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P4

Transcranial attenuation of bone conducted sound measured acoustically and psychoacoustically

*S. Reinfeldt¹, S. Stenfelt², B. Håkansson¹,
Göteborg¹, Linköping²; Sweden*

Background/purpose: The transcranial attenuation of bone conducted (BC) sound has been described in several investigations and has been determined from the vibrations of the skull bone or from the BC hearing thresholds. However, these studies report different results.

Methods: Four different methods were used on 20 normal hearing subjects to estimate the transcranial attenuation of BC sound. The ear canal sound pressure (ECSP) and the monaural BC hearing thresholds were obtained with stimulation from a BC transducer at the contralateral and ipsilateral mastoids and at the forehead. All measurements were made both with open and closed ear canal. The transcranial attenuation was determined by relating the result from the ipsilateral stimulation with the result from the contralateral stimulation. The attenuation between the forehead stimulation and the ipsilateral stimulation was determined in the same way.

Results: The transcranial attenuation increases with frequency with all methods. At low frequencies, the methods produced slightly different results. A closed ear canal gives slightly less attenuation than an open ear canal; at frequencies below 500 Hz, stimulation at the contralateral side gives a higher ECSP and a better BC hearing threshold than at the ipsilateral side. For frequencies above 800 Hz, similar results are obtained with all methods and the transcranial attenuation increases from 0 dB at 1 kHz to 15 dB at 8 kHz. The attenuation between stimulation at the forehead and the ipsilateral mastoid is, for all four methods, between 3 and 10 dB at frequencies between 0.7 and 4 kHz. For both higher and lower frequencies, the closed ear canal produces less attenuation.

Conclusions: The result of the transcranial attenuation in this study agrees fairly well with results from studies where the transcranial attenuation was derived from vibrations of the skull bone. The differences are greater for the attenuation between stimulation at the forehead and the ipsilateral mastoid. The relative BC sensitivity can be estimated by the ECSP at frequencies above 800 Hz.

P6