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MORPHOLOGICAL VARIATIONS OF STAPES IN MALE CADAVER

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ABSTRACT

The transmission of sound waves across the tympanic cavity is mediated by three auditory ossicles which include; malleus, incus and stapes in a latero-medial sequence. These auditory ossicles transfer the sound vibrations in the tympanic membrane from the middle ear to the inner ear. They are located in the petrous part (pars petrosa) of the temporal bone and in the dorsal aspect of the tympanic membrane and form a chain across the tympanic cavity from tympanic membrane to fenestra vestibule (oval window). The study was aimed at providing the morphological variations of stapes in male cadaver. The middle ear of 20 adult male cadavers from the Department of Anatomy of various Universities in Nigeria were dissected bilaterally and 27 Stapes (R=10, L=17) were obtained to investigate their morphologic characteristics. The morphologic observations on the stapes showed different variations of all, one stapes did not have foramen obturatum. The knowledge of the variations of the stapes will provide insight for the surgeons during ear surgery which may have been congenitally absent, malformed, fixed, disrupted or destroyed by trauma or diseases.

KEYWORDS: Stapes, Ossicles, morphology.

INTRODUCTION

Ear is an organ that exhibits complicated organization in all organisms in terms of its anatomical and functional features.[1] The Ear plays an important role in body balance.[2,3,4&5] The transmission of sound waves across the tympanic cavity is mediated by three auditory ossicles which include; malleus, incus and stapes in a latero-medial sequence.[6&7] Auditory ossicles transfer the sound vibrations in the tympanic membrane from the middle ear to the inner.[8&9] The stapes is located in the petrous part (pars petrosa) of the temporal bone and in the dorsal aspect of the tympanic membrane.[10,11&12] The stapes consists of head (caput stapedis), neck, two legs (crus anterior and crus posterior) and footplate (basis stapedis). Whereas the head of the stapes articulates with the lenticular apophysis of the incus in a shallow, ball-and socket cartilaginous joint, the footplate has a fibrous articulation with the rim of the oval window by means of the annular ligament.[13,14&15]

Globally, over 5% of the world population (430 million) require improvement to address their disabling hearing loss (432 million adults and 34 million children).[16] W.H.O estimated that by 2050, 2.5 billion people worldwide or one in four people will be living with some degree of hearing loss. Nearly 80% of people with disabling hearing loss live in low and middle-income countries and Nigeria with the largest population in Africa falls into this category.[16] Therefore, Nigeria needs more than 32 million hearing aids per year.[16]

Many congenital malformations of the stapes have been reported to cause hearing problems.[17,18,19&20] To restore appropriate sound transmission, ossicular chain reconstruction has to be perform using delicate alloplastic titanium prostheses.[21,22] by the otolaryngologists which can bring a significant improvement in conductive hearing loses due to ossicular erosion.[23,24]

MATERIALS AND METHOD

The study was carried out on 27 Stapes (R=10, L=17) from 20 unidentified adult male cadavers from the Department of Anatomy of various Universities in Nigeria.

The stapes were obtained manually after dissection of the petrous part of temporal bone using Cobbler's Cut Method.[25] The head of the cadavers were severed first from their bodies using handsaw for easy maneuvering then the calvaria was removed and the brain taken out to expose the petrous part of the temporal bone. Removal of the intact temporal bone from the skull was done by opening the zygomatic-temporal suture using a chisel.[26] The chisel was placed through the parieto-temporal suture and pushed on the lateral side making the

temporal bone rid from the skull. The temporal bone were placed in an upright position with the squamous part as its base and the petrous part as apex. The chisel was placed between the squamous part and the petrous part of the bone and hit gently with a hammer till the time there appears a crack (cobbler's cut) in between the two parts of the temporal bone.

Then with precise and gentle manual force these two portions were easily separated in two unequal halves of the middle ear; the lateral and medial parts. The lateral part bears the tympanic membrane and two ossicles (malleus and incus) while the medial part bearing the stapes. The stapes were easily picked up from the exposed parts with fine forceps cleansed and dried. Photographs were taken with a digital camera.

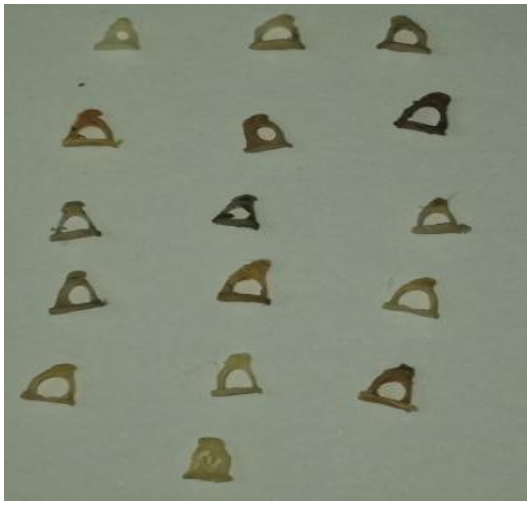

Fig 1: Diagram showing harvested Stapes.

RESULTS

In this study, the morphological data were based on observation (fig. 1). The Stapes had maximum morphological variations in the middle ear ossicle. The variations of stapes were in the hole (foremen obturatum), neck and the cruses (fig. 1). The hole of stapes (foremen obturatum) was circular, oval, triangular, tunnel shaped and without hole (fig. 2). The stapes had no neck, a short or a long neck (fig. 3). The cruses of the stapes had symmetry or asymmetry (fig. 4).

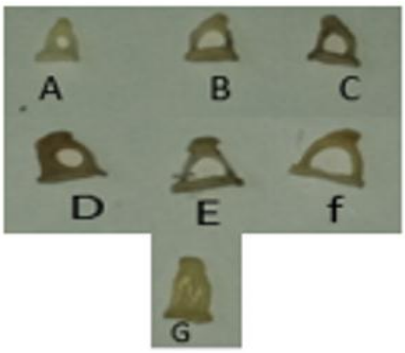

Fig. 2: The hole variations of the stapes. The circular hole (A & C), oval hole (D), triangular hole (E), tunnel shape (B & F) or without hole (G).

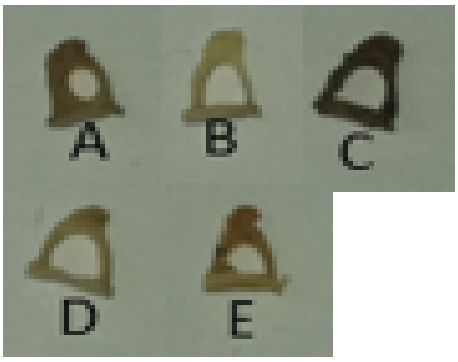

Fig. 3: The neck variations of the stapes. The stapes without neck (A), with long neck (B & E) and short neck (D).

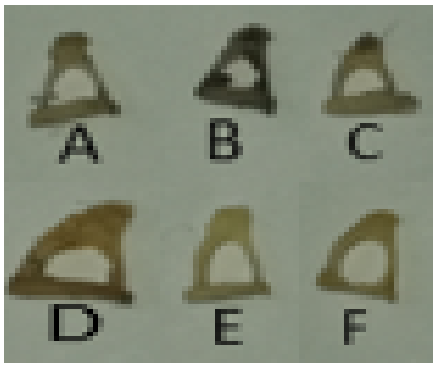

Fig. 4: The cruses variations of the stapes. The stapes had symmetry (A, B & C) and asymmetry (D, E & F) cruses.

DISCUSSION

There are general anatomic explanations about the middle ear ossicle in anatomy textbooks. However, there are few studies in the literature on individual differences in these ossicles and these studies were on either adult or different species.[27] Congenital malformations of middle ear ossicles can cause hearing problems. The aim of middle ear surgery is to eradicate a disease or improve hearing, or often a combination of both. This way, middle ear surgery can have a substantial positive impact on a patient's quality of life. On the other side, middle ear surgery can be associated with a number of severe complications such as hearing impairment and deafness.

It was found in the present study that the stapes had variations.[28] These variations could be in the neck, the cruses and the foremen obturatum of the stapes. In addition to these variations, a stapes without the hole (foremen obturatum) was found in the present study. As a result, it could be concluded that the stapes had most variations in view of morphological variations.

CONCLUSION

The middle ear diseases and surgery can be associated with a number of complications; the most important ones being hearing deterioration or deafness, dizziness, facial palsy and life-threatening intracranial complications. To minimize risks, a solid knowledge of and respect for

neurootologic structures is essential for an otosurgeon who must train him or herself intensively on temporal bones before performing surgery on a patient. The knowledge of the variations of the stapes will provide insight for the surgeons during ear surgery which may have been congenitally absent, malformed, fixed, disrupted or destroyed by trauma or diseases.

REFERENCES

1. Erdogan, S. & Kilinc, M. Gross anatomy and arterial vascularization of the tympanic cavity and osseous labyrinth in mid-gestational bovine fetuses. *Anatomical Record*, 2010; 293: 2083-2093.
2. Ramirez, L. M. & Ballesteros, L. Anthropometry of the Malleus in Humans: A Direct Anatomic Study. *International Journal of Morphology*, 2013; 31(1): 177-183.
3. Mason, M. J. Evolution of the middle ear apparatus in Talpid moles. *Journal of Morphology*, 2006; 267: 678-695.
4. Kenji, H., Du, Y., Shimizu, Y. & Puria, S. Ossicular resonance modes of the human middle ear for bone and air conduction. *Journal of Acoustical Society of America*, 2009; 125(2): 968–979.
5. Huttenbrik, K.B. The mechanics and function of middle ear. Part I: The ossicular chain and middle ear muscles. *Laryngo-rhino-otologie*, 1992; 71: 545-51.
6. Dyce, K. M., Sackand, W. O. & Wensing, C. J. G. Textbook of veterinary anatomy. 2nd ed. Philadelphia, USA Saunders, 1996; 342-345.
7. Mogra, K., Panwar, L. & Shekhawat, S. Morphological and morphometrical variations of incus in human cadavers. *International Journal of Medical Research*, 2015; 2: 11–13.
8. König, H. E. & Liebich, H. G. Veterinary Anatomy of Domestic Mammals: *Textbook and Color Atlas.* 3rd edition. Schattauer Co, Stuttgart, Germany, 2007; 595–601.
9. Standring, S. *Gray's Anatomy*. 40th Ed; Elsevier Churchill Livingstone, 2005; 627-630.
10. Sarrat, R., Torres, A. & Guzman, A.G. Functional structure of human auditory ossicles. *Acta Anatomica*, 1992; 144: 189-195.
11. Sodhi, S., Singh, Z. & Davessar, J. L. A study on morphological variations of middle ear ossicles. *Journal of Advanced Medical & Dental Science Research*, 2017; 5(5): 1–7.
12. Kurtul, I., Cevik, A. & Bozkurt, E. U. A detailed subgross morphometric study on the auditory ossicles of the New Zealand rabbit. *Anatomia Histologia Embryologia*, 2003; 32(4): 249-252.
13. Rathava, J., Trivedi, P. & Kukadiya, U. Morphometric study of malleus in gujrati population. *International Journal of Advanced Research*, 2015; 3(3): 306- 310.
14. Wadhwa, S., Kaul, J. & Agarwal, A. Morphometric Study of Stapes and its Clinical Implications. *Journal of Anatomical Society of India*, 2005; 54(2): 7-12.
15. Dass, R., Grewal, B. S & Thapar, S. P. Human stapes and its variations. I. General features. *Journal of Laryngology & Otology*, 1966; 80(1): 11–25.
16. World Health Organization (3rd March, 2021). World Hearing Day: Hearing care for all! Screen, rehabilitate, Communicate. *http//:www.vanguardngr.com/2021/03/hearing-loss-center-tasks-Nigerians on regular checks*.
17. Evcimik, M.F., Ozkurt, F. E. & Ahmet, K. The morphological findings of malleus and incus in a case of Marfan's syndrome. *The laryngoscope*, 2012; 122: 389-392.
18. Bruintje, T. D. The auditory ossicles in human skeletal remains from a leper cementry in Chichester, England. *Journal of Archaelogical Science*, 1990; 17(6): 627-633.
19. Møller, A. R. Hearing: Anatomy, Physiology, and Disorders of the Auditory System. 3rd ed. Amsterdam, the Netherlands: San Diego Plural Publishing, 2012; 415.
20. Aziz, A. & Daud, M. K. Primary middle ear tuberculosis mimicking cholesteatoma. *Malaysian Family Physician*, 2020; 15(1): 44-46.
21. De La Cruz, A. & Doyle, K. J. Ossiculoplasty in Congenital Hearing Loss. *Otolaryngologic Clinics of North America*, 1994; 27(4): 799-811.
22. Lord, R. M., Mills, R. P. & Abel, E. W. An anatomically shaped incus prosthesis for reconstruction ossicular chain. *Hearing Research*, 2000; 145: 141-148.
23. Kartush, J. M. Ossicular chain reconstruction: capitulum to malleus. *Otolaryngologic Clinics of North America*, 1994; 27: 689-715.
24. Prendergast, P. J, Ferris, P. & Ric, H. J. Vibroacoustic modeling of the outer and middle ear using the nite element method. *Audiology & Neuro-otology*, 1999; 4: 185-191.
25. Singh, K., Sirohiwal, B. L., Rohilla, A., Chhabra, S. & Gupta, G. Cobbler's cut: An Innovative Technique for Middle Ear Dissection. *Journal of Forensic Research*, 2014; 5: 222.
26. Sodhi, S., Singh, Z. & Lal, J. Morphometric dimensions of human ear ossicles of males. *National Journal of Medical Research*, 2017; 7(1): 47-51.
27. Arrensburg, B., Harell, M. & Nathan, H. The human middle ear ossicles, morphometry and taxonomic implications. *Journal of human Evolution*, 1981; 10: 199-205.
28. Sarrat, R., Guzman, G. & Tores, A. Morphological variations of Human ossicula tmpani. *Acta Anatomica*, 1988; 131: 146-149.