MedCrave
Step into the World of Research

Journal of Otolaryngology-ENT Research

Clinical Paper

Open Access

CrossMark

Study of external ear and middle ear functions and hearing aid adjustments to deal with pathological changes

Volume 9 Issue 1 - 2017

Anjan Muhury
Board Certified Hearing Instrument Specialist Jays Hearing Aid Center, USA

Correspondence: Anjan Muhury Board Certified Hearing Instrument Specialist Jays Hearing Aid Center 3740 E 7th St Long Beach CA 90804, USA, Email anjanmuhury@hotmail.com

Received: July 24, 2017 | **Published:** October 23, 2017

Clinical paper

As incoming sound enters the external ear canal, there is a formative, three dimensional changes in its structure to conform to the tunnel like structure in its forward movement inside this canal as a part of its ongoing journey to the TM (eardrum). The resonant characteristics of this canal have been recorded using pure tone inputs. There is a resonant peak at approximately at 2700Hz. The purpose of this ear canal is to miniaturize the world representation of the external world sounds, condensing, and therefore adding more sound energy by way of design of the canal structure, varying shape and direction right up to the TM. The specific location of the resonant peak is averaged to be within the end of the second bend and variously proposed to expand the molecular movements to resemble the real inputs from within the external environment. What is perhaps more relevant is that the resonant peak is used to amplify consonant sounds of language giving them better reproduction within the spectra of noise and competing sounds. Again, this peak at approximately at 2700Hz is good for ease of codified sounds (speech) to be clear and concise and without excessive interference by artifacts.

The main purpose of the external ear canal is to amplify speech/language signals which are a coded expression of communication. The real-world presentation of accompanying sounds is to generate spatial reality from the point of origin of coded sounds.

Variations in the design of the ear canal due to developmental changes, ear surgery, impacting earwax will marginally affect the natural resonant characteristics, and are generally corrected by the action of higher order efferent effects on the impulses within the synapses transiting to the temporal lobe sites. The surgical ear will modify the resonant peak in the external ear canal, usually spreading the spectral image and blurring the clarity of speech sounds. The placement of any type of hearing aid (custom or RIC), also alters the specific position of the resonant peak and changing the natural characteristics causing perceptive changes in the inputs of other accompanying worldly sounds and may cause distraction, and forced attention of the user to process the wanted, from the unwanted elements. The coded sounds of speech will generally retain their spectral integrity. The overall effect will be that of increased stress in the process of understanding speech inputs.

The TM (ear drum) is the center for collating the impacting inputs of energized sound, frequency wise arranged to impact the membrane in a wave like series of impulses that collate at the umbo (the point of connect between the long handle of the malleus bone, and the vibrations transiting through this joint are vastly amplified and the ossicular vibrations are directed through the malleus, the incus bone, the stapes bone, then through the stapedius footplate and a transductive change places the incoming sound into the cochlea as a hydraulic wave train.

The entry of all incoming acoustic energy is through the tympanic membrane vibration in a process that collects and collates all frequency vibrations on the pars flaccida (outer sections), and the umbo (low frequency (center section). The vibrational characteristic of the TM, collects incoming sounds temporally and focuses this energy to add to increase in sound pressure as the second point of processing of these sounds. As long as the malleous bone is still attached at the umbo, the temporal characterization will be reduced but adequate. A perforation in the flaccida (due to rise of bacterial effusion in the ME cavity) will create a loss of higher frequency sound energy and change the real-world relationship of the environmental presentation in the middle ear. Similarly, the resonance of the middle ear cavity occurs approximately at 2000hz and this provides an “envelope” to the ossicles to protect the transmission characteristics for more accurate analysis in the cochlea. A compromise to the resonance, brought about by patulous eustachian tube function, can create breaks in the flow of this mechanical energy, disrupting the continuity of flow that is crucial for language information. Changes in sound perception are felt when flying, and scuba diving. A hearing loss further aggravates this problem.

Let us now objectively understand what can be deviations in the process of the transition of incoming sound right from the TM (eardrum), till the entry of such sounds into the oval window at the cochlea.

The tympanic membrane may be perforated due to an episode of acute middle ear infection. Such a perforation would affect the preset ear canal volume, increasing it due to air connectivity with the middle ear cavity, which is naturally air filled. This increased volume changes the vibratory pattern of the TM, and passes sound energy through the perforation of the TM into the ME cavity which serves no purpose other than to adversely change the conductivity and resonant characteristics of this cavity. The change in perception is quite apparent to the patient.

Submit Manuscript | http://medcraveonline.com

©2017 Muhury. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestrited use, distribution, and build upon your work non-commercially.

The presence of effusion (ME fluid) behind the ear drum will restrict the back and forth vibrational movement causing the smooth transition to the malleus to be affected. The barrier like effect due to effusion, causes a buildup of sound energy at the TM causing muffled, distorted responses and feedback of excessively accumulated sound to the hearing aid. This feedback, besides being of nuisance value, recycles through the microphone of the hearing aid creating distortion during which nothing else is heard.

Repeated infections of the middle ear cavity lead to glue ear like conditions that generate stiffness in the vibratory characteristics that corrupt the incoming signals, causing erratic changes in speech inputs and affect the localization cues that depend entirely on the fidelity of the traveling sound through the ossicles.

Air pressure variations in the middle ear cavity cause changes in the ossicular transmission that lead to fluctuations in hearing. The problem lies in eustachian tube malfunction, and varying autonomic functions due to sinusitis, tympanosclerosis, changes in mucus lining of the eustachian tubes, this directly affects the hearing aid inputs and is the prime reason for return of hearing aids. When the air pressure changes the conductivity with the cavity changes and the sounds change their quality, becoming more high pitched, or becoming more low pitched in their sensations. It's like roller coaster fluctuations in hearing and not acceptable when there is added amplification due to hearing loss.

Dis-articulation of the ossicular joint couplings cause suspension of low input sounds and like spark plug electrode jumps , cause sudden increases of incoming sounds that are definitely distracting, if not painful. Hearing aids are immediately rejected by the user when this happens, and has not been detected.

How can we solve such problems?

The only instrument that we can use to detect abnormal behavior within the middle ear is the TYMPANOMETER. The preceding abnormalities indicated (1-5) are detected as Type B, C, As, Ad, tracings and lead the way for appropriate hearing aid adjustments. The deployment of the tympanometer for resolving these issues makes for better services and satisfaction for the hearing impaired patients.

A summation of ME deviations and hearing aid adjustments are placed below:

i. Disarticulation: Type Ad. Use higher compression at mid frequencies to reduce shock loads due to amplified sounds.

ii. ME stiffness: Type As: Increase mid frequency gain to offset sensations of sudden high pitched sounds.

iii. Type C: Use the average gain principle, and apply low energy and high energy programs separately that can be used when Eustachian tubes create changing pressure profiles.

iv. Type B: increase high frequency inputs, and change prescription formulae to semi linear or linear configurations till the problem is resolved medically.

v. Type A: This indicates normal ME function, and a sensorineural hearing loss. The gain settings must be within +/- 2dbSPL of targets.

vi. Impacted Earwax: Flat tracing noted. Resolve medically.

vii. Type As: with negligible TM mobility indicates a blocked Eustachian tube, this creates own voice issues and leads to immediate hearing aid rejection. Refer to ENT for medical attention. You may try lower amplification settings, with reduced gain at 1000hz to offset negative sensations with own voice.

Acknowledgments

None.

Conflicts of interest

Author declares there are no conflicts of interest

Funding

None.