

Traumatic incudomalleolar dislocation

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History

A 33-year-old female patient, who had sustained injuries following a fall, was presented to the emergency department. Upon arrival, she had altered consciousness with visible bleeding from the right ear and a superficial hematoma on the right side of the skull. A routine head CT scan, as a part of our institutional polytrauma protocol, was performed with a photon-counting detector (PCD) CT scanner (NAEOTOM Alpha.Prime) for further assessment.

Diagnosis

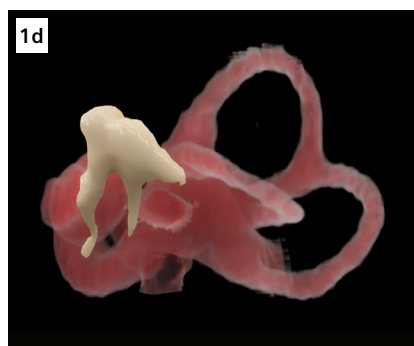
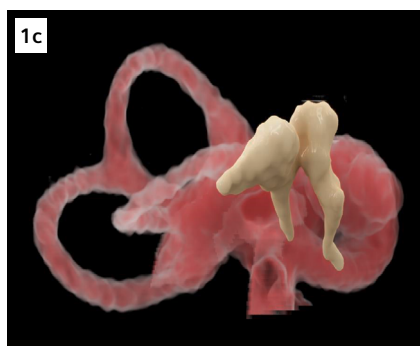
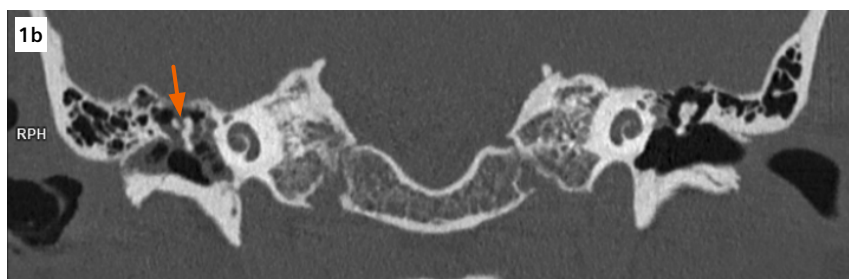
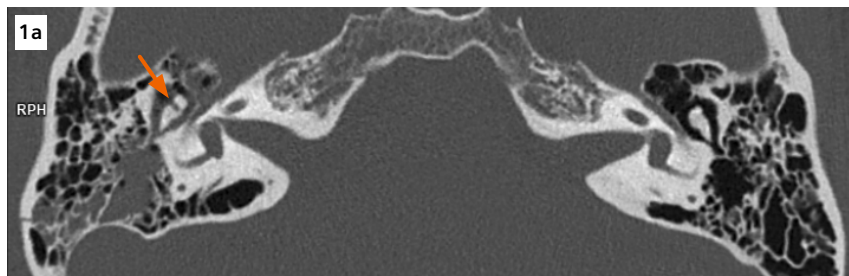
CT images showed an incudomalleolar dislocation with a typical “broken heart” sign in the thin-slice coronal multiplanar reformats (MPR). The displacement of the head of the malleus from the body and short process of the incus disarticulating the normal “ice cream cone” of the joint was also seen in axial images (Fig. 1). These structures were visualized in more details in zoomed reconstructions (Fig. 2). Longitudinal fractures of the right temporal bone (Fig. 3a), involving the mastoid cells, the external auditory canal, the middle ear and the ossicles, as well as a complex fracture of the body of the sphenoid bone were present (Fig. 3b and 3c). Temporal subdural hematoma, subarachnoid bleeding as well as parenchymal brain contusion injuries on the left, due to the contrecoup mechanism, were seen. There was no evidence of extracranial traumatic lesions. A subsequent control CT examination demonstrated stable contusional injuries with mild progression of the perifocal edema and a regressing subdural hematoma. Immediate neurosurgical inter-

vention was not considered. The patient was treated conservatively on the intensive care unit for two days and was then transferred to the traumatology ward. Ear-nose-throat (ENT) consultation found a right-sided conductive hearing loss.

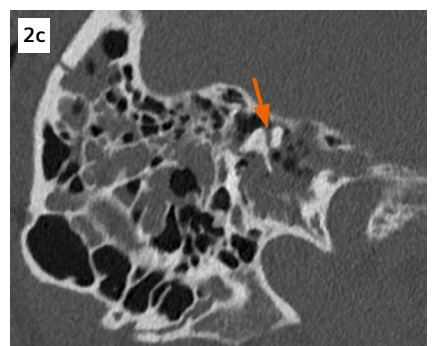
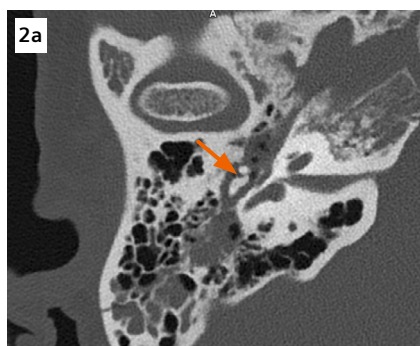
Comments

Temporal bone trauma is commonly encountered in the emergency department. The tympanic cavity and tegmen, the ossicular chain, the bony labyrinth, the facial canal, the internal carotid artery, the jugular foramen and venous sinuses, as well as the intracranial contents are all potential injury sites. A specific and thorough reporting approach is needed due to the unique composition of these anatomical structures. A delayed or missed diagnosis of injuries to these structures can result in severe and permanent disabilities for the patient. [1] Ossicular luxation or fracture, disrupting the conductive chain, may cause conductive hearing loss (CHL). Six months after temporal bone trauma, persistent CHL occurs in 50% of the patients. The most common sites of ossicular dislocation are the incudostapedial and the incudomalleolar joints. [2] In the latter case, the joint dislocation is marked with displacement of the scoop (head of the malleus) from the cone (body and short process of the incus), disarticulating the normal “ice cream cone” in axial images and the typical “broken heart” sign in coronal MPR. [3] [4] CT is the imaging modality of choice in cases of temporal bone trauma. Traditionally, CT examination for head and for temporal bones are two separate scans, with the former

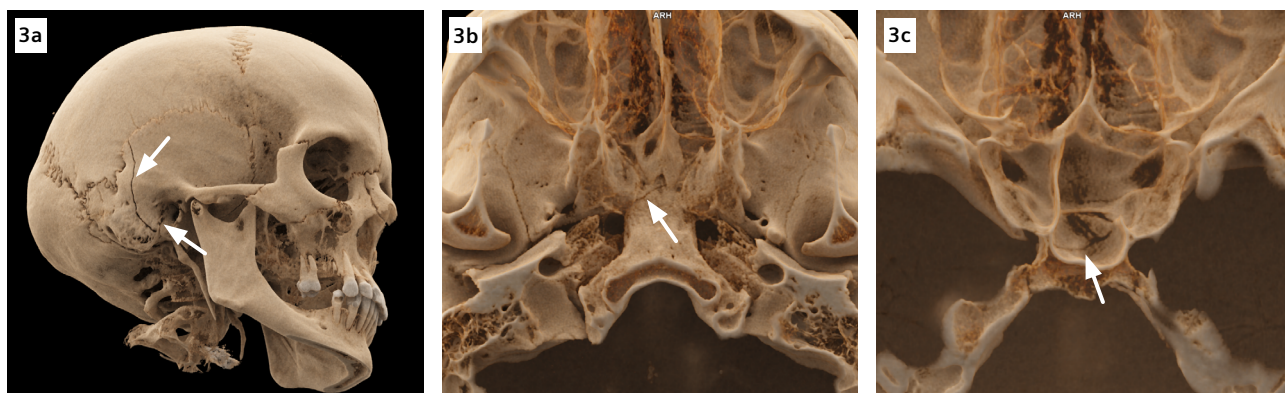
focused on the low-contrast cerebrum and the latter, on high-contrast bony structures. This case is acquired with a newly developed single source PCD CT, NAEOTOM Alpha.Prime. The principle of PCD differs from that of conventional, energy-integrating detector (EID). With EID, X-ray photons are first converted into scintillation light and then into electrical signals, while with PCD, X-ray photons are converted directly into electrical signals. The detector elements in EID are separated by physical separators, while in PCD, they are separated by electric fields. The electronic circuit noise is also eliminated in PCD. These differences result in increased efficiency of X-ray photon utilization, and potentially, reduced image noise and radiation dose. Additionally, PCD has a smaller detector pixel size, which contributes to the decreased partial volume effects and blooming artifacts. This increases spatial resolution, which is especially important for imaging small, high-contrast structures, such as the ossicular chain. [5] Images acquired in routine head scan can be reconstructed both at 0.4 mm slice width with a sharp kernel (Hr76) for visualizing the temporal bones and at thicker slice width with a standard or smooth kernel for cerebrum imaging, obviating the necessity of having to do two separate scans. These high-resolution images can also be used to create three dimensional images, using cinematic rendering technique (cVRT), providing detailed, lifelike visualization. In trauma settings, PCD CT, with its increased spatial resolution in routine scans, may enable radiologists to reach diagnostic conclusions that were previously only possible with high resolution CT (HRCT) examinations. ●



1 An axial image (Fig. 1a) shows displacement of the head of the malleus from the body and short process of the incus (arrow) on the right. A typical "broken heart" sign (arrow) is seen in a coronal MPR image (Fig. 1b). Two cVRT images (Figs. 1c and 1d) created with thin slices (0.4 mm, sharp kernel of Hr76) demonstrate the incudomalleolar dislocation (Fig. 1c) in three dimensions.



2 Images from zoomed reconstructions show the incudomalleolar dislocation (arrows) with signs of disarticulated "ice cream cone" (Fig. 2a) and "broken heart" (Fig. 2b) in details.



3 cVRT images show longitudinal fractures (Fig. 3a, arrows) of the right temporal bone, involving the mastoid cells and the external auditory canal, as well as a complex fracture of the body of the sphenoid bone (Fig. 3b and 3c, arrows).

Examination Protocol

Scanner	NAEOTOM Alpha.Prime
Scan area	Head
Scan mode	Quantum Plus
Scan length	182 mm
Scan direction	Cranio-caudal
Scan time	69 s
Tube voltage	120 kV
Effective mAs	167 mAs
IQ level	225
Dose modulation	CARE Dose4D
CTDI _{vol}	28 mGy
DLP	554 mGy*cm
Rotation time	0.5 s
Pitch	0.35
Slice collimation	144 × 0.4 mm
Slice width	0.4 mm
Reconstruction increment	0.2 mm
Reconstruction kernel	Hr76

References

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The products/features (mentioned herein) are not commercially available in all countries. Their future availability cannot be guaranteed.