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Post-traumatic Malleo-Incudal Complex Dislocation

A 27-year-old man undergoes otolaryngologic evaluation for blunt head trauma suffered in a vehicular accident. With regards to the right ear, pertinent otologic findings include an ear canal laceration and a delayed-onset facial nerve paresis. Tuning fork testing reveals an abnormal Rinne test on the right (AC<BC). The radiologist's interpretation of the computerized tomographic imaging study of the temporal bone indicated the presence of a longitudinal fracture of the right temporal bone with no disruption of the ossicular chain. (*Figure 1*) However, careful examination of the anatomy of the malleo-incudal complex in relation to the other structures in the epitympanum actually reveals findings indicative of a malleo-incudal complex dislocation. How can this discrepancy in the radiologic interpretation be accounted for? By what objective parameters can the presence of a malleo-incudal complex dislocation be identified?

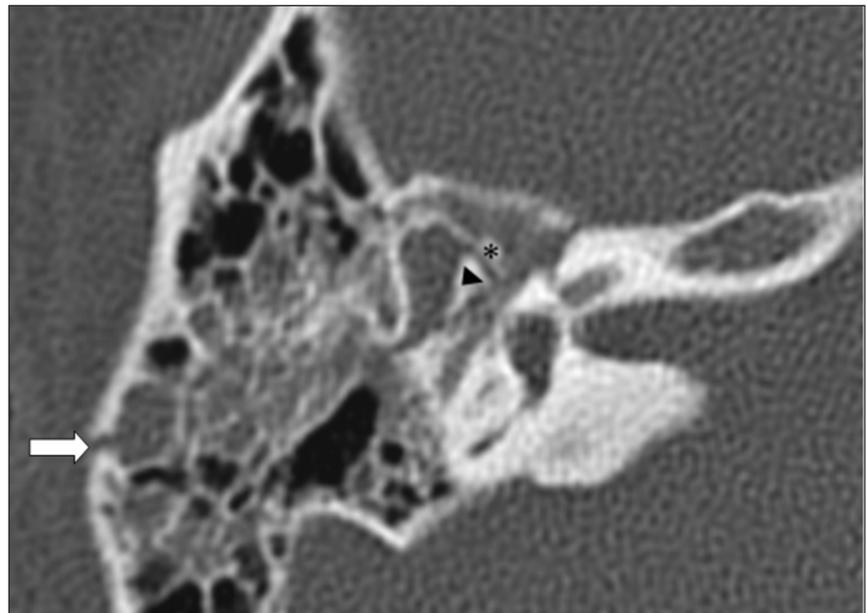


Figure 1. Axial CT image at the level of the malleo-incudal complex (0.6 mm, bone algorithm). The longitudinal fracture can be seen starting at the break in the outer cortex of the mastoid bone (white block arrow). The malleus head (black asterisk) and the incus body and short process (black triangle) appear to be in the normal "ice-cream cone" configuration.

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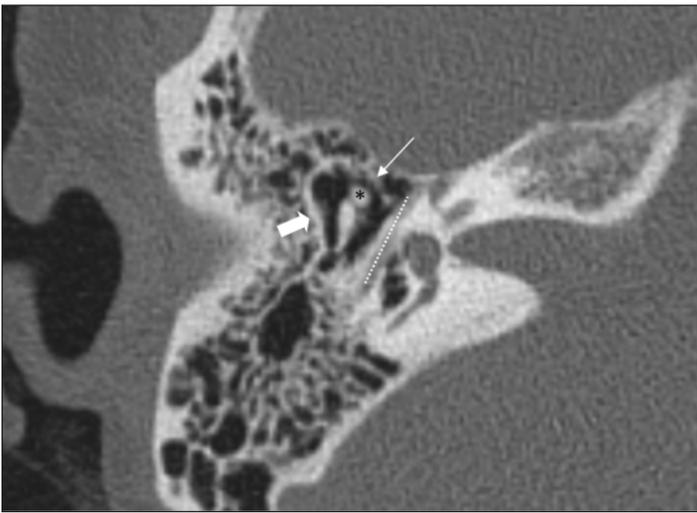


Figure 2. Axial CT image in a normal temporal bone study (0.1 mm, bone algorithm), showing the malleo-incudal complex located in the middle of the posterior epitympanum, appearing to be equidistant from the lateral bony border called the scutum (white block arrow) and the medially located tympanic segment of the facial nerve (white dashed line). The malleus head (black asterisk) is clearly located posterior to the cog (white line arrow).

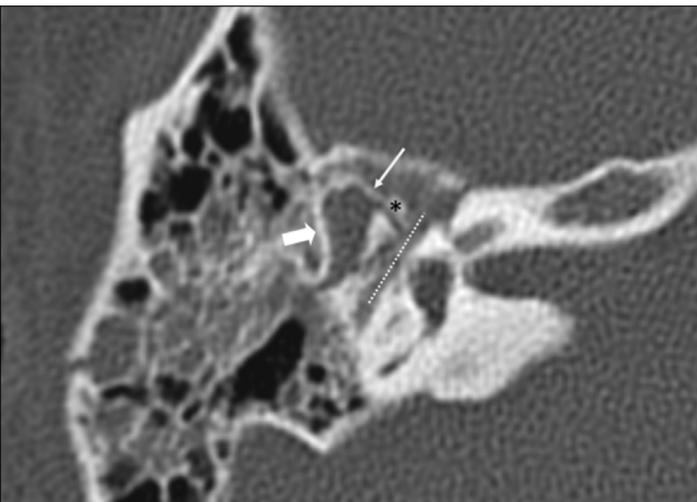


Figure 3. Original Axial CT image at the level of the malleo-incudal complex. The malleus head (black asterisk) is located at the same level as the cog (white line arrow) in the antero-posterior plane. The malleo-incudal complex is medially located, closer to the tympanic segment of the facial nerve (white dotted line) than the scutum (white block arrow)

Meriot *et al.*¹ described five types of traumatic ossicular dislocation injury: incudomalleolar joint separation, incudostapedial joint separation, stapediovestibular dislocation, incus dislocation, and **malleo-incudal complex dislocation**. Of these, incudomalleolar joint separation would probably be the most easily identified, as it would manifest as a disruption in the distinctive **ice-cream cone** appearance of the malleus head and the body and short process of the incus visualized on axial CT imaging of the temporal bone. (Figure 2) In contrast, malleo-incudal complex dislocation would involve movement of both ossicles en-bloc within the tympanic cavity (usually into the

mesotympanum), without disruption of the incudomalleolar joint.¹ As such, the ice-cream cone configuration may be preserved in this type of injury. Proper identification of this type of injury would be based on identifying any discrepancy in the positional relationship between the ossicular complex and the other structures within the confines of the tympanic cavity.

The malleus head and the body and short process of the incus are located in the most superior portion of the tympanic cavity, the pneumatised area called the epitympanum. Also known as the attic or epitympanic recess, this region is bordered superiorly by the tegmen tympani and inferiorly by the mesotympanum. The epitympanum is divided into two compartments: the anterior epitympanic space or recess, and the much larger posterior epitympanum, which houses the epitympanic portions of the malleus and incus. This division is created by a thin bony plate known as the **cog**, which projects downwards from the tegmen tympani and is located **anterior** to the malleus head.² In the axial plane, the malleo-incudal complex is normally centered within the posterior epitympanum with the short process of the incus pointing into the incudal fossa. The position of the malleo-incudal complex may sometimes be slightly lateral, but is never medial in the normal situation.¹

Based on these broader anatomical relationships, it can be seen that in the imaging study under investigation (Figure 3), the malleo-incudal complex (the ice-cream cone) has actually shifted forward - the malleus head is located not posterior to the cog, but at the same level as the cog in the antero-posterior dimension. Additionally, the malleo-incudal complex is located more medially within the posterior epitympanum, and is much closer to the tympanic segment of the facial nerve than to the lateral bony margin (the scutum) of the epitympanum. These findings clearly and unequivocally demonstrate the presence of a malleo-incudal complex dislocation.

In summary, one of the keys to the proper evaluation of post-traumatic ossicular injury is to look not only at the anatomical relationship between ossicles, but also at the relationship of the entire ossicular complex to the other structures that are also located within the confines of the tympanic cavity.

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