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Original Article

A morphometric study of human middle ear ossicles in cadaveric temporal bones of Indian population and a comparative analysis

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ABSTRACT

Introduction: Malleus, Incus and Stapes are the three middle ear ossicles which form an articulated chain and help in conduction of sound from external ear to inner ear. Morphometric study of these ossicles has been going since the early 60s. Although the methods of been changing due to advent of newer technologies and treatments.
Methods: We studied ossicles of 60 temporal bones. The ossicles have been obtained by 'canal-wall down' mastoidectomy technique. They have been measured by an open software, Fiji (https://imagej.nih.gov) where the scale was standardized and set to mm (millimeter).
Results: The mean total length of the malleus is 8.23 mm; a mean angle of 128.76°, mean width of the head 2.56 mm, and mean length of manubrium is 4.17 mm. The mean total length of incus is 7.04 mm, mean angle of 97.23°, mean total width of 5.31 mm, and mean length of long process is 3.27 mm. The mean total height of stapes is 3.44 mm; mean width of the footplate is 1.10 mm and a mean angle of 51.01°.
Discussion: Morphometric data obtained in the present study can be useful for the reconstructive procedures. Preoperative radiological assessment is advised for these small bones. The present study also emphasizes on the future directions where in reconstructive procedures can be improved with the artistic renderings of the blueprints provided, for new prosthetic designs which can be manufactured by using Teflon materials.
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1. Introduction

Jaw components of vertebrates and columella auris of reptiles have rendered themselves to become Malleus, Incus and Stapes respectively in evolutionary process. These 3 small bones are one of the contents of tympanic cavity, which are irregular, and laterally placed in the middle ear.[1,2] They are an articulated chain (Fig. 1) connecting laterally with the tympanic membrane and medially with medial wall of the tympanic cavity which conducts the sound from tympanic membrane to cochlea through oval window.

Knowing the morphometric anatomy of ossicles has become very important in otologic surgeries. In any ear pathology the disease can erode the ossicles causing hearing loss. The aim of the present study is to analyse and establish a morphometric data of ossicles in cadaveric temporal bones of Indian origin and data comparison with ossicles of other origins.

2. Materials and methods

The present study has been carried out on 60 sets of ossicles collected during temporal bone dissection by 'canal wall-down mastoidectomy' technique. Eroded and broken ossicles were excluded from study.

The collected ossicles were cleaned, and photographed, under 6.4 x magnifications using a LEICA microscope 320, with a resolution of 2048 × 1098 pixels. Every photograph has been standardized to 900 × 900 pixels in both width and length.

All the photographs were measured using a software, Fiji (https://imagej.nih.gov) where the scale was standardized and set to mm(millimeter). The analysis has been made accordingly from morphometric data of ossicles.

The parameters taken into consideration are as follows:

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Fig. 1. Middle ear ossicles. M-malleus, I-Incus, S-Stapes.

2.1. Malleus (Fig. 2)

- Total length(A–B): Maximum distance between the top of the head and distal part of the manubrium.
-

Length of manubrium(C–A): Maximum distance from the superior edge of the lateral process to the distal end of the manubrium.

- Angle(MlA)(D–E): Measured between the long axis of the neck and manubrium.
- Total Width of head(F–G): Maximum width of the head.

2.2. Incus (Fig. 3)

- Total length(A–B): Maximum distance between the superior edge of the body and the distal end of the long process.
- Total Width(C–D): Maximum distance between the tip of the short process to the most protruding part of the articular facet.
- Total length of the long process(E–F): Maximum distance between the superior edge and the distal end of the long process measured in long axis.
- Angle(InA): Measured between the inferior edge of the short process and posterior edge of the long process.

2.3. Stapes (Fig. 4)

- Total height(A–B): maximum distance between the top of the head to the footplate.

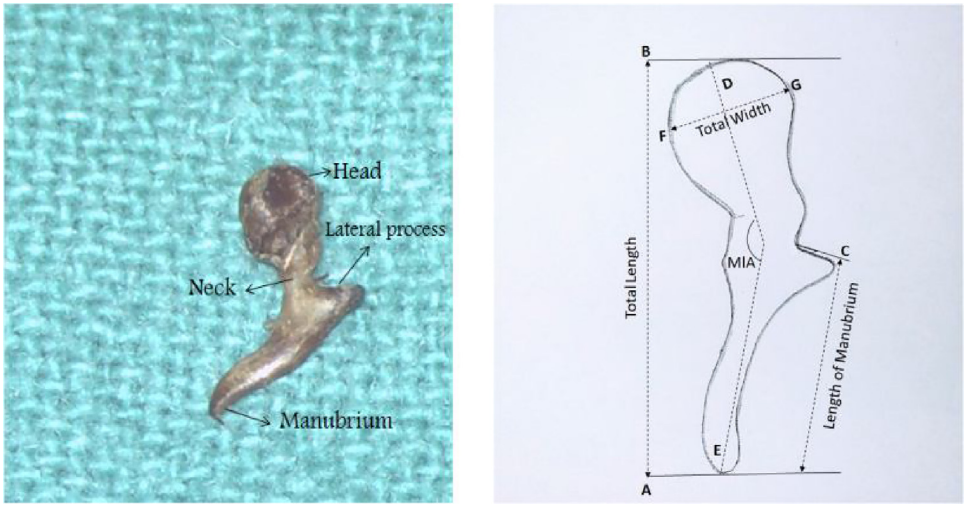

Fig. 2. Malleus and its measurements, MlA-Malleus angle.

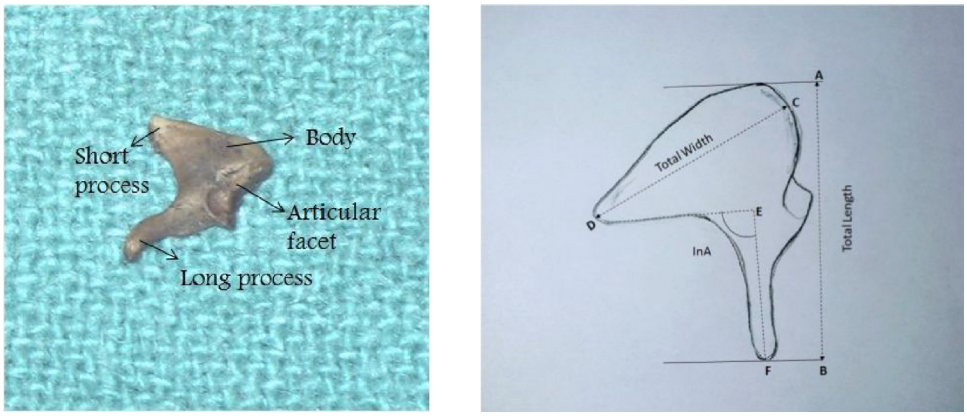

Fig. 3. Incus and its measurements, InA-Angle of the incus.

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