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Research Article

A NEW ULTRASTRUCTURAL STUDY OF HUMAN MALLEUS IMPEDANCE MATCHING, BY SCANNING ELECTRON MICROSCOPE (SEM)

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ABSTRACT

The malleus with special bony structure is a one of the hypersensitive ear ossicles that receives vibrations from the tympanic membrane and transmits this to the incus. Any infection and disease like arthrosclerosis can do unrevert modified the bony structure very soon and finally effect the sound transmits while other side effects like Chronic Otitis media? The objective of this study was to survey ultrastructure of the malleus by Scanning Electron Microscopy images perhaps to know cause of revert modified, for protocol treatments' and micro surgery and prosthesis. In this descriptive type study, 7malleus were taken from the middle ear of 7 male cadavers. A scanning electron microscope equipped (Zise, DSM.940) was used in the experiments. Classical process of fixation for SEM was done. Taking micrograph by 15KV, images were obtained at magnification × 11, × 13 and × 34; and then the dimensions of malleus were studied. The length average of heads: 1.82 mm, width average of head to neck junction: 1.07 mm, width average of base of neck: 1.50 mm, width average of lateral process: 1.79 mm, distance average of end of manuberium form lateral process: 3.99 mm, width average of upper end of manuberium: 1.19 mm, width average of manuberium: 0.74 mm, width average of 1/3 inferior of manuberium: 0.67 mm. also reticular formation with many air cells was seen in bony structure of mallaose. In this study, we open a new approach for ENT specialist for patients treatment, follow up and prosthesis. it seems that special malleuse ultrstructure, and variation on the dimensions of the malleus bone compression other human bony structure will be helpe for one of the cases' of infection Effluence and aquate otitis media or arthrosclerosis' dependent treatment.

Keywords: *Ultrastructure, Human Malleus, Scanning Electron Microscope (SEM)*

INTRODUCTION

The middle ear starts from the tympanic membrane, the epitympanic recess, and the ossicles – malleus, incus, and stapes. The ossicles sense the vibrations of the sound waves on the tympanic membrane, converting and amplifying the energy into mechanical energy, which travels into the inner ear (Hednk-023; Drake *et al.,* 2005; Drake *et al.,* 2005) The malleus (hammer) attaches to the tympanic membrane and articulates with the incus The malleus is one of three ossicles in the middle ear which transmit sound from the tympanic membrane (ear drum) to the inner ear. The malleus receives vibrations from the tympanic membrane and transmits this to the incus [2]: 862 The incus (anvil), is the largest of the ossicles and links the malleus to the stapes. In humans, the cartilaginous bar of the mandibular arch is formed by what are known as Meckel's cartilages (right and left) also known as Meckelian cartilages; above this the incus and malleus are developed (Drake *et al.,* 2005; Drake *et al.,* 2005; Chapman, 2011; Awengen *et al.,* 1995). The intervening part of the cartilage disappears; the portion immediately adjacent to the malleus is replaced by fibrous membrane, which constitutes the sphenomandibular ligament, while from the connective tissue covering the remainder of the cartilage the greater part of the mandible is ossified (Chapman, 2011; Keith, 1998; Federspil, 2001; Asher, 2001). The malleus is a hammer-shaped small

bone or ossicle of the middle ear which connects with the incus and is attached to the inner surface of the eardrum. The word is Latin for hammer. It transmits the sound vibrations from the eardrum to the incus. The malleus is a bone situated in the middle ear. It is the first of the three ossicles, and attached to the tympanic membrane. The head of the malleus is the large protruding section, which attaches to the incus. The head connects to the neck of malleus, and the bone continues as the handle of malleus, which connects to the tympanic membrane. Between the neck and handle of the malleus, lateral and anterior processes emerge from the bone [2]: 862. The malleus is unique to mammals, and evolved from a lower jaw bone in basal amniotes called the articular, which still forms part of the jaw joint in reptiles and birds [3]. Embryologically it is derived from the first pharyngeal arch along with the rest of the bones of mastication, such as the maxilla and mandible (Keith, 1998;). The malleus is one of three ossicles in the middle ear which transmit sound from the tympanic membrane (ear drum) to the inner ear. The malleus receives vibrations from the tympanic membrane and transmits this to the incus [2]:862

MATERIALS AND METHODS

In this descriptive type study, 7malleus were taken from the middle ear of 7 male cadavers. Surfaces of each malleuse were cline and dray in lab. ovens (700 f.). The slides were cut and mounted on 12.5 mm stubs. 3–5 nm layer of gold was evaporated onto the surface of the sample. Scanning electron microscope equipment (Zise, DSM.940) was used in this study. Classical process of fixation for SEM was done. Taking micrograph by 15KV, images were obtained at magnification × 11, × 13 and × 34; with 3.6 mm working distance and then the dimensions of malleus were measured by computer.

RESULTS AND DISCUSSION

Results

The ultra structure study, did show that malleuos ossicles has a reticular structure (Figure 1) in the all of malleuos surface did show cribriform pleat that related with reticular structure.

Inside of the bone include many air Cells (Figure 2). Although in outer surface of these Ossicles located few oval foramina that has very regular structure, it Semmes that this foramen that thought created for passing nutrition vessels so we can suggested is nutrition foramen (Figure 2). The length average of heads: 1.82 mm, width average of head to neck junction: 1.07 mm, width average of base of neck: 1.50 mm, width average of lateral process: 1.79 mm, distance average of end of manuberium form lateral process: 3.99 mm, width average of upper end of manuberium: 1.19 mm, width average of manuberium: 0.74 mm, width average of 1/3 inferior of manuberium: 0.67 mm.

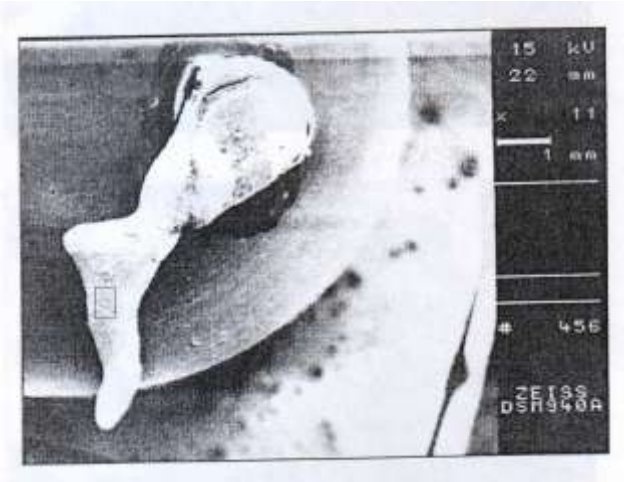

Figure 1: Macro anatomy view of Malleous.X 11

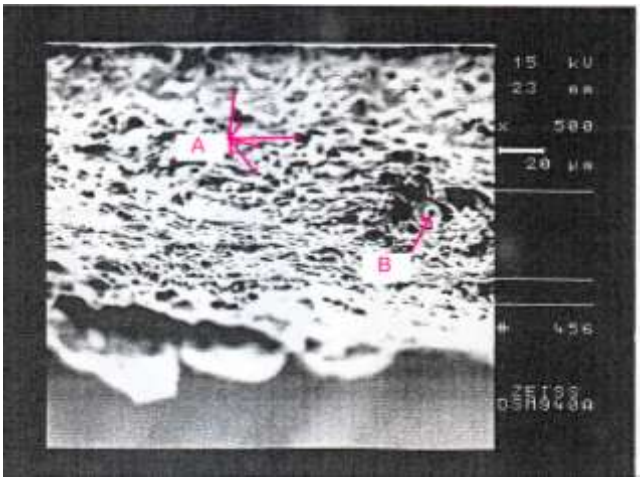

Figure 1: Ultra morph structure of Malleuse (500 Magnification). Cribriform surface of this Ossicle (A) and oval foramen structure (B) is show

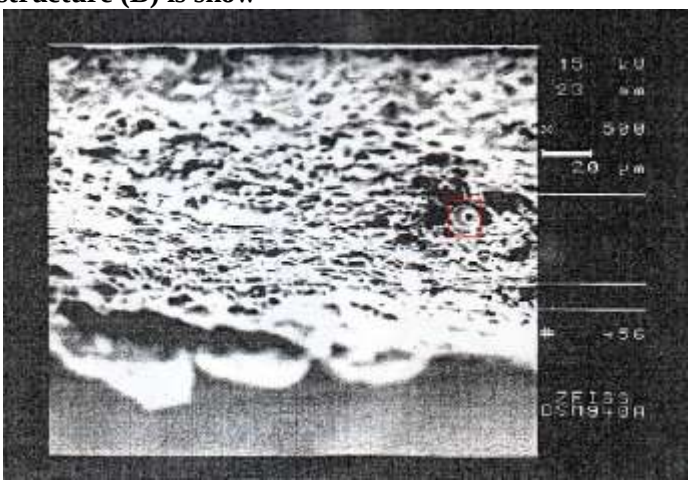

Figure 2: Oval foramina structure show in a quadrangle cadre. X 500

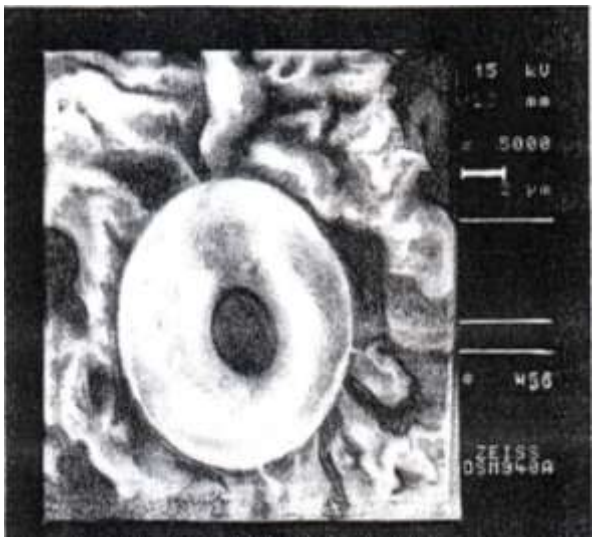

Figure 3: Ultra structure view of oval foramina structure in the outer surface of malleous. X 5000

Discussion

The result of this study demonstrated that the malleuse ultrstructure open a new approach for ENT specialist for patients treatment , fallow up and prosthesis. because this finding show the special structure in outer surface and internal structure of this ossiclese to increase variation on the dimensions of the malleus bone compression other human bony structure. In addition, the researchers report several significant findings from the study. The malleus is clearly human-like, and its size and shape can be easily distinguished from our closest living relatives, many aspects of the skull, teeth and skeleton in these early human ancestors remain quite primitive and ape-like, but the malleus is one of the very few features of these early hominins that is similar to our own species, Homo sapiens. Since both the early hominin species share this human-like malleus, the anatomical changes in this bone must have occurred very early in our evolutionary history. Says Quam, "Bipedalism (walking on two feet) and a reduction in the size of the canine teeth have long been held up as the "hallmark of humanity" since they seem to be present in the earliest human fossils recovered to date (Wijhe, 2000).

However in another research the study analyzed the tiny ear bones, the malleus, incus and stapes, from two species of early human ancestor in South Africa. The ear ossicles are the smallest bones in the human body and are among the rarest of human fossils recovered (Hednk-023; Drake *et al.*, 2005; Ramachandran and Blakeslee, 1999; Chapman, 2011).

Unlike other bones of the skeleton, the ossicles are already fully formed and adult-sized at birth. This indicates that their size and shape is under very strong genetic control and, despite their small size, they hold a wealth of evolutionary information (Batman *et al.*, 2001; Willi *et al.*, 2002; Ramachandran and Blakeslee, 1999).

In another study suggested that the list may need to be updated to include changes in the malleus as well. More fossils from even earlier time periods are needed to corroborate this assertion, says Quam (Federspil *et al.*, 2001; Batman *et al.*, 2001; Decraemer *et al.*, 2003; Asher, 2001). In contrast to the malleus, the two other ear ossicles, the incus and stapes. The ossicles, then, show an interesting mixture of ape-like and human-like features (Drake *et al.*, 2005; Drake *et al.*, 2005; Decraemer *et al.*, 2003).

Conclusion

Based on the obtained evidence and data, it suggest that the new anatomical ultra structure finding in humans ear ossicles for example existence of reticular structure, cribriform pleat and round nutrition foramina can guide us to have a new idea and approach in Cochlear implantation, patients treatments, vestibulocochlear disease and surgical complications also. This funding may be will be help for one of the cases' of infection Effluence and aquate otitis media or arthrosclerosis' dependent treatment..

REFERENCES

Batman C *et al.*, (2001). Cochlear implantation: patients, problems and surgical complications, *Turk Otolarengoloji Arsivi- Turkish Archives of Otolaryngology* 39(2) 1-7.

Chapman SC (2011). Can you hear me now? Understanding vertebrate middle ear development. Frontiers in bioscience (Landmark edition) 16 1675–92.

Daniel F Awengen *et al.*, (1995). Measurements of the stapes super structure. *Annals of Otology, Rhinology and Laryngology* **104**.

Daniel J Kelly *et al.*, (2001). An investigation of middle-ear biomecanis using finite element modeling, BED 50 bioengineering conference, *ASME*.

Decraemer WF *et al.*, (2003). Three dimensional modeling of the middle-ear ossicular chain using a commercial high resoulution X-ray ct scanner, *JARO* 04 250-263.

Federspil PA *et al.*, (2001). Robotik , dimension in der HNO-Heilkude, Springer-Verlag 49 505-513.

Funnell WRJ (1996). Finite-element modeling of the cat middle ear with elastically suspended malleus and incus, 19th mid winter Research Management, *Journal of the Association for Research in Otolaryngology*, St-Petersburg beach.

Hednk-023 (No Date). Embryo Images at University of North Carolina.

Jacopo Moggi-Cecchi (2013). Early hominin auditory ossicles from South Africa.
Moore Keith (1998). The developing human: clinically oriented embryology, Saunders, Embryo Images at University of North Carolina) 507.
Peter L Williams (1995). Gray's anatomy, Churchilliving stone 1375.
Ramachandran VS and Blakeslee S (1999). Phantoms in the Brain. Quill 210.
Ramachandran VS and Blakeslee S (1999). Phantoms in the Brain. Quill 210.
Rene G Van Wijhe (2000). A finite-element model of the middle ear of the monstched bat, thesis for master of engineering degree, faculty of graduate study, Mc Gill university, Montreal.
Richard L Drake, Wayne Vogl A, Adam WM Mitchell and Richard Tibbitts (2005). Illustrations by Richard Richardson, Paul, Gray's anatomy for students. Philadelphia: Elsevier/Churchill Livingstone.
Richard L Drake, Wayne Vogl A, Adam WM Mitchell and Richard Tibbitts (2005). Illustrations by Richard Richardson, Paul, Gray's anatomy for students. Philadelphia: Elsevier/Churchill Livingstone.
Richard L Drake, Wayne Vogl A, Adam WM Mitchell and Richard Tibbitts (2005). Illustrations by Richard Richardson, Paul, Gray's anatomy for students. Philadelphia: Elsevier/Churchill Livingstone.
Robert J Asher (2001). Cranial anatomy in tenercid insectivorans: character evolution across competing phylogenies, published by the American museum of natural history central park west.
Rolf M Quam, Darryl J de Ruiter, Melchiorre Masali, Juan-Luis Arsuaga, Ignacio Martínez and Urban B Willi *et al.*, (2002). The incudo malleolar joint and sound transmission losses, *Hearing Research Journal* 174 32-44.