Abstracts - MEMRO 2006, Zurich July 27-30, 2006
4th International Symposium on Middle Ear Mechanics in Research and Otology

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Measurements of human inner-ear function with superior semicircular canal dehiscence (SCD)

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Purpose: Superior semicircular canal dehiscence (SCD) syndrome is a recently-described clinical condition that offers an opportunity to investigate inner-ear sound conduction in human ears. Patients with SCD show a break in the superior or lateral wall of the bony superior semicircular canal, frequently have oscillopsia and sound- and/or pressure-induced vertigo, and may show a low-frequency conductive hearing loss of as large as 50 dB. It has been hypothesized that the dehiscence introduces a "third window" into the inner ear that shunts acoustical energy into the brain via the semicircular canal (causing the vestibular symptoms) and away from the cochlea at low frequencies (causing hearing loss). Such a shunt is expected to produce (1) sound-induced fluid velocity within the open dehiscence, (2) a reduction in sound-induced round-window velocity by shunting sound-induced fluid velocity away from the cochlea, and (3) an increase in sound-induced umbo and stapes velocities by increasing inner-ear input admittance.

Material and Methods: Middle- and inner-ear mechanics in SCD were explored in a human temporal-bone preparation: stapes, umbo, and round-window velocities were measured in response to air-conducted sound (a) with the inner ear intact, (b) with a dehiscence in the superior canal, and (c) with the dehiscence patched. Sound-induced fluid velocity in the open dehiscence was also measured.

Results: Dehiscences larger than 1 mm2 caused 10–22 dB reductions in round window velocity below 200 Hz (implying a 10– 22 dB hearing loss) and small but statistically significant increases in stapes velocity below 4 kHz and reduced umbo velocity between 0.3–1 kHz. These SCD induced changes were reversed on patching the SCD. Significant sound- induced fluid velocity was observed in the open dehiscence.

Conclusion: Results are consistent with hearing loss and umbo velocity measurements in SCD patients and with the predictions of the "third window" hypothesis. [Supported by NIDCD