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Middle ear of human and pig: A comparison of structures and mechanics

Abstract:
Animal studies are an essential method to evaluate implants for the middle ear prior to clinical studies. New Zealand rabbits, guinea pigs and chinchillas are, among other small mammals, well established animal models, but their auditory system is significantly smaller compared to human. Hence, the suitability of the domestic pig (Sus scrofa domesticus) as a new animal model for research on the middle ear (ME), that would match the human in size, was investigated. Methods: Thirty halved pig heads were obtained from the butcher and each middle ear was dissected. Using a digital light microscope, several anatomical magnitudes were determined for 24 specimens, namely the planar projected area of the tympanic membrane (TM), in relation to the stapes footplate as well as the dimensions and weight of the ossicles, in order to determine the effective lever ratios. Using normal and micro computed tomography (CT), six porcine temporal bones were scanned and the geometric data obtained were transferred into a finite element model (FEM) simulation of the porcine middle ear. The transfer function was determined and compared to those from humans determined by measurements and simulations, respectively. Results: The anatomy investigated presented itself as highly comparable to that of the human. Differing from literature, no fourth ossicle could be found. The porcine dimensions and lever ratios determined match the humans far
better than those of all established animal models. The obtained transfer function was congruent to the human one. This underlines the suitability of the pig as an animal model for middle ear implants. © 2011 by Walter de Gruyter Berlin Boston.