Congenital Incus Fixation to the Fallopian Canal

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**IMPORTANCE** An isolated congenital anomaly of the ossicular chain is a rare finding in an ear that, otherwise, appears clinically normal. The most common congenital ossicular anomaly is fixation of the stapes footplate. The least common congenital ossicular anomaly is isolated incus fixation, with only a few reported in the literature.

**OBSERVATIONS** We describe a woman in her 50s with a long history of left-sided hearing loss and unremarkable neurologic findings aside from a tuning-fork examination result suggestive of left-sided conductive hearing loss. Intraoperatively, she was found to have isolated fixation of the incus to the fallopian canal. The incus–fallopian canal fixation was separated, and an autologous bone graft was placed between the lenticular process and stapes capitulum to create elevation and prevent refixation. One month postoperatively, an audiogram revealed a nearly complete air-bone gap closure.

**CONCLUSIONS AND RELEVANCE** Patients who present with conductive hearing loss, normal physical examination findings, and an apparent normal radiograph are generally assumed to have otosclerosis. This case illustrates an unanticipated unique anomaly that was surgically corrected by releasing the bony fixation of the incus to the fallopian canal and placing an autologous bone graft at the incostapedial joint.


A woman in her 50s was evaluated for a long history of left-sided hearing loss. She reported a recent history of air travel that resulted in several weeks of left-sided aural fullness, pressure, and slightly decreased hearing, all of which resolved after the use of a systemic decongestant. She denied any history of ear disease, otologic surgery, and significant head trauma, and there was no family history of hearing loss. The patient’s neurotological examination findings were unremarkable except for the tuning fork test result, which suggested a left-sided, mild-moderate conductive hearing loss. An audiogram revealed a left-sided moderate mixed hearing loss with a 20-dB pure-tone average air-bone gap, 92% word recognition, and normal tympanometry (Figure 1A). There was mild sensory hearing loss on the right with 100% word recognition and normal tympanometry. High-resolution computed tomography (HRCT) of the temporal bone failed to demonstrate any abnormalities of the ossicular chain or otic capsule (Figure 2). The patient was provided the options of either middle ear exploration for possible correction of an ossicular chain abnormality or placement of a hearing aid.

Middle ear exploration was performed, and intraoperative findings included stiffness of the malleus and incus and normal mobility of the stapes. Bone overlying the medial aspect of the posterior superior canal wall was removed to improve exposure of the proximal aspect of the long process of incus and the posterior epitympanum anatomy. A narrow point of bony fixation was identified between the medial surface of the long process of incus and the tympanic segment of the fallopian canal (Figure 3A). The incudostapedial (IS) joint was separated, and the point of fixation was palpated gently to determine the extent of fixation and the integrity of the fallopian canal. The point of bony fixation was gently removed using a blunt Rosen needle pick, and the incus was freed from its attachment to the fallopian canal.

To elevate the incus into a position that would prevent possible refixation, an interposition graft was placed between the lenticular process and the stapes capitulum. Because an alloplastic interposition prosthesis was unavailable at the time of the procedure, a thin bone chip graft, removed from the medial aspect of posterior superior canal wall, was used as an in-

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**Figure 1** A). There was normal mobility of the malleus and incus and unremarkable neurotologic findings aside from a tuning-fork examination result suggestive of left-sided conductive hearing loss. Intraoperatively, she was found to have isolated fixation of the incus to the fallopian canal. The incus–fallopian canal fixation was separated, and an autologous bone graft was placed between the lenticular process and stapes capitulum to create elevation and prevent refixation. One month postoperatively, an audiogram revealed a nearly complete air-bone gap closure.

**Figure 2** A). The incudostapedial (IS) joint was separated, and the point of fixation was palpated gently to determine the extent of fixation and the integrity of the fallopian canal. The point of bony fixation was gently removed using a blunt Rosen needle pick, and the incus was freed from its attachment to the fallopian canal.

**Figure 3** A). The incudostapedial (IS) joint was separated, and the point of fixation was palpated gently to determine the extent of fixation and the integrity of the fallopian canal. The point of bony fixation was gently removed using a blunt Rosen needle pick, and the incus was freed from its attachment to the fallopian canal.
The bone graft was supported with Gelfoam packing (Pfizer) placed into the middle ear space. This manner of reconstruction of the IS joint provided the necessary elevation of the incus off the fallopian canal. The ossicular chain was freely mobile after placement of the bone chip graft. The tympanomeatal flap was replaced, and the canal was packed with antibiotic-soaked Gelfoam pledgets. A 1-month postoperative audiogram showed nearly complete closure of the air-bone gap in the left ear (Figure 1B).

Discussion

Jahrsdoerfer\(^6\) classified congenital middle ear anomalies into major and minor categories. Major anomalies are described as involving the middle ear structures plus external auditory canal and auricle. Minor anomalies are those that are limited to the middle ear structures. To understand the etiology of these anomalies it is prudent to have a basic knowledge of the embryologic development of otologic structures.

The first branchial arch and the associated Meckel cartilage serve as developmental precursors for the head of the malleus and the body of the incus. The second branchial arch and the associated Reichert cartilage serve as precursors for the manubrium of the incus.

the malleus, the long process of the incus, and the stapes superstructure. The stapes footplate is formed from the otic capsule.

The facial nerve develops from the second branchial arch. During its development, the nerve traverses the preossified temporal bone; thus, its course is determined prior to ossification of the temporal bone.8 The ossification of the tympanic segment, known as the fallopian canal, starts from 2 distinct ossification centers that subsequently fuse after birth.9 The major ossification center starts anteriorly at 21 weeks gestation eventually forming 80% of the fallopian canal. The minor ossification center starts posteriorly at 26 weeks gestation near the stapedius muscle. In normal development, the 2 ossification centers eventually fuse near the oval window. A dehiscent tympanic segment of the facial nerve is most often related to the failure of these 2 ossification centers to fuse post partum.9

Of the 3 ossicles, the incus is the first to begin ossification followed by the malleus, and finally the stapes. Their outer endochondral ossification is complete by the time the fallopian canal begins its ossification process. Prior to ossification of the fallopian canal, the Meckel and Reichert cartilages may exert some influence on the position of the facial nerve. Whether the ossicles or facial nerve are normal, malpositioned, or malformed seems to have only a minor influence on the developing ossous fallopian canal.9 Rather, their malformations or malpositions are superimposed onto the ossifying fallopian canal.

Congenital fixation of the incus is the least common isolated congenital ossicular anomaly. There have been a few reports in the literature that describe isolated congenital incus fixation. Staeker and Merchant5 reported the case of a boy with Dubowitz syndrome who died at age 5 years, and on postmortem histopathologic examination of the temporal bone, he was found to have a malformed incus that was ankylosed to the scutum. In a series of 68 patients with congenital ossicular anomalies with mobile stapes footplates, only 2 cases were associated with an isolated fixation of the incus within the epitympanum. It should be noted that in both cases, in addition to incus fixation, the incus and stapes were structurally malformed. In another series reported by House,3 3 patients were noted to have isolated incus fixation. Hashimoto et al10 reviewed 52 cases of ossicular malformation, 4 of which were identified as fixation of the malleus and/or incus. It is unclear from the article whether any of the cases were associated with an isolated incus fixation.

In our case, the patient’s history of a long-standing left-sided hearing loss, no history of otologic disease, normal external ear anatomy, and intraoperative evidence of an isolated bony fixation between the incus and fallopian canal suggest a congenital abnormality. Radiographic evidence of bony fixation between the incus and fallopian canal was not apparent until the preoperative HRCT was reexamined postoperatively. Despite the use of HRCT imaging techniques for the purpose of reducing volume averaging and defining delicate bony anatomy, the close proximity of the incus and head of the malleus to structures within the epitympanum may lead to the perception of a bony fixation, particularly where a ligamentous structure or thickened mucosal band exists. While the radiologist and/or otologist may discount an apparent bony fixation owing to volume averaging, the patient’s history might suggest the existence of a congenital bony fixation and render further credence to findings on the HRCT images.

While congenital ossicular anomalies are most often associated with additional abnormalities of middle ear structures and/or the external ear, this case represents a rare finding of incus fixation in isolation. Furthermore, isolated bony fixation between the incus and the fallopian canal is a rather unique congenital anomaly. Despite an unexpected intraoperative finding, surgical correction was possible in this case, and the postoperative hearing result was favorable.

Conclusions
Patients who present with conductive hearing loss and normal auricle, external auditory canal, and tympanic membrane and an apparently normal HRCT finding of the temporal bone are often assumed to have otosclerosis. The diagnosis is made during middle ear exploration and examination of the ossicular chain. Although unanticipated in the adult patient, a congenital ossicular chain anomaly may be present. This case represents a rare finding of isolated incus fixation to the fallopian canal that was corrected by releasing the fixated incus and placing an autologous interposition graft at the IS joint.

References