The vibration analysis of bone conduction for bone anchored hearing aids:In-vivo human mastoid

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Abstract

The 3D model of mastoid was reconstructed non-invasively based on the image of in-vivo mastoid reconstructed by computed tomography scan to observe the geometry and the measurements of the mastoid in this study. Then the finite element model was built by ANSYS®. The finite element model included two phases. The first phase was to discuss the natural vibration frequencies and vibration mode of mastoid. The second phase was to investigate the harmonic response. The base center and central line were established in the external auditory meatus and the 0 degree direction, respectively. The amplitude force was applied along central line and 15 degrees direction with distance of 30 mm, 35 mm and 40mm from the center. The amplitude of the bone anchored hearing aids is approximately 550 g excited by the vibrator. The frequency responses and the characteristics of the BAHA vibrator on the mastoid at the frequencies of 125 Hz, 250 Hz, 500 Hz, 750 Hz, 1 kHz, 2 kHz, 3 kHz, 4 kHz, 5 kHz, 6 kHz, 7 kHz, 8 kHz, with sound pressure 20 dB and 70 dB, were discussed. Based on the results of modal analysis of mastoid, the 9 natural frequencies, 125 Hz, 250 Hz, 500 Hz, 750 Hz, 1 kHz, 2 kHz, 3 kHz, 4 kHz and 6 kHz, were similar to the pure-tone stimuli frequency for the clinical hearing test. Based on the results obtained by the harmonic analysis of mastoid, the performance of bone conduction at 35 mm of 15 degrees was better than those at 0 and -15 degrees.

Keyword：Mastoid; Vibration analysis; Finite element method; Computed tomography image