

INTRA-AURAL MUSCLE REFLEX TESTING

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The following facts are basic in the use of the intra-aural muscle reflexes for clinical purposes: Contractions in both muscles are elicited acoustically via the cochlea and the brain stem as a bilateral reflex at intensities of 70—90 db above normal threshold in the intermediate auditory frequency range. The controlling factor, however, is not absolute intensity, but the subjective loudness sensation evoked by sound. Thus the reflex threshold yields objective evidence of the suprathreshold response of the ear. In patients with recruitment of loudness reflexes are elicited at an intensity, that is considerably below the normal 70—90 db when compared to the threshold of hearing. If the interval between hearing threshold and reflex threshold is less than 60 db it is safe to assume that recruitment is present. Extensive clinical experience has shown, that this is a very reliable method for determining recruitment and with the further advantage of being essentially a monaural procedure.

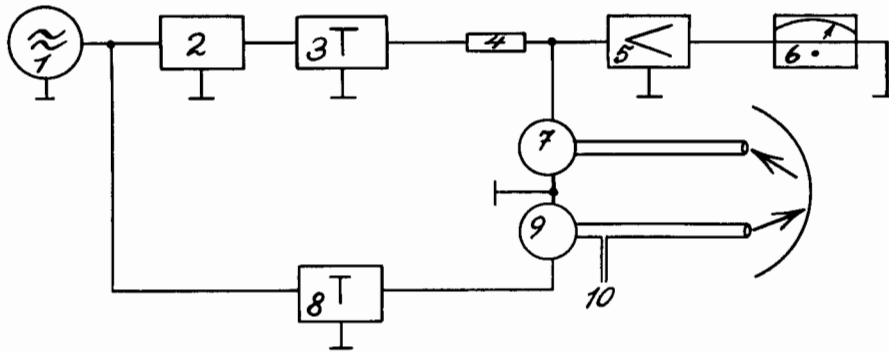
In psychogenic hearinglosses the presence of reflexes at intensities, that are below the alleged level of hearing will prove the true nature of this condition.

For reasons, that still are under debate, reflexes are missing altogether if only the stapedius muscle is out of action. Thus patients with otosclerosis will show complete absence of reflexes because of fixation of the stapes. This is of diagnostic value in early stages of this disease, and where the perceptive element in the hearingloss is so pronounced, that ordinary audiometric results are inconclusive.

The stapedius muscle derives its innervation from the facial nerve, and testing for intra-aural muscle reflexes is an important part of our diagnostic means to locate diseases in this nerve.

Several methods have been devised for the purpose of investigating the intra-aural muscle response. Among these the impedance method is the only one of clinical value. The apparatus presented here is designed especially for clinical use.

The main part of the apparatus is the ear piece with its two hearing aid type earphones. One of these generates a steady test sound of 220 cps, while its opposite number acts as a sound probe microphone, that is activated in a passive way according to the sound level. Both are connected to the external ear canal by means of narrow tubes, that are carried in a common somewhat larger insert tubing. Around the distal part of this insert there is a rubber cuff, which can be inflated in order to ensure a completely airtight



Block schema of impedance apparatus.

1. oscillator, 220 cps; 2. var. phase shift; 3. attenuator (amplitude); 4. resistor; 5. selective amplifier; 6. vacuum tube voltmeter; 7. microphone; 8. attenuator (sound pressure); 9. telephone; 10. pressure control inlet.

closure of the ear canal. Thus the deep part of the ear canal is converted to an isolated space connected to the two earphones via narrow high impedance tubes. From this space some sound energy is transmitted through the eardrum to the middle ear, depending above all upon the degree of stiffness presented by the eardrum. During contractions of the middle ear muscles the stiffness increases and more sound energy is retained in the deep ear canal space. The sound level here will increase and thus permit a determination of the onset of muscle reflexes. The magnitude of these variations are so small, that it is necessary to introduce a balancing principle in order to obtain a satisfactory degree of sensitivity. The balancing is performed by means of a voltage from the test sound generator, passed to the microphone via an attenuator and a phase control stage. Through adjustments in these two stages it is possible gradually to bring the microphone to a complete zero state. The degree of balancing is followed on a vacuum tube voltmeter, which is preceded by a selective amplifier. Before testing for reflexes this amplifier should be close to its maximum at the same time as the voltmeter reading is around zero. The reflex eliciting sound is presented to the opposite ear by means of an ordinary audiometer, which is built into the apparatus. During examinations for recruitment and psychogenic deafness the test ear is the one to which the reflex eliciting sound is applied. If information is wanted about the middle ear the insert is placed in this ear and the sound presented to the contralateral ear.

A major source of error in such measurements are abnormalities of the middle ear pressure. It is therefore advisable to check the middle ear pressure level before testing for reflexes. It is immediately understandable that the stiffness of the eardrum depends upon the pressure applied to it. If the pressures on its inside and outside are identical it is under no tension and the sound transmission will be maximal. With the present apparatus it is possible to introduce controlled artificial pressures in the closed deep ear canal space. In the so-called tympanometric test procedure a positive pressure

is established towards the outside of the eardrum in order to produce an artificial increase of stiffness, and the microphone is balanced to zero at this stage. If now the ear canal pressure is made to drop towards zero and negative values the voltmeter will show a deviation, which reaches a maximum at the very level of the middle ear pressure. From thereon it returns towards zero as the load to the eardrum again increases because of the negative pressure in the ear canal. This is the pneumophone principle over again, and it might appropriately be called an objective pneumophone determination.

The pitfalls in the use of this apparatus are few. If the rubber cuff does not occlude the ear canal or the tubes leading to the earphones are obturated, the system does not work, and it is impossible to balance the sound probe microphone. Perforations of the eardrum and obliteration of the pneumatic middle ear space, as in middle ear catarrh, will also invalidate the method. Examination for the middle ear pressure eliminates these uncertainties.

Carried out in this way the impedance method is reliable and yields important information about the middle ear as well as diseases in the inner ear. In normal persons reflexes will be missing in less than 1 pct, and even in the presence of cicatricial changes reflexes will usually be demonstrable if there is no conductive hearingloss.

L'EXAMINATION DES REFLEXES MUSCULAIRES INTER-AURAUX

L'examen des réflexes musculaires inter-auraux donne des renseignements précieux d'un point de vue diagnostique aux affections suivantes: perte d'oreille perceptive, dureté d'oreille psychogène, parésie de nervus facialis et otosclérose.

La seule méthodologie clinique dont on peut se servir pour cette sorte d'examinations est liée aux altérations d'impédance, aux quelles la membrane tympanique est soumise à cause des contractions musculaires.

On décrit ici un appareil electro-acoustique pour la mesure de l'impédance de l'oreille. Cela épouse le canal auditif hermétiquement, et par conséquent on peut travailler avec des pressions arbitraires contre la membrane tympanique. C'est là la condition de pouvoir avoir des résultats exacts, et en outre on a, dans cette manière, des informations sur la présence éventuelle de conditions pathologiques dans l'oreille moyenne.

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