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**3.7**

**Six years of experience with measurements of tympanic membrane velocity by laser Doppler vibrometry as a clinical diagnostic tool**

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Purpose: Laser Doppler Vibrometry can be used to measure tympanic membrane (TM) velocity in live patients. Since 1999, we have made such measurements in a prospective manner in over 50 normal subjects and over 150 patients with middle- or inner-ear disease in order to determine their clinical utility.

Material and Methods: The laser is focused on the umbo or a target on the TM, and the transfer function of TM velocity to ear canal sound pressure is measured in response to sound stimuli of 300 Hz to 6000 Hz range at intensities up to 90 dB SPL. We can make accurate, safe, repeatable and non-invasive measurements of TM motion within 5 to 10 minutes per ear.

Results and Conclusions:

- (1) We have a normative data base of umbo velocity from 56 subjects with no history of middle ear disease, normal otoscopy, no air-bone gap on audiometry, and air and bone conduction thresholds less than or equal to 20 dB.
- (2) Pre-surgical measurements of umbo velocity were made on 57 ears with fixed stapes, 5 ears with fixed mallei and 16 ears with ossicular interruptions. These pathologies were confirmed at middle ear surgery. Measurements were also made on 28 ears with superior canal dehiscence (SCD), which was confirmed either surgically or by CT scanning. We found that measurements of umbo velocity in conjunction with audiometry allowed reliable, pre-surgical diagnosis of ossicular pathology, and helped to differentiate SCD from ossicular fixation.
- (3) We have made measurements of umbo velocity on 65 ears after stapedectomy, which have provided insight into the mechanics of a stapes prosthesis.
- (4) We have measured TM velocity in 10 ears after type III tympanoplasty (TM graft applied to stapes head), which have enabled clinical differentiation of causes of postoperative air bone gaps such as non-aeration of the middle ear, fixation of the stapes, and loss of contact between the TM graft and stapes head. [Supported by the National Institute on Deafness and Other Communication Disorders, National Institutes of Health, USA]