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Reply:

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REPLY:

We appreciate the careful reading of our article on high-resolution MR imaging of the human inner ear by Drs Naganawa and Sone.

The Reissner membrane is indeed a very delicate structure, and questioning whether in vivo detection and depiction are possible is certainly justified. Only a few reports on the size and cellular structure of the Reissner membrane of the human cochlea are available. Measurements are based on cadaveric studies, making them prone to underestimation of size and positional changes due to fixation-induced shrinkage.¹ The measurements with micro-CT by Shibata et al,² for instance, were undertaken in still-born fetuses perfused in formalin solution and stored in ethanol solution for 40 years; the Reissner membrane could be visualized in only 1 of 3 fetuses.

In addition to physical size, the chemical makeup of a structure will influence its appearance on MR imaging. Felix et al³ and de Fraissinette et al⁴ studied the morphology of the human Reissner membrane in patients with normal age-related hearing and with sensorineural hearing loss. They reported the presence of melanocytes within the Reissner membrane on the mesothelial side of the basement membrane. The number of melanocytes was highest in the upper half of the basal turn and in the lower half of the middle turn in patients with normal age-related hearing, but pigmentation increased in the middle and apical turns in patients with hearing loss as present in our patient population. We hypothesize that the ferromagnetic melanin may create magnetic field inhomogeneities leading to the structure appearing much larger than its dimensions in high-field MR imaging, so that the Reissner membrane becomes visible—albeit incompletely and mostly only faintly. This phenomenon is very common at high field and indeed forms the basis for visualization of many structures whose physical size is subpixel, such as iron-loaded microglia and plaques in patients with Alzheimer disease.

This phenomenon is supported by the findings of Silver et al,⁵ who reported visualization of this structure at 9.4T MR imaging. We note that there are several discrepancies in this article with respect to the claimed spatial resolution, which does not agree with the image acquisition parameters in the “Materials and

Methods” section. Using the latter, they actually imaged with a resolution of 230 μm rather than 23 μm .

The artifacts indicated by Drs Naganawa and Sone in Fig 2B are also present in Figs 3B and 4 and are described in the article as being the result of B_1 inhomogeneities. Their orientation and regular spacing involving the complete width of the vestibule or basal cochlear turn differ distinctly from the oblique line restricted to the scala vestibuli at the anatomic location of the Reissner membrane.

Unfortunately confirmation by contrast-enhanced FLAIR images is not possible in these patients because all have undergone cochlear implantation in the meantime. However, further improvement of image quality and anatomic verification will be the subject of future investigations in our group.

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