duloxetine)
- Comorbid sleep disturbances or agitation: first choice may be mirtazapine or tricyclics (e.g. amitriptyline, trimipramine)
- Comorbid pain syndromes: amitriptyline, mirtazapine, venlafaxine, duloxetine (Evidence Level I)
- At least 4 weeks treatment at sufficiently high daily dosages depending on tolerance (Evidence Level I)
- Psychotherapy (cognitive behavioral therapy), sociotherapy, special therapies (Evidence Level I)
Anx. Disorder

Diagnostic criteria / characteristic features

The sufferer must have primary symptoms of anxiety most days for at least several weeks at a time, and usually for several months. These symptoms should usually involve elements of:
- apprehension (worries about future misfortunes, feeling "on edge", difficulty in concentrating, etc.);
- motor tension (restless fidgeting, tension headaches, trembling, inability to relax); and
- autonomic overactivity (lightheadedness, sweating, tachycardia or tachypnoea, epigastric discomfort, dizziness, dry mouth, etc.).

- The ICD-10 Classification of Mental and Behavioural Disorders, World Health Organization, Geneva, 1992

Treatment recommendation

Non-pharmacologic
• Cognitive behavioral therapy (Evidene Level I)

Pharmacotherapy
• SSRIs (e.g. Citalopram, paroxetine, sertraline) (Evidene Level I)
• Pregabaline (pregabaline especially in patients with comorbid sleep disturbances reasonable) (Evidene Level I)

At least 4 weeks treatment at sufficiently daily high dosages depending on tolerance
Insomnia

Diagnostic criteria
Suffering from sleep problems (falling asleep or maintaining sleep) with impact on daytime functioning

Treatment recommendation

Non-pharmacologic
• “Sleep hygiene” (e.g. regular bed-times (including weekends), bedtime restriction;
• avoiding stimulating substances like caffeine, nicotine, alcohol or heavy meals;
• comfortable temperature;
• Sound enrichment (e.g. gentle music)
• Cognitive behavioural therapy with special focus on tinnitus and sleep

Pharmacologic
• Benzodiazepineagonists (e.g. Zopiclon 7,5 mg, Zolpidem 10 mg) (avoid regular long-term treatment if possible)(Evidenve level I)
• antidepressants e.g, amitriptylin (25-50 mg), trimipramine (50-100 mg), mirtazapine (7.5 – 15 mg) (Evidence level I)
• pregabalin (25-150 mg at night) (evidence Level I for improvement of sleep in fibromyalgia patients)

Literature
**Somatoform disorder**

**Diagnostic criteria**
- Multiple unspecific somatic symptoms without physical basis;
- Persistent requests for medical investigations;
- If somatic disorders are present, they do not explain the nature and extent of the symptoms;
- Comorbidity with other psychiatric diseases (e.g. depression) is common;
- Duration of 2 years or longer.

**Screening question**
Have you had *many* physical complaints not clearly related to a specific disease.

**Treatment recommendation**

**Non-pharmacologic**
Psychoeducation; cognitive behavioural therapy (Evidence Level II-2)

**Pharmacologic**
According to psychiatric comorbidity (anxiety, depression) or other comorbidity (e.g. fibromyalgia)
Antidepressiva may be helpful¹(Evidence Level III)

**Literature**
Tinnitus associated with cervical pathology

**Diagnostic criteria**
1. Myofascial trigger point
2. Muscular tension and/or tender points
3. Vertebrae fusion or rotation
4. Muscular or joint dysfunction

**Treatment recommendation**
1. Deactivation of myofascial trigger / tender points (manual, infiltration, or acupuncture) (evidence level III)
2. Other options (not directed to trigger points):
   - manual cervical therapy (evidence level III)
   - infiltration of the afferences in the neck (evidence level III)
   - trans-electrical nerve stimulation (evidence level III)
   - Tai Chi or Gi Cong (evidence level III)

**Literature**
Estola-Partanen M (2000) *Muscular Tension and Tinnitus*. Dissertation. Tampere: Faculty of Medicine, University of Tampere
Diagnostic criteria
- TMJ dysfunction diagnosed by a specialist
- Modulation of tinnitus by temporomandibular maneuvers

Treatment recommendation
- Infiltration of muscles with trigger points (evidence level III)
- Orofacial myofascial therapy (evidence level III)
- TENS (evidence level III)
- Acupuncture (evidence level III)
- Oral rehabilitation (splint) (evidence level III)
- Surgery (evidence level III)
- Biofeedback (evidence level III)

Literature
Symptomatic Treatment

Definition
The term symptomatic treatment describes treatment options, which are indicated irrespective of the exact tinnitus etiology and which aim to reduce tinnitus perception and tinnitus related distress.

Indication
In case of an identified underlying pathology and available causal treatment this treatment approach should have first priority. Independently of any potential causal treatment, symptomatic treatment should always be considered. Symptomatic treatment is especially indicated, when specific treatments (as described in the blue section) are not possible or do not result in sufficient relief.

Combination of treatments
Frequently a combination of different treatment strategies leads to best results. In case that synergistic effects of different treatment strategies are known (e.g. auditory stimulation + cognitive behavioural therapy), this is mentioned.
Tinnitus Counselling

Indication / contraindication
Counselling should occur at many stages in the treatment process, by many professionals.

Counselling is the process of informing, advising and empowering individuals with a need for support.

The following aspects should be considered:
Patients may have developed inappropriate ways of thinking about tinnitus.
Bothersome tinnitus may be a failure to habituate or a failure to shift attention away from tinnitus.
Learning mechanisms may be involved in the response to tinnitus.

Literature:
Tyler RS (2005) Psychological frameworks for considering tinnitus treatment. Tinnitus Treatment. Thieme
Description of treatment
Counselling can be psycho-education (Informational counseling) and/or CBT based, depending on training of the professional

Basis: Education/information alone contribute to reduce distress

Client-centered
A client centered approach is used with greater discussion of those areas important to the tinnitus sufferer. The clinician must assess the level of understanding and needs of the patient and adjust their counseling appropriately (e.g. slides ►83, ►84).

Directive counselling
Structured counselling sessions aim to achieve reclassification of tinnitus into a category of neutral signal. Tinnitus is demystified and patients are taught about physiological mechanisms of tinnitus and its distress, as well as the mechanisms through which tinnitus habituation can be achieved (e.g. slides ►83, ►84).

Information regarding tinnitus and explanation of probable causes
Functional analysis of influencing factors on tinnitus annoyance
Advice regarding hearing loss and its possible remedies
Use of environmental sound enrichment strategies
Relaxation training
Cognitive restructuring of thoughts and beliefs
Emotional reactions are focused upon, especially fear and avoidance in relation to tinnitus
Advice regarding problems with concentration and methods of improvement
Advice regarding sleep hygiene for those with sleeping difficulties
Relapse prevention advice
Complete version structured on the anatomy and physiology of auditory pathways:

1. outer and middle ear, as responsible for conduction and amplification of sounds to the inner ear
2. Eustachian tube, as a source of repetitive sounds during swallowing, which are usually filtered by the central auditory pathways, although they are normally louder than the own tinnitus.
3. inner ear: hair cells and possible pathologies (noise trauma, ototoxicity, ageing, etc)
4. nerve: conducting stimuli from periphery to central, possibility of acoustic neuroma (very careful to avoid increasing fear and awareness)
5. brainstem: reaction to sound when detecting danger or an unidentifiable source and provoking a strong and subconscious reaction: anxiety, muscular tension, sleep and concentration problems, inability to externalise sound, etc. Tinnitus as a new signal to the brain creating arousal, fear, threaten-oriented reaction. Hyperactivity plus anxiety / depression become chronic, originating also the hyperacusis
6. Midbrain: add emotions to the sound depending on the subconscious evaluation, focusing even more in the tinnitus sound. Ex: cricket outside and inside the brain, mother and child, good / bad neighbour cutting grass

Explain that habituation means reducing tinnitus towards a harmless cricket; importance of having sound enrichment as soon as possible (through different ways) to avoid neuroplasticity; increase hope in the treatment, whichever the option is (explanation of therapeutic steps tailored to each one);
Auditory Stimulation

Also known as Acoustic Therapy or sound therapy
Aim: use of external sound(s) to provide relief from tinnitus via masking or habituation. Sound therapy can also induce neurophysiological functional changes in the deafferentiated auditory pathways. For all patients whom surgical or medical treatment is impossible or has been unsuccessful or wish to avoid such intervention.
Contraindications: Lack of motivation of the patient. Not indicated in patients with severe depressive illness or high suicidality
The auditory stimulation can be divided in two groups as follows.

#### Passive auditory stimulation

Goals are:
- reducing the attention drawn to the tinnitus, induce habituation,
- reducing the perceived loudness of the tinnitus,
- induce brain plastical changes in deafferentiated neural areas.

Includes:
compensation for hearing loss, total or partial masking, music therapy, habituation and desentisation approaches. These techniques can be used in conjunction or alone.

Sounds used:
nature or therapeutical customized sounds or electrical stimulation in the case of cochlear implant

Devices:
hearing aids and cochlear implants, sound generators, combination instruments (sound generator with hearing aid), MP3 players, music and custom sound generators.

#### Active auditory stimulation and training

Goals are:
sound is used in listening tasks to divert attention from tinnitus and/or lead to reduced representation of tinnitus within central auditory pathways
Involves cognitive processing of sound

Includes:
- discrimination tasks;
- categorisation tasks
- selective attention
- virtual reality multimodal training
**Passive Auditory Stimulation**

The passive auditory stimulation can be considered a well-established treatment for providing replicable long-term reduction of tinnitus impact in terms of annoyance and quality of life. However, most studies show Evidence Level II and III.

- **Masking**
  - Evidence Level II-1

- **Habituation with: sound stimulation at mixing point and/or environmental device**
  - Evidence Level II-3

- **Habituation with: music**
  - Evidence Level I

- **Hearing compensation for:**
  - 1) habituation, 2) elicit auditory neural plasticity and reprogramming
  - Evidence Level III:
  - Evidence Level II-2:

Immediate relief from tinnitus-high tinnitus severity

Medium time relief from tinnitus (low, medium and high severity) not associated with hearing loss

Medium time relief from tinnitus (low, medium and high severity) associated with hearing loss (i.e. SN, Meniere, sudden hearing loss, presbioacusys, conductive)
Indication
For patients whom surgical or medical treatment isn't possible or has been unsuccessful or wish to avoid such intervention
Immediate relief from tinnitus

Contraindication
Not indicated in patients with severe depressive illness or high suicidality
High levels of masking sound requested in some cases
Severe hearing loss
Discomfort or adverse reaction to sound (hyperacusis or reduce sound tolerance)

Description of treatment
Can be used in conjunction with hearing compensation or alone in case of normal hearing level. Sound used to mask the tinnitus, for this reason the masking produce a sense of immediate relief from the annoyance caused by tinnitus
Uses whatever type of sound that produces the greatest relief
Accomplished by :
Total masking = Covering up tinnitus sound
Partial masking = Changing the sound of tinnitus by reducing the perceived loudness
Recommend lowest level masker that provides adequate relief
Instrumentation:
Wearable ear-level devices, Hearing aids, sound generators, combination aid [hearing aid + masker], Non-wearable devices (to enrich sound environment),Tabletop devices (eg. water fountains, sound machines), Pillow speakers.

17/01/2011
Passive Auditory Stimulation
Habituation

Indication
For all patients whom surgical or medical treatment isn't possible or has been unsuccessful or wish to avoid such intervention. Relief from tinnitus because induce habituation to the tinnitus perception

Contraindication
Not indicated in patients with severe depressive illness or high suicidality
Low motivation people - expectations of quick or immediate relief
Unwilling to use sound for 8 hours or greater per day
Severe hearing loss (cochlear implant aside)

Description of treatment
Can be used in conjunction with hearing compensation or alone in case of normal hearing level
Sound and counselling used to produce an enduring sense of reduced tinnitus after cessation of sound (e.g. TRT)
Decline in response to familiar auditory stimuli (tinnitus) due to repeated exposure.
Attention and emotional defocusing of tinnitus.
Recommend lowest level sound that reduces tinnitus detectability (TRT suggests “Mixing point” - blending of tinnitus and therapeutic sound”).
Uses whatever type of sound that produces the greatest relief, often broadband sound

Instrumentation:
Wearable ear-level devices, Hearing aids, sound generators, combination aid [hearing aid + masker], Non-wearable devices (to enrich sound environment), Tabletop devices (eg. water fountains, sound machines), Pillow speakers.
Passive Auditory Stimulation
Music

Indication
For patients whom surgical or medical treatment has been unsuccessful or wish to avoid such intervention
Better than moderate hearing loss
High levels of stress, need for relaxation
Desire immediate relief from tinnitus

Contraindication
Not indicated in patients with severe depressive illness or high suicidality
Moderate or severe hearing loss

Description of treatment
Music used to produce a sense of relief from the annoyance caused by tinnitus through masking or habituation
Music has positive effect on emotion, mood, stress & anxiety
Suppress negative reactions and associations caused by tinnitus
Accomplished by: Music therapy, self selected music, custom music

Instrumentation:
Radio, digital music players (MP3, ipod), CD, live music, commercial tinnitus instruments (e.g Neuromonics)
Indication
For patients with aidable (hearing aids or cochlear implant) hearing loss. The aim is to use of external sound(s) to provide relief from tinnitus via masking or habituation. Hearing compensation could also induce neurophysiological functional changes in the deafferented auditory pathways (even if not already completely proof)

Contraindication
Not indicated in patients with severe depressive illness or high suicidality.
Normal hearing or Hearing loss and tinnitus above 6 kHz.
Severe hyperacusis.

Description of treatment
Normalisation of auditory activity through prosthetic correction of hearing loss for full access to masking, habituation, auditory neural path regeneration, and all other sound therapeutic approaches.
Amplified environmental sound used to produce a sense of relief from the annoyance caused by tinnitus. Amplified sound results in masking or tinnitus habituation.

Instrumentation:
Hearing aids appropriate for individual's hearing loss (flexible programming characteristics, multichannel adjustment of gain, output and compression, open fitting where appropriate) and amplification of environmental sounds (ability to turn off expansion & noise reduction, low compression thresholds).
Combination instruments for intrusive tinnitus where hearing aids alone are ineffective.
Cochlear implants when hearing loss is too great to benefit from hearing aids.
CROS aids in the presence of unilateral “dead ears”.
Auditory Stimulation: PERCEPTUAL (Active) TRAINING

Perceptual training for tinnitus can be considered an emerging treatment for tinnitus treatment. Most studies are preliminary small scale experimental studies.

Frequency Discrimination training
Evidence Level II-3
Auditory Discrimination Training for the Treatment of Tinnitus. Applied Psychophysiology and Biofeedback, 29 (2), 113-120.


Diversion of attention from tinnitus to everyday sounds
Evidence Level II-3
Object identification and attention training for treating tinnitus. Prog Brain Res. 166, 441-60.

Virtual reality
Cognitive restructuring through representation of tinnitus as a visual and auditory avatar that can be manipulated by interaction in a virtual environment.

Categorisation training
Cognitive behavioural Therapy

Indication / contraindication
Motivation of the patient
More indicated in decompensated tinnitus
Not indicated in patients with high suicidality, clinically relevant cognitive deficits or language problems

Description of treatment
Aim of the therapy is the analysis and modification of disturbances induced by the tinnitus.
Dysfunctional cognitions and / or behaviour will be analysed and modified.
Coping strategies will be enhanced.
Informations about tinnitus (mechanisms, course etc.) will be provided (“Counselling”).
Tinnitus perception will be modified (“Retraining”).

Evidence level
Significant Improvement in Quality of life by CBT (Evidence Level I)
No improvement in Tinnitus loudness / depressive symptoms

Literature
Pharmacotherapy

No pharmacologic treatment can yet be considered well established in terms of providing replicable long-term reduction of tinnitus impact, in excess of placebo effects (Dobie RA et al (1999) *A review of randomized clinical trials in tinnitus*. Laryngoscope 109:1202-1211)

However for specific subgroups of tinnitus, specific drugs have shown some efficacy (most studies Evidence Level II)

- High Tinnitus severity
- Comorbidity with depression

**Antidepressants, e.g. sertralin, nortriptyline, amitryptiline**

Evidence Level II-2


- auditory nerve vascular compression
- myoklonus tinnitus

**Carbamazepine**

Evidence Level II-2


Rahko and Häkkinen (1979) *J Laryngol Otol* 93:123-127

- decompensated tinnitus (indication careful, due to risk of dependency)

**Benzodiazepines, e.g. alprazolam, clonazepam**

Evidence Level II-3


- tinnitus, associated with chronic noise trauma

**Acamprosate**

Evidence Level I

Aazevedo AA and Figureido RR (2005)

- Menière's disease

**Intratympanic Dexamethasone**

Evidence Level I:


- sudden hearing loss

**Intratympanic Dexamethasone**

Evidence Level II-3:

Haynes et al (2007)

- benign intracranial hypertension

**Furosemide**

Acetazolamide

Evidence Level II-3

Sismanis et al (1990)

17/01/2011
Cortisone IV: 250mg prednisolone once a day, for 3 days
To discuss:
- Oral
- Local: whenever IV is counterindicated (diabetics, children, etc)
- Hemorheological agents (oral or IV)

Cervical/TMJ treatment
Indications:
- Children
- Trauma/pain/manipulation of head and neck
- Abnormalities in cervical examination (pain, limitation of movements, tinnitus modulation, etc)
Options:
- Manual therapy
- Physiotherapy
- Osteopathy
- Infiltration

Hyperbaric chamber
1 à 2 meetings by day during 5 or 10 Days with cocktail IV (corticoids, Vasodilators…) and inhalation O2 under pressure at 1.5 Bar

Evidence in acute tinnitus with sudden hearing loss: yes
Evidence in acute tinnitus without hearing loss: no

Auditory stimulation / environmental sound
Recommendation based on animal data, no data in humans yet

Evidence level / Literature:

17/01/2011
Neuromodulation

Tinnitus suppression by single sessions of rTMS

yes

Epidural stimulation with implanted electrodes

10 days of 1 Hz rTMS over the left temporal or temporoparietal cortex

Better results in patients with:
- better hearing
- shorter tinnitus duration

Evidence Level II-2
De Ridder et al (2007)
Acta Neurochir Suppl. 97(Pt 2):451-62

Evidence Level I (short term efficiacy)
Brain Stimulation 1(3):192-205

Evidence Level I (short term efficiacy)
Dohrmann et al (2007)
Restor Neurol Neurosci. 25(3-4):371-8

Neurofeedback

Evidence Level II-2
Langguth / De Ridder
yes

Evidence Level I (short term efficiacy)
Epidural stimulation

**Indication:**
severe tinnitus (grade III / IV)
Treatment resistance to noninvasive treatment strategies
Unilateral pure tone tinnitus,
tinnitus suppression by single sessions of rTMS

**Contraindication:**
epilepsy, cardiac pace-maker, need for frequent MRI scans (e.g. follow-up of tumor)
personality disorder, pregnancy

**Description of treatment**
In case of transient suppression of the tinnitus by rTMS presentation of the tinnitus tone in fMRI for exact localisation of the representation of the tinnitus frequency in the secondary auditory cortex.
Neuronavigation guided implantation of the epidural electrode over this area; in case of positive test stimulation, implantation of a stimulus generator abdominally. Optimization of the stimulation parameters over the following weeks.

**Evidence level:** II-2

**Literature:**
**Transcranial magnetic stimulation**

**Indication**
Preferable tinnitus of shorter duration (< 4 years) and with normal hearing

**Contraindication**
Mechanical or electrical implants, cardiac pace maker, epilepsy, pregnancy

**Description of treatment:**
10 sessions of rTMS over the left temporal or left temporoparietal cortex within two weeks

**Evidence level:** I (for short term efficacy)

**Literature:**
Langguth et al (2008) [Controversy: Does repetitive transcranial magnetic stimulation/transcranial direct current stimulation show efficacy in treating tinnitus patients?](#)
Brain Stimulation 1(3):192-205
**Neurobiofeedback**

**Indication:**
Motivation to do at least 10 sessions of neurobiofeedback therapy

**Contraindication:**

**Description of treatment:**
Assessment of ratio between alpha and delta spectral power in the EEG;
Neurofeedback with the goal to increase alpha and reduce delta

**Evidence level:** I (for short term efficacy)

**Literature:**
VEMPs (following tinnitus constant + vertigo)

**Indication**
Vestibular evoked myogenic potential test (VEMPs) is indicated in all tinnitus patients with dizziness or imbalance disorders, and all those with vertigo under the presence of intense sound stimulation.

**Short description**
Brief loud monaural clicks or tone-bursts produce a large inhibitory potential in the tonically contracting ipsilateral sternocleidomastoid muscle, even in profound sensorineural hearing loss. This potential is generated by synchronous discharges of muscle cells through stimulation of the saccule and transmission via the ipsilateral medial vestibulospinal tract to the sternomastoid motoneurons. VEMPs tests the function of the saccule, superior and lateral semicircular canals (SCC).

**Diagnostic value**
- Superior semicircular dehiscence (lower threshold and large amplitude VEMPs)
- Ménière’s Disease diagnosis and they can be used to monitor intratympanic gentamicin
- Vestibular neuritis and Superior SCC benign paroxysmal positioning vertigo.
- Vestibular schwannoma, multiple esclerosis.

**Literature**

17/01/2011
Cran. + cerv. CT / MRI (following trauma)

Indication and short description
- X-ray of the neck, eventually with flexion and extension
- Cran. CT / MRI in tinnitus after ear, neck (whiplash) or head trauma
- Cerv. CT / MRI + MR Angio in tinnitus after neck trauma (whiplash)
- CT for detection of bony lesion
- **In case of neck trauma, CT / MRI before functional neck exam !**

Diagnostic value
- bone lesions (spine, scull, petrous bone, craniocervical junction, ossicular chain, TMJ)
- cerebral lesions (e.g. contusions, bleeding, ischemia, e.g. due to carotid dissection)
- nerve compression / dissection
- carotid or vertebral dissection

Literature
BAEP (in posttraumatic tinnitus)

**Indication**
- Screening tool for acoustic nerve pathology, in case that MRI is not available
- Functional assessment of auditory pathways up to inferior colliculus

**Short description**
BAEP at high intensities while identifying the first 5 waves of the Brain Stem, the variations of inter-waves and inter-auricular conduction, appreciation of the correlation between the objective thresholds to the CLICK and the data of the tonal audiogram.

**Diagnostic value**
If absent or pathologic, suspicion of structural or functional deficit in the auditory pathways such as cochlear damage, traumatic hearing loss or nerve compression or dissection (CT / MRI should be performed)

17/01/2011
**Indication**
After head trauma

**Short description**
Standard EEG, eventually with provocation (flashlight, hyperventilation)

**Diagnostic value**
- Irritative focus in temporal or temporal with secondary generalization
- Video-EEG demostrative if tinnitus coexists with temporal lobe discharges

**Literature**
Echo-Doppler

**Indication**
Tinnitus after neck trauma
especially if there are further symptoms for carotid or vertebral dissection such as
unilateral neck pain or headache, face numbness, Horner’s syndrome, transitory ischemic attacks etc.

**Short description**
Echo- Doppler of neck vessels. Measurement of flows, resistances and thickness of
the Intima. Search for dissection of the vessel

**Diagnostic value**
Proof or exclusion of neck vessel dissections
Neck exam (in posttraumatic tinnitus)

**Indication**
Tinnitus after neck trauma (whiplash)
Cave: before a functional neck exam a dissection of neck vessels and a cervical neck fractures / dislocation has to be excluded

**Short description**
Inspection, palpation of the neck
Passive and active antero-, postero- and lateroflexion of the neck
Turning of the neck

**Diagnostic value**
Functional or structural disorders (e.g. muscle tension abnormalities)

Differential indication for physical therapy

**Literature**
Psych Exam (in posttraumatic tinnitus)

**Indication**
- Tinnitus associated with emotional trauma

**Short description**
- Psychiatric interview
- Psychometric evaluation if necessary

**Cave:** Careful exploration, exploration of the traumatic event is not necessary and should be better avoided,

**Diagnostic value**
- Diagnosis of posttraumatic stress disorder

**Literature**