

Audiological Considerations in the Hearing Assessment of a Patient with Anterior Crus Fracture of the Stapes: A Case Report

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Case Report

Abstract

Introduction: Isolated fracture of the anterior crus of the stapes is a rare etiology of post-traumatic conductive hearing loss, which may lead to delayed diagnosis due to unremarkable otoscopic findings. In such scenarios, the integration of a meticulous clinical history, comprehensive audiological evaluation, and high-resolution computed tomography (HRCT) is decisive in identifying the lesion.

Case Report: A 35-year-old man presented with right unilateral hearing loss, aural fullness, and mild tinnitus following direct trauma to the right temporal region in a motor vehicle accident. Audiological assessment revealed conductive hearing loss in the right ear with an air-bone gap of approximately 30–35 dB, a type A tympanogram, and absent acoustic reflexes. HRCT of the temporal bone demonstrated an isolated fracture of the anterior crus of the stapes, without evidence of incudostapedial joint dislocation or labyrinthine fistula. The patient underwent transcanal stapedotomy with the placement of a piston prosthesis. At the six-week follow-up, air-conduction thresholds improved to approximately 15–20 dB.

Conclusion: This case underscores that in patients with post-traumatic conductive hearing loss, the presence of normal tympanometry coupled with absent acoustic reflexes should prompt the consideration of subtle ossicular chain injuries, particularly those involving the stapes. Furthermore, a precise audiological assessment plays a pivotal role in guiding surgical decision-making, documenting therapeutic outcomes, and planning postoperative rehabilitation.

Keywords: Stapes; Anterior crus fracture; Conductive hearing loss; Stapedotomy; Hearing assessment; Case report

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Introduction

The stapes is the smallest bone in the human body and the terminal component of the middle ear ossicular chain, responsible for transmitting acoustic vibrations from the incus to the oval window (1). Any disruption in the integrity of the stapes footplate can impair the efficiency of sound energy transmission, leading to conductive hearing loss (CHL) (2).

Traumatic injuries to the ossicular chain typically occur following direct impact to the temporal bone, penetrating trauma, blast-related injuries, or previous surgical interventions (3). However, an isolated fracture of the anterior crus of the stapes is a rare occurrence. Because the tympanic membrane and otoscopic findings

may appear normal, identification of such a lesion is challenging without precise audiological data (4-7).

In patients presenting with post-traumatic conductive hearing loss, the presence of an air-bone gap associated with a Type A tympanogram and absent acoustic reflexes is highly suggestive of ossicular chain lesions. In this context, high-resolution computed tomography (HRCT) of the temporal bone serves as a critical complementary imaging modality to localize the injury, differentiate it from otosclerosis or ossicular dislocation, and plan the surgical intervention (8).

Surgical reconstruction, via stapedotomy or the placement of a Partial Ossicular Replacement Prosthesis (PORP), provides successful outcomes in

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60–80% of cases; however, success is contingent upon the integrity of the remaining ossicular components and the absence of labyrinthine involvement (9). This case report describes the comprehensive diagnostic process, surgical intervention, and auditory rehabilitation of a patient with an isolated fracture of the anterior crus, highlighting the pivotal role of the audiologist within the multidisciplinary team (10).

Given the rarity of this lesion and the scarcity of documented cases in Persian literature, this report is significant in two respects: first, by elucidating the diagnostic value of comprehensive hearing assessments in post-traumatic conductive hearing loss; and second, by demonstrating the collaborative synergy between the audiologist and the ear surgeon in treatment selection and the monitoring of post-surgical outcomes.

Case Report

The patient, a 35-year-old male, presented with no prior history of hearing loss, known otologic pathology, previous ear surgery, familial otosclerosis, or occupational exposure to high-intensity noise. He experienced direct trauma to the right temporal region following a motor vehicle accident. Immediately following the incident, the patient reported a decrease

in hearing in the right ear, accompanied by persistent aural fullness and mild, low-frequency tinnitus. He denied experiencing rotational vertigo, otorrhea, aural bleeding, or a progressive exacerbation of symptoms.

Following hemodynamic stabilization, the initial brain CT scan was reported as unremarkable. In the second week post-accident, the patient was referred for a comprehensive audiological evaluation. Otoscopic examination revealed that the tympanic membranes bilaterally were healthy and translucent, with no evidence of perforation, scarring, or effusion. Tuning fork tests demonstrated a negative Rinne test in the right ear and Weber lateralization to the affected side, which was consistent with unilateral conductive hearing loss.

Diagnostic Findings

A) Audiological Evaluation: Pure-tone audiometry (PTA) revealed elevated air-conduction thresholds in the speech frequency range for the right ear, with an air-bone gap (ABG) of approximately 30-35 dB, while bone-conduction thresholds remained within normal limits. Speech audiometry results were also consistent with conductive pathway impairment, with no evidence of reduced speech clarity associated with sensorineural involvement (Figure 1).

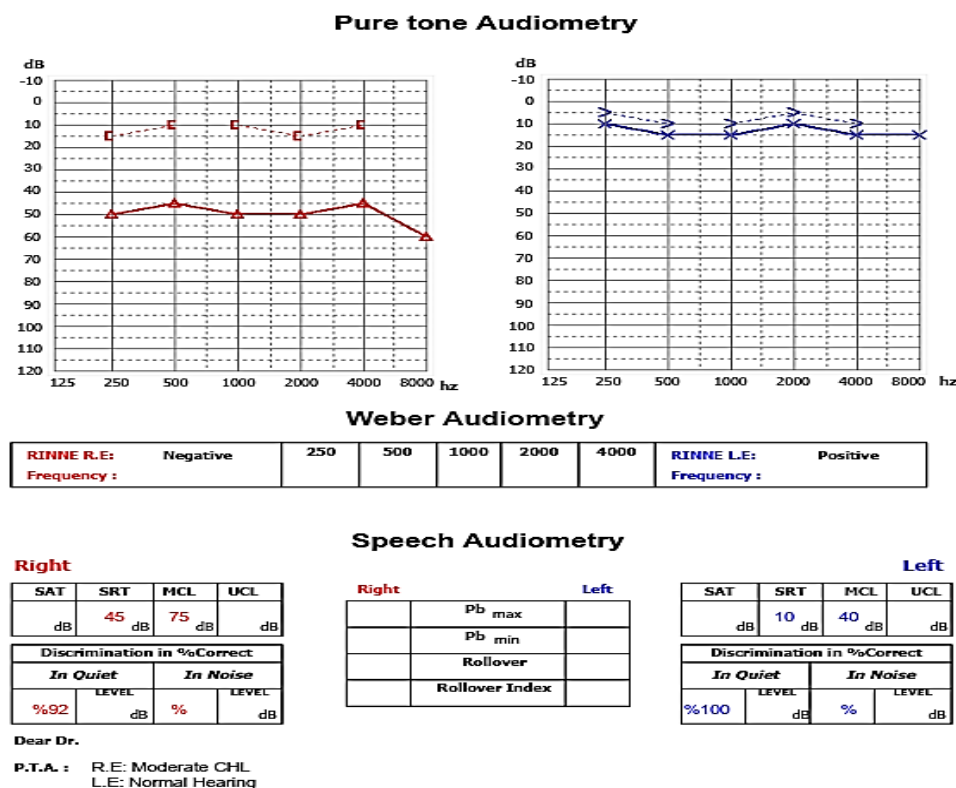


Figure 1. Preoperative pure-tone audiogram

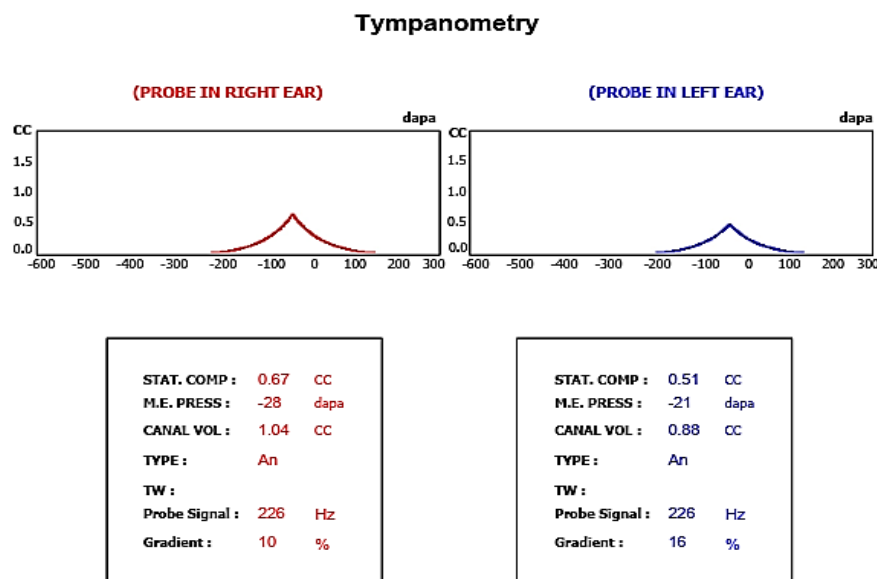


Figure 2. Preoperative tympanograms

Tympanometry revealed normal tympanograms bilaterally, indicating relatively preserved tympanic membrane mobility and normal middle ear pressure; however, acoustic reflexes were absent in the affected ear. Despite the unremarkable tympanometric results, this specific pattern reinforced the likelihood of an ossicular chain lesion, necessitating further targeted imaging (Figure 2).

B) Imaging: High-resolution computed tomography (HRCT) of the temporal bone was performed using 0.5 mm slices in axial, coronal, and reconstructed planes. The findings revealed an isolated fracture of the anterior crus of the stapes with mild displacement of 1–2 mm. The posterior crus, stapedial footplate, and other ossicular components were intact, with no evidence of incudostapedial joint dislocation or labyrinthine fistula.

C) Therapeutic Intervention and Follow-up: Due to the persistence of the patient's complaints, the presence of a significant air-bone gap, and the confirmatory imaging results, the patient underwent a transcanal stapedotomy under general anesthesia. Intraoperatively, the middle ear mucosa appeared normal, and exploration of the ossicular chain confirmed the fracture of the anterior crus. Mechanical sound transmission was restored by creating an appropriate fenestration and inserting a piston prosthesis (0.4 mm in diameter and 4.5 mm in length).

In the postoperative period, no complications such as vertigo, labyrinthine fistula, or deterioration of vestibular function were reported. Follow-up audiometry conducted six weeks post-surgery

demonstrated that air-conduction thresholds in the right ear had improved to approximately 15–20 dB, with a significant reduction in the air-bone gap. Consequently, the surgical outcome was evaluated as functionally successful (Figure 3).

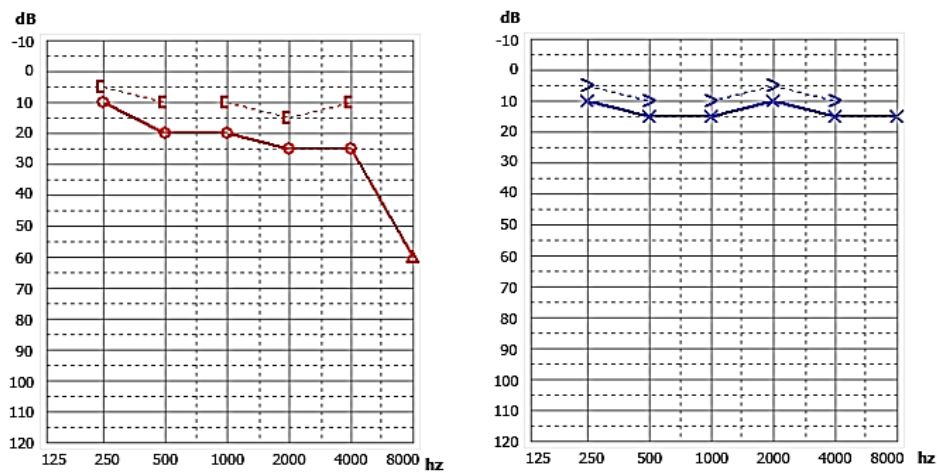
Discussion

This case demonstrates that subtle injuries to the ossicular chain may remain occult during routine otoscopic examinations and can only be identified through a meticulous analysis of clinical and audiological evidence. In the present patient, the combination of post-traumatic unilateral conductive hearing loss, a normal tympanogram, and absent acoustic reflexes created a pattern highly suggestive of an ossicular dysfunction, which was ultimately confirmed through targeted CT imaging.

Differentiating this lesion from more common etiologies of conductive hearing loss—such as otosclerosis, middle ear adhesions, or more extensive ossicular dislocations—is critical, as the therapeutic approach and prognosis vary significantly for each. In this instance, the absence of a gradual onset of hearing loss, a clear temporal correlation with the traumatic event, and the direct visualization of the fracture on imaging reinforced the diagnosis of a traumatic stapedial injury.

From a clinical standpoint, this case underscores the pivotal role of the audiologist across three key stages: the initial screening and identification of the hearing loss pattern, the objective documentation of preoperative status, and the monitoring of postoperative outcomes.

Pure tone Audiometry



Weber Audiometry

RINNE R.E: Negative	250	500	1000	2000	4000	RINNE L.E: Positive
Frequency :						Frequency :

Speech Audiometry

Right

SAT	SRT	MCL	UCL
dB	45 dB	75 dB	dB
Discrimination in %Correct			
In Quiet		In Noise	
%92	LEVEL	%	LEVEL
	dB		dB

Dear Dr.

P.T.A. : R.E: Mild CHL
L.E: Normal Hearing

Right

	Pb max	
	Pb min	
	Rollover	
	Rollover Index	

Left

SAT	SRT	MCL	UCL
dB	10 dB	40 dB	dB
Discrimination in %Correct			
In Quiet		In Noise	
%100	LEVEL	%	LEVEL
	dB		dB

Figure 3. Postoperative pure-tone audiogram at 6 weeks

Furthermore, should surgical reconstruction fail to fully close the conductive gap for any reason, the audiologist remains essential in planning complementary rehabilitation, including counseling, periodic follow-ups, and, if necessary, hearing aid prescription.

This report also holds educational value as a case study, providing a cohesive account of the clinical trajectory, diagnostic reasoning, intervention, and short-term outcomes.

Limitations

While the inherent limitation of such reports is the lack of generalizability to all patients, documenting rare occurrences enhances clinical awareness and facilitates the early diagnosis of similar cases.

Recommendations

In patients with a history of direct trauma to the temporal region who develop conductive hearing loss following the incident, a complete audiological evaluation including acoustic reflex testing is recommended on a routine basis, even when otoscopy and tympanometry are normal, since absent reflexes may be the only indirect indicator of ossicular chain injury. In medical centers that admit patients with head and temporal trauma, the development of a standardized hearing screening protocol (including pure-tone audiometry, tympanometry, and acoustic reflex testing) is recommended for all patients presenting with hearing complaints, in order to prevent diagnostic delay in subtle ossicular chain lesions.

Given the limitations of otoscopy and audiometry in precisely differentiating the site of injury, early request for HRCT of the temporal bone with thin slices should be considered alongside clinical and audiological findings in cases suspected of post-traumatic ossicular injury. Due to the scarcity of existing reports on isolated anterior crus fracture of the stapes, prospective studies with larger sample sizes or case series are recommended to determine the true prevalence, common audiological patterns, and long-term outcomes of stapedotomy surgery in these patients. Long-term audiological follow-up (beyond 6 weeks) is recommended in patients undergoing traumatic stapedotomy to properly assess the stability of hearing outcomes, the possible occurrence of delayed complications such as prosthesis necrosis or sensorineural threshold shift, and the need for additional rehabilitative interventions such as hearing aids. Strengthening interdisciplinary collaboration among the audiologist, radiologist, and otologic surgeon from the initial encounter with a trauma patient presenting with hearing loss is proposed as a model for improving diagnostic accuracy and reducing the time to surgical intervention in similar cases.

Conclusion

In patients presenting with unilateral conductive hearing loss following trauma, unremarkable otoscopic and tympanometric findings should not preclude the possibility of an ossicular chain injury. A combination of a detailed medical history, comprehensive audiological testing, and targeted

imaging is decisive in diagnosing subtle stapedial fractures, and timely surgical intervention can lead to a significant restoration of auditory function.

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Authors' Contribution

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Overall accountability for the integrity of the study and responding to reviewers: Mohammad Hossein Nilforoush, Mahsa Sepehrnezhad

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Conflict of Interest

The authors did not have a conflict of interest.

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