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Adipose replacing intracochlear architecture following meningioma removal

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Introduction

It is well known that most cochleae, that are either deprived of blood supply or subjected to surgical trauma, undergo ossification, termed “labyrinthine ossificans”.¹ Here, we report a temporal bone histopathology case that reveals adipose tissue replacement of the cochlea architecture, rather than ossification, 30 years after a translabyrinthine approach for meningioma resection. Interestingly, the patient’s other ear exhibits typical intracochlear ossification after cochlear implantation.

Case report

At age 9, the patient had experienced a profound sensorineural hearing loss in the left ear after sustaining rheumatic fever. At age 57, she underwent a right translabyrinthine excision of a 3.3 cm meningioma in late 1979, and the operative report indicated that her facial nerve was intrinsically involved with the tumor medial to the porus acousticus, and the facial nerve was sacrificed. The labyrinthine, tympanic and mastoid segments were mobilized and a primary anastomosis was performed at the time of initial tumor removal. The wound was packed with abdominal fat graft. Because of her pre-existing left-sided deafness, she had anacusis post-operatively and underwent left cochlear implantation (CI) in early 1980. Computed tomography of the temporal bones was performed in 1981 and showed patency of both right and left cochleas “without osseous disruption or inflammatory change”, according to the radiology report.

She achieved no recovery of facial function over the following 24 months and, therefore, underwent a hypoglossal (XII) to facial (VII) anastomosis in 1982. It was noted that the adipose tissue in her mastoid cavity was “firm” during removal of the mastoid tip for facial nerve release from the stylomastoid foramen.

She passed at the age of 86 in 2009, 30 years after right translabyrinthine approach and 29 years after left CI insertion, and donated her temporal bones for histopathological research. Routine fixation and processing of the temporal bone with celloidin embedding, sectioning and H&E staining was performed. Microscopic examination of the sections revealed that the

right cochlea was filled with adipose and fibrous tissue (Figure 1A,B). All sensory and neural elements are absent, having been replaced with adipose and fibrous tissue. Only the hook area reveals new bone formation (Figure 1C). The modiolus has been resorbed and replaced with strands of trabecular bone (Figure 1D). The Organ of Corti is absent in all segments except for a few scattered clumps (Figure 2). In contrast, the left cochlea reveals that a round window enlargement approach was used and there is typical osseous and fibrous tissue formation filling the scala tympani as far as the ascending basal segment (not shown).

Discussion

This case is an anomaly in that there is very little ossification of the right cochlea 30 years after a translabyrinthine resection. Rather, it is almost completely replaced with adipose tissue. While the mastoid cavity and craniotomy defect are routinely packed with fat after translabyrinthine approach, it is not placed into the cochlea. The usual observation is ossification and fibrous tissue filling the cochlea, rather than adipose tissue. It has been suggested that activation of mesenchymal stem cells (MSC) can result in new tissue formation, including adipose tissue, osteochondral tissue, and muscle.² Pluripotent cells derived from MSC in bone marrow, blood, dermis, muscle, and adipose tissue have demonstrated this ability upon stimulation.³ Additionally, fetal perichondral progenitor cells have been shown to differentiate into osteoblasts, chondrocytes, adipocytes, and stromal cells.⁴ Perhaps, the endochondral bone of the otic capsule contains such MSC or perichondral progenitor cells, and the disruption of this otic capsule bone during surgical drilling is sufficient stimulation under appropriate circumstances to initiate adipogenesis. Furthermore, this process could explain the presence of new bone formation with disruption of the endosteum during CI when round window enlargement or cochleostomy approaches are employed.

Finally, this case demonstrates an important reason for using fat-suppression sequences when re-imaging for follow-up surveillance after tumor resection, because the adipose tissue here could be mistaken for a recurrence on magnetic resonance imaging with standard T1-weighted images (with and without contrast).

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Figure 1.

Low power (2x magnification) view of the cochlea showing adipose in upper basal and middle turns with mostly fibrous tissue in the apex (A). High power view (10x) of the middle turn showing adipose and fibrous tissue infiltration (B). High power view showing new bone formation in the basal turn (C). Low power view (2x) demonstrating replacement of the modiolus with strands of trabecular bone (D).

Figure 2.

Low (2x magnification; A, arrow) and higher (10x magnification; B & C, arrows) power view of remnant clumps of Organ of Corti within the cochlea.