

2.8

The ossicular chain contributes to the effects of static pressure on middle-ear sound conduction

JJ. Rosowski², ML. Wood¹, Boston; USA^{1,2}

Purpose: Trans-tympanic (between the ear canal and the middle ear) static-pressure differences have long been known to adversely effect hearing. It is generally believed that the primary effect of such pressure differences is to stress the tympanic membrane and ossicular system. Large static stresses (relative to the stresses associated with sounds) strain the mechanical processes that determine the sensitivity to sound with the result that the mobility of the middle- ear sound-conducting apparatus is decreased. Such a decrease in mobility implies a non-linear acousto-mechanical system whose response to sound is modulated by large static stresses and strains. The anatomical locations of the controlling nonlinear processes within the middle ear are not well described.

Materials& Methods: Measurements of middle-ear input admittance and sound-induced umbo velocity were measured in gerbils in which the middle-ear cavity pressure was varied between +/- 25 cm H₂O re ambient pressure. Measurements were made before and after two ossicular modifications 1) interruption of the incudo-stapedial joint, 2) interruption of the bony anterior process of the malleus and the posterior incudo-ligament.

Results: The middle-ear input admittance and the sound-induced umbo velocity in normal ears are differently affected by trans-tympanic static pressures: These two mechanical measurements are most affected by pressures of different polarity. The umbo-velocity vs. static pressure tympanograms also show greater hysteresis than admittance tympanograms in the normal ear. The degree and sign of the asymmetry and the degree of hysteresis are greatly affected by interruption of the ossicular joints and ligaments.

Conclusions: The cochlea and the ossicular ligaments play a significant role in determining how the middle ear responds to sound while under static pressure loads. [Supported by NIDCD]