

# STAPEDOTOMY-HOUGH TECHNIQUE TO CORRECT OTOSCLEROSIS

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## Introduction

The stapes, the smallest bone in the human body, is the third component in the tympano-ossicular chain of the middle ear. Otosclerosis is a disease that can cause stapes fixation, resulting in different kind of hearing losses. It is a disorder that involves the growth of abnormal bone around stapes footplate. The tonal and vocal audiometry, tympanometry, and acoustic reflexes, are the most used diagnostic tests. The treatment can be done by amplification with hearing aids or more effective, by surgery. To correct small focus of otosclerosis, Hough, in 1960, suggested the implementation of a technique (Figure 1) in which part of the anterior crura is breached and the posterior one is rotated, getting only the connection between the stapes footplate and the inner ear made through the posterior crura [Glasscock et al., 1995].

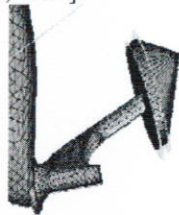


Figure 1: Stapes in the Hough technique.

## Methods

The first step of this work was the creation of the tympano-ossicular chain of the middle ear, eardrum and ossicles (malleus, incus and stapes) including ligaments and muscles based on computerised tomography images. The finite element method was applied using the ABAQUS software [Gentil et al., 2009]. The eardrum is modeled by hexahedral (C3D8) elements and the ossicles by tetrahedral (C3D4), assumed to have isotropic behavior, and with elastic properties obtained by literature [Prendergast et al. 1999]. The ligaments and muscles are modeled using linear elements of type T3D2. Based on the Yeoh model, hyperelastic non-linear behavior for the ligaments is considered, being the Hill model used for the muscle. In this

work, the simulation of surgical technique described above was carried out and the results compared with the ones achieved using a model representative of normal ear and models in which stapes was replaced by stainless steel and teflon prostheses, taking into account the displacements that occur in the central part of stapes footplate.

## Results and discussion

In Figure 2, the stapes footplate displacement is shown, comparing the model of normal ear with models simulating Hough technique and replacement of the stapes by stainless steel and teflon prostheses. One can see that the Hough technique provides the closest results to the normal model, leading to conclude that can be a good option to treat small focus of otosclerosis.

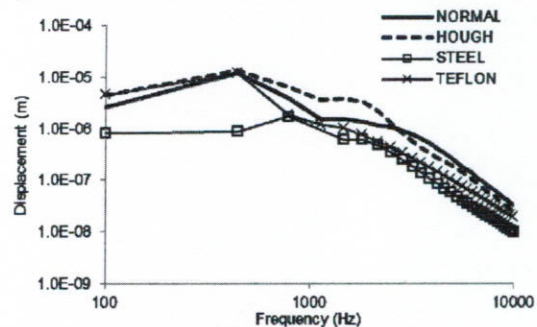


Figure 2: Stapes footplate displacements.

## References

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