# Absence of both stapedius tendon and muscle

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## ABSTRACT

During surgery for otosclerosis, it is common for the surgeon to cut the stapedius tendon. The absence of the stapedius muscle with its tendon is uncommon. In this study, we present a case of the absence of the unilateral stapedius tendon and muscle. During dissections of adult temporal bones, the absence of the stapedius tendon and muscle was found in one case. The tympanic cavity was explored with the help of a surgical microscope. The pyramidal process was not developed. A possible ontogenetic explanation was provided. In the presented case, the cause of the anomaly may be failure of the embryological development of the muscle. Awareness of the variations or anomalies of the stapedius muscle and tendon are important for surgeons who operate upon the tympanic cavity, especially during surgery for otosclerosis.

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The congenital ear anomalies, which have many different types, may be divided into major and minor anomalies.[1,2] The major congenital anomalies involve the malformations of the middle ear, external meatus and the auricle, while the minor congenital anomalies are restricted to the middle ear. It has been stated that congenital malformations of the middle ear have been described in association with various head and neck anomalies,[1,3] while the isolated middle ear anomalies may present with only conductive hearing loss and are rarely encountered during surgery. Also, these anomalies could be identified only during surgical explorations.[1,3] The anatomy textbooks report that the normal stapedius muscle extends from the wall of a conical cavity in the pyramidal eminence; its tendon passes forwards through the apex of the pyramid to the neck of the stapes.[4] The stapedius and the tensor tympani contract together in a reflex response for sounds of high intensity, and the stapedius pulls the footplate of the stapes for decreasing the amplitude of vibrations at the oval window. It also prevents the excessive movement of the stapes.[4,5] The stapedius muscle may be doubled or ectopic,[6,7] or the muscular unit may be absent,[6-8] and its tendon may ossificate.[8] The middle ear variations have a reported incidence of approximately 5.6%.[6] The incidence of the absence of the tendon of stapedius is 0.5%.[9] There are limited literature reports on the absence of the stapedius muscular unit,[8,10] and so, the absence of this muscular unit can be confused with the other anomalies or pathological conditions. During surgery for otosclerosis, cutting of the stapedius tendon is common.[11] The anatomic variations or anomalies of this muscle have recently become significant because of new imaging techniques such as CT and MRI. We present this rare case with the aim of defining the different anatomic features of the stapedius in relation to clinical diagnosis and for surgical procedures.

**Case Report.** During practical courses on dissections, the congenital absence of the stapedius tendon and muscle was found in the right middle ear in one case (**Figures 1 & 2**). The dissection was performed on the formalin fixed adult temporal bones obtained from the cadavers at the Departments of Anatomy of separate Medical Schools in Turkey, sex

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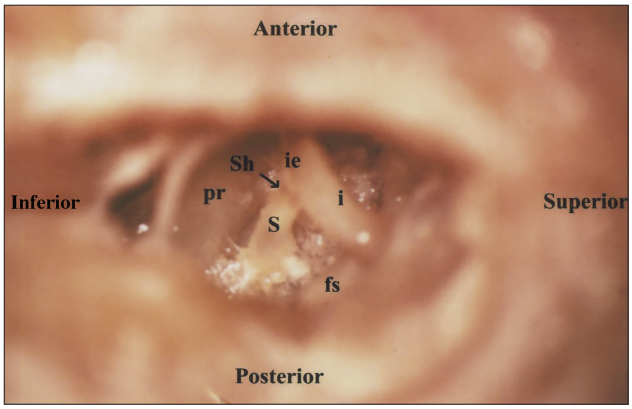


**Figure 1 -** View of exploration of the right middle ear with absence of the stapedius tendon and muscle. i - the long process of the incus, fs - intratympanic part of the facial nerve, S - posterior limb of the stapes, pr - promontory, ie - incudostapedial joint, Sh - head of the stapes.

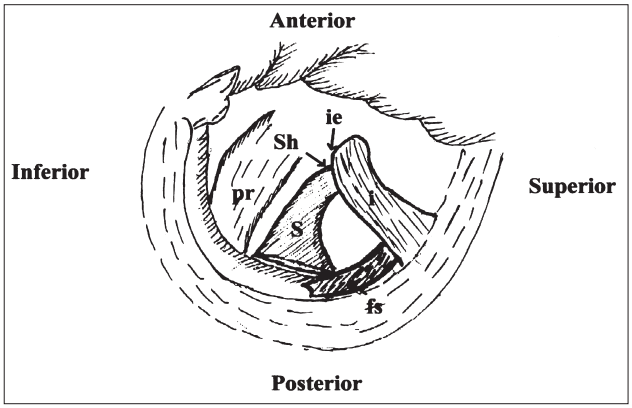


**Figure 2 -** Schematic diagram of the Figure 1. i - the long process of the incus, fs - intratympanic part of the facial nerve, S - posterior limb of the stapes, pr - promontory, ie - incudostapedial joint, Sh - head of the stapes.

and age were unknown. It is not known whether the adult cadavers have any other craniofacial or head and neck anomalies. The tympanic cavity was explored with the help of a binocular operating microscope (Opmi 1 Zeiss) using the stapes surgery technique performed in otosclerosis. The entrance of the middle ear was performed by permeatal tympanotomy. An incision was made from the 6 o'clock position directly lying into the meatus. A second incision was made immediately above the short process of the malleus, and this incision met with the outer end of the first incision. The fibrocartilaginous tympanic annulus is reflected out of the bony sulcus. The chorda tympani was cut. Sufficient meatal bone was removed to expose the pyramid, stapedius tendon, and the stapedial footplate. The middle ear cavity was normally sized. The malleus, incus and stapes were intact and mobile, however, the long process of incus was thickened and was positioned more anteriorly. The pyramidal process was not well developed. The location of the facial nerve, tympanic membrane, external auditory canal, and eustachian tube appeared normal, and the footplate and oval window was present. It had normal appearance of the incudostapedial joint. The stapes was soft. The stapedius muscle and tendon were absent. There were no tendinous fibers connecting the stapes head to a not well developed pyramidal process (**Figures 1 & 2**).

**Discussion.** The congenital middle ear anomalies of many cases have been reported by Hough and Herman.[1,12] A number of variations or anomalies of the stapes bone have also been described.[1,2] The absence of both the stapedius tendon and muscle appears to be a rare congenital malformation of the middle ear. The incidence of the absence of the stapedius tendon has been reported as 0.5%.[9] Hough[12] reports 5 cases of total absence of the stapedius muscle in his series. Magnuson et al[13] found the absence of the stapedius muscle; in his case few tendinous fibers connected the stapes head to a well-developed pyramidal process. Djeric and Savic[9] described the absence of the stapedius tendon in association with the deformation of the stapes in one case. According to Bergman,[6] the incidence of the middle ear variations is 5.6% (28/500); the stapedius muscle may be doubled or absent or its tendon may fail to develop. In Bergman's series,[6] ectopic muscle have been found in 19/500 bones near the facial nerve, and are believed to be derived from mesenchyme originating from the hyostapedial ligament. Other reports show that the isolated absence of the total stapedius can be considered as a relatively rare variant.

In the present case, the middle ear has neither the stapedius tendon, nor the muscle. The long process of incus was thickened and more anteriorly positioned. The pyramidal process was not well developed. The tendon is of special interest with the absence of its muscle belly. While our case did not show other major or minor middle ear anomalies, it is not known whether our case had neck and head anomalies. In other reports, this anomaly has been frequently described in association with other middle ear malformations. Very few cases of the absence of the stapedius tendon and muscle have been reported in the English medical literature.[10,12]

A brief review of the embryology of the ossicles and stapedius muscle is essential in understanding this anomaly. The ossicular chain and their attachment develop from the mesenchyme of the first (mandibular) and second (hyoid) branchial arches.[1,8] At the 4th week of gestation, the development of the

stapes begins with a concentration of mesenchymal cells at the second branchial arch adjacent to the facial nerve. During the 5th week, stapedial blastema is represented by a dense mesenchymal ring that is formed around the stapedial artery.[8] At the same time, the facial nerve forms a fissure on the blastema of stapes, and by this, a separation is formed for the stapes primordium into the stapes proper and the laterohyale, which are bridged by the interhyale.[8,14]At the end of the second month, the primordium of the stapedius muscle appears close to the artery and facial nerve.[4] At 9 weeks, the stapedius muscle develops as a condensation of blastema cells in the mesenchyma at the interhyale in the second arch. The stapedius tendon is formed from the remainder of the interhyale. Moreover, the interhyale contributes to the development of the anterior wall of the facial nerve canal, as well as the pyramidal eminence.[8,14]The bone of the pyramidal eminence housing the muscle derives from the pre-cartilaginous cells of the hyoid arch. These 3 histologically different groups ultimately fuse to form the muscular unit.[7]The origin of the stapedius muscle is the fasciculi of the posterior belly of the musculi digastrici. The digastric muscle reaches the eminence of the mastoid process, gives a fiber group of muscle into the tympanic cavity, passing through the stylomastoid opening and approaching the neck of hummer to form the stapedius muscle, hence, the same innervation of both muscles from the facial nerve.[4,15]

We believe that the absence of the stapedius tendon and muscle is due to the fact that blastema cells are not concentrated enough at the interhyale, or 3 different groups described above do not completely fuse. Additionally, the probable cause of this anomaly may be that the musculi digastrici posterior belly does not pass the muscle fasciculi to the pyramidal eminence or into the tympanic cavity.

The absence of the stapedius may cause the inhibited movements of the stapes. The stapedial reflex is important for protection against hazardous levels of noise, and for improving intelligibility of speech in the presence of background noise.[4,5,11] Anatomic variations of the tendons and muscles of the middle ear may easily be confused with pathologic conditions in CT and MR imaging. All diagnostic, or surgical procedures, or both, involving the middle ear, require a careful approach because of possible variations of the stapedius muscle. Finally, even though these anomalies are rare, knowledge of their existence is important in interpretations of images taken by CT and MR, and for procedures in the treatment of pathologies of this region.

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