



## Measurements and finite element modeling of stapes and prosthesis vibration modes following surgical middle ear hearing reconstruction in the cadaveric human ear.

**INVESTIGATOR:** Dr. Manohar Bance  
Ear and Auditory Research Laboratory  
Dalhousie University

Restructuring human hearing is an inexact science; many factors affecting the result. Currently, the acoustic performance of many types of middle ear reconstruction are almost unexplored. There are more than 100 different middle ear prosthesis to choose from, and since there is almost no objective analysis of the important aspects of prosthetic reconstruction for maximal hearing results, surgeons' personal choices usually determine the choice of reconstruction.

Dr. Manohar Bance, Director of Dalhousie University's Ear and Auditory Research (EAR) Laboratory, is striving to make hearing reconstruction a more exact science. His research, unique in Canada, focuses on surgical techniques to repair the middle ear (which has immediate clinical results), the micromechanics and microanatomy of the middle ear, finite element modeling, and innovative hearing technologies.

Dr. Bance's lab is examining surgical procedures commonly used to improve hearing and testing their mechanical efficiency using a realistic model of the living ear obtained from organ donors. These models have very similar vibration characteristics to the surgical or live human ear.

Stapes surgery is commonly undertaken to reconstruct hearing in people with otosclerosis – an abnormal hardening of the bone in the ear causing the third middle ear bone (the stapes) to become fixed, which prevents it from moving, and thus, preventing the transmission of sound from the middle ear to the inner ear. The EAR Lab is investigating the three-dimensional vibration characteristics of the stapes footplate after different kinds of surgical reconstruction. Results to date have yielded specific recommendations and suggestions for surgical techniques that will improve the chances for successful hearing reconstruction.

The research team's results have been published and presented at professional meetings including the Association for Research in Otolaryngology, the Canadian Society of Otolaryngology, the American Otolaryngology Society, the American Academy of Otolaryngology, and the International Symposium on Middle Ear Mechanics.

Dr. Bance is also developing a mathematical (or finite element) model of the reconstructed human ear in conjunction with Dr. Robert Funnell of McGill University. This model will enhance understanding of how the ear works and how to design better diagnostic tests and middle-ear prostheses.

-30-

### **CONTACT INFORMATION:**

Dr. Manohar Bance  
Ear and Auditory Research Laboratory  
Dalhousie University  
Phone: (902)473-7769/494-6375  
Email: M.Bance@Dal.ca



Research Results