EXPERIMENTAL AND ANALYTICAL STUDY OF DISPLACEMENT OF ARTIFICIAL BASILAR MEMBRANE (ABM) PROTOTYPE

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Abstract

In this research, we report and analyze the prototype of artificial basilar membrane (ABM) which works using sinusoidal wave and also various frequency. Design and dimension of the prototype was chosen using trapezoidal shape with 30 mm length and 2 mm to 4 mm width. Experimentally, the vibration of artificial basilar membrane is measured using Laser Doppler Vibrometer (LDV). The main result, the resonance frequencies of the prototype of ABM are showed can be reached in the range of human audio, between 20 Hz to 20 kHz.

Keywords: Artificial basilar membrane, cochlea, resonance frequency, frequency selectivity

1 INTRODUCTION

Hearing is one of the important sense of human to interact each others. One of the important organ of hearing is cochlea. Cochleae are located in the inner ear. In the normal hearing, sound wave from the environment outside the outer ear, travel through the ear canal and strike the eardrum. Vibration of this eardrum causes the three bones that are located in the middle ear vibrate, this vibration will cause the fluid in the cochlear duct fluctuate which are influence the basilar membrane to oscillated [1]. The basilar membrane is one of membrane in the cochlea. This membrane is worked as the frequency selectivity of the sound wave.

At present, the deafuid of cochlear implant consists of two parts, there are implantable stimulating electrodes and an extracorporeal device which are necessary tools in this system. Implantable stimulating electrodes consist of receiver and electrodes. In the extracorporeal device, there are batteries, processor and microphone as shown in Fig 1. This condition is inconvenient for the user. This situation motivates us to develop a fully self contained artificial cochlea. In this research, we report and analyze a prototype of artificial basilar membrane (ABM) analytical and experimental-ly. This ABM is one of the important part in the artificial cochlea.

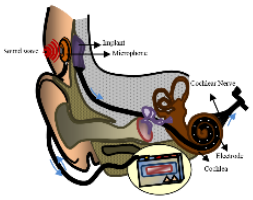

Figure 1. Present Implantable Cochlear

2 MECHANICAL MODEL AND METHODOLOGY

The actual shape of the cochlea is coiled and has a

separated by a flexible membrane structure corresponding to the prototype of ABM.

Thickness of the ABM prototype is 40 μm with the PVDF material. The shape of the membrane is trapezoidal channel with the width of the channel is proportional 2 mm to 4 mm with 30 mm along longitudinal direction as shown in figure 2. The Young's modulus and density of the membrane are 4 GPa and 1790 kg/m^3 respectively. The acoustic wave is generated using a speaker (FORTEX, Japan). Distance between speaker and the prototype is 120 mm. Voltage of the speaker is adjusted using function generator to get the constant sound pressure at 75 and 80 dB. The frequency is controlled from 3 kHz to 20 kHz.