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The effect of cochlear implant electrode insertion on middle ear transfer function as measured by in-vivo laser doppler vibrometry

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Background: Preservation of residual low-frequency hearing with addition of electrical speech processing can substantially improve the speech perception abilities and hearing in noise of cochlear implant users. To utilise preserved low frequency hearing requires an intact middle ear conductive mechanism in addition to inner ear mechanisms. Little is known about the effect of a cochlear implant electrode on middle ear function. Aim: The aim of this study is to investigate the impact of cochlear implant electrode insertion on middle ear low frequency transfer function. Patients and methods: Stapes displacement was measured in seven patients undergoing cochlear implantation. Measurements were carried out intra-operatively before and after electrode insertion. Each patient acted as their own control. Sound was delivered into the external auditory canal via a speaker and calibrated via a probe microphone. The speaker and probe microphone were integrated into an individually made ear mould. Ossicular displacement to a multisine stimulus at 80 dB SPL was measured at the head of stapes via the posterior tympanotomy using an operating microscope mounted laser Doppler vibrometry system. Results: Insertion of a cochlear implant electrode into the scala tympani has a variable effect on stapes displacement. In three patients, there was little change in stapes displacement following the electrode insertion. In two patients there was a significant increase, while in a further two there was a significant reduction in stapes displacement. This variability may reflect differing loss of perilymph associated with the electrode insertion and subsequent alteration of cochlear impedance. Conclusion: Insertion of a cochlear implant electrode produces a change in stapes displacement at low frequencies, which may have an effect on residual low-frequency hearing thresholds.