

ENCASED IN SCLEROSIS: UNRAVELING A RARE MIDDLE EAR ENIGMA

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ABSTRACT

Background: Tympanosclerosis represents a complex physiological response characterized by the accumulation of hyaline material within the middle ear cavity, specifically around the tympanic membrane and the hypertrophic submucosa. This condition arises primarily as a chronic inflammatory sequela of middle ear disease, though it may also manifest following the spontaneous healing of a tympanic membrane perforation. While a substantial majority of these cases remain functionally asymptomatic and do not necessitate clinical intervention, rare and atypical presentations introduce severe structural complications that make therapeutic management highly challenging. Furthermore, a significant clinical controversy persists regarding whether the complete surgical eradication of these sclerotic plaques reliably results in postoperative auditory improvement for patients suffering from chronic otitis media.

Aim: This report aims to comprehensively describe the unique clinical presentation, precise diagnostic evaluation, intricate surgical management, and significant intraoperative challenges encountered in a rare case of bilateral tympanosclerosis.

Case Presentation: A 22-year-old female patient presented with a three-year history of bilateral otorrhoea and progressive hearing impairment. Extensive preoperative imaging and subsequent surgical exploration of the right ear revealed dense, stony hard tympanosclerotic masses completely obstructing the mastoid antrum and severely restricting the mobility of the ossicular chain.

Intervention and Outcome: Through highly precise surgical drilling techniques during a cortical mastoidectomy and epitympanotomy, the ossicular chain was meticulously liberated from the sclerotic encasement. Following a Type I tympanoplasty, the patient demonstrated substantial postoperative hearing improvement.

Conclusion: Despite the profound intraoperative challenges posed by stony hard tympanosclerosis causing severe ossicular fixation, meticulous surgical clearance of the disease can successfully restore mechanical mobility and yield highly favorable auditory outcomes.

INTRODUCTION

Tympanosclerosis is an otological pathology defined by the abnormal deposition of dense hyaline material within the middle ear cleft.[1][2] This deposition predominantly localizes around the tympanic membrane and within the hypertrophic submucosal layers of the middle ear cavity.[3] The underlying etiology of this condition is deeply rooted in inflammatory processes, serving as a direct sequela to chronic middle ear disease.[3] Calcific deposits involving the tympanic membrane and ossicular chain limit their mobility, resulting in conductive or mixed hearing loss. [4] Interestingly, the pathological cascade leading to tympanosclerosis is not solely limited to active chronic infections; it can also present as a byproduct of the natural physiological healing process following a perforation of the tympanic membrane.[5]

Epidemiologically, the incidence of tympanosclerosis among patients with relevant otological histories ranges from 7% to 33%. [6] The condition demonstrates a clear demographic predilection, affecting males more frequently than females with a recorded ratio of 1.6:1.[7] In standard clinical practice, the vast majority of tympanosclerosis cases are entirely asymptomatic, presenting merely as incidental clinical findings that require no active medical or surgical intervention.[8] However, a subset of patients presents with highly atypical and aggressive manifestations of the disease. These severe cases are characterized by extensive sclerotic tissue that profoundly alters the intricate anatomy of the middle ear, thereby making therapeutic and surgical treatment exceptionally challenging.[9]

A central dilemma in the surgical management of such patients particularly those with a background of chronic otitis media (COM) is the ongoing debate regarding the efficacy of plaque removal.[10] Otologists frequently face a controversy over whether the aggressive excision of these dense sclerotic plaques will genuinely translate into meaningful improvements in the patient's hearing, given the risk of iatrogenic trauma to the delicate middle ear structures.

AIMS AND OBJECTIVES

The primary aim of this comprehensive report is to elucidate the clinical presentation, diagnostic pathway, surgical strategy and specific intraoperative technical challenges associated with a rare and severe case of bilateral tympanosclerosis.

The specific objectives of this study are:

1. To document the exhaustive clinical history and precise otological examination findings in a patient suffering from advanced tympanosclerosis.
2. To analyze and describe the specific radiological features and anatomical mapping of the tympanosclerotic disease as visualized on High-Resolution Computed Tomography (HRCT) of the temporal bone.
3. To detail the step-by-step surgical intervention, highlighting the intraoperative anatomical realities and the distinct technical challenges faced during the execution of a cortical mastoidectomy, epitympanotomy, and Type I tympanoplasty.

Case Presentation

Patient History and Symptomatology A 22-year-old female patient sought otolaryngological consultation with primary complaints localized to both ears. Her clinical history was notable for a three-year duration of bilateral ear discharge (otorrhoea). Concurrently, the patient reported a noticeable reduction in her auditory acuity over the same three-year period. Subjectively, she noted that the hearing impairment was asymmetrical, with the right ear being more severely affected than the left ear.

Clinical Examination A detailed otoendoscopic evaluation was performed to directly visualize the tympanic membranes and the middle ear status. The examination revealed bilateral medium-sized central perforations of the tympanic membranes. Specifically, these perforations were anatomically localized to the anteroinferior and posteroinferior quadrants of both the right and left ears. Accompanying these perforations, the endoscopic view clearly demonstrated the presence of patchy tympanosclerotic plaques distributed bilaterally across the visible middle ear structures.

Audiological Assessment To objectively quantify the patient's subjective complaints of hearing loss, a pure tone audiometric (PTA) evaluation was conducted. The audiometric profile confirmed a bilateral hearing deficit. In the right ear, the patient exhibited a hearing loss of 37.5 dBHL, while the left ear demonstrated a loss of 30 dBHL. These quantitative findings were entirely consistent with a diagnosis of mild conductive hearing loss, correlating directly with the observed structural impairments in the middle ear.

Table 1: Preoperative Clinical Profile

Parameter	Findings
Oto endoscopy	Bilateral medium-sized central perforations (anteroinferior posteroinferior & quadrants); bilateral patchy tympanosclerosis
Audiological Evaluation (PTA)	Right Ear: 37.5 dBHL loss; Left Ear: 30 dBHL loss
Hearing Loss Classification	Mild Conductive Hearing Loss

Radiological Evaluation

Given the chronicity of the symptoms and the visual confirmation of tympanosclerosis, HighResolution Computed Tomography (HRCT) of the temporal bone was ordered to map the full extent of the submucosal and intraosseous disease. The HRCT imaging provided critical preoperative insights. It revealed the presence of abnormal soft tissue densities occupying multiple critical spaces within the right temporal bone, specifically mapping to Prussak’s space, the epitympanum, the mesotympanum, the mastoid antrum and the broader network of mastoid air cells. Furthermore, the imaging demonstrated a mild structural thinning of the tegmen mastoideum. A striking radiological feature was the near-complete sclerosis of the right mastoid air cell system, which contrasted with the partial sclerosis observed within the left mastoid air cells.

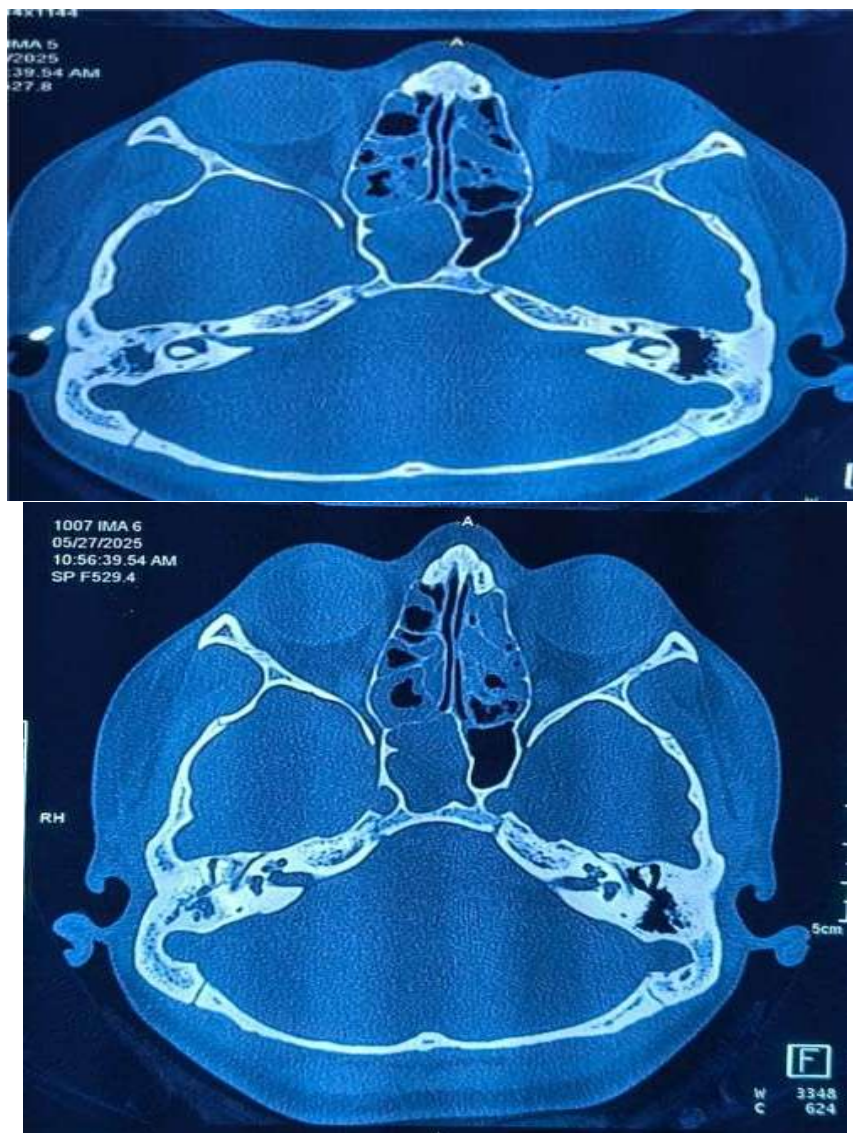
Table 2: Right Temporal Bone HRCT Findings

Anatomical Region	Radiological Observation
Prussak’s Space	Presence of soft tissue densities
Epitympanum & Mesotympanum Ossicles	Presence of soft tissue densities Loss of characteristic ice cream cone appearance
Mastoid Antrum	Presence of soft tissue densities
Mastoid Air Cells	Near-complete sclerosis; soft tissue densities
Tegmen Mastoideum	Mild thinning noted

(Note: The mild thinning of the tegmen mastoideum was identified alongside the extensive disease mapped within the right temporal bone.)

Table 3: Left Temporal Bone HRCT Findings

Anatomical Region	Radiological Observation
Prussak’s Space	Nil
Epitympanum & Mesotympanum Ossicles	Nil Normal
Mastoid Antrum	Nil
Mastoid Air Cells	Partial sclerosis
Tegmen Mastoideum	Nil



Surgical Management and Intraoperative Challenges

Based on the comprehensive clinical and radiological picture, which indicated severe right-sided disease, the patient was scheduled for surgical intervention. The planned procedure was a right cortical mastoidectomy combined with a tympanoplasty.

Initial Approach and Mastoidectomy The surgical procedure commenced with the elevation of the tympanomeatal flap. Upon entering the middle ear cavity, direct visualization confirmed that the middle ear mucosa was highly edematous and heavily burdened with established tympanosclerotic plaques. We proceeded with the cortical mastoidectomy to systematically expose the mastoid antrum.

The Epitympanic Enigma Upon attempting to access the antrum, the primary surgical challenge materialized: a dense, incredibly thick chunk of tympanosclerotic tissue was discovered completely obstructing the antral space. To bypass this obstruction and fully comprehend the extent of the ossicular involvement, we advanced to an epitympanotomy to expose the attic region.

The attic exposure revealed a severe pathological reality. The head and the short process of the malleus were completely admixed and encased within the massive tympanosclerotic chunk. This stony hard encasement acted as a mechanical anchor, severely hampering the natural mobility of the ossicular chain.

Ossicular Reconstruction and Clearance Addressing this fixity required exceptional surgical precision. Utilizing meticulous drilling techniques, we systematically cleared the dense sclerotic tissue away from the encased ossicles. This precise clearance successfully liberated the malleus and restored the mobility of the primary ossicular chain.

Further exploration of the ossicular chain revealed that the suprastructure of the stapes was also fixed by adjacent sclerotic patches. Fortunately, while the suprastructure was bound, the stapedial footplate itself remained mobile. We successfully cleared the restrictive patches from the stapes suprastructure. Following the complete eradication of the pathological plaques from the ossicles, the surgeon confirmed total ossicular mobility and observed a positive round window reflex, indicating a structurally intact and functionally capable conductive mechanism.

Conclusion of the Procedure With the tympanosclerotic plaques removed, the surgeon confirmed the definitive patency of the mastoid antrum. The reconstructive phase of the operation was then finalized by performing a Type I tympanoplasty utilizing an underlay technique to repair the tympanic membrane perforation and seal the middle ear cavity.

Table 4: Intraoperative Ossicular Status and Surgical Interventions

Anatomical Structure	Intraoperative Finding	Surgical Intervention / Outcome
Middle Ear Mucosa	Edematous with tympanosclerotic plaques	Extensive removal of tympanosclerotic patch
Mastoid Antrum	Completely blocked by a thick tympanosclerotic chunk	Cortical mastoidectomy; precise drilling for clearance; patency confirmed
Malleus Head & Short Process of incus	Admixed and encased within sclerotic chunk, restricting mobility	Epitympanotomy and precise drilling; successfully cleared and mobility restored
Stapes Suprastructure	Surrounded by sclerotic patches	Sclerotic patches surgically cleared
Stapes Footplate	Found to be naturally mobile	Preserved; positive round window reflex noted
Tympanic Membrane	Perforated (Preoperative finding)	Reconstructed via Type I Tympanoplasty (underlay technique)

Intraoperative pictures:



POSTOPERATIVE OUTCOMES AND DISCUSSION

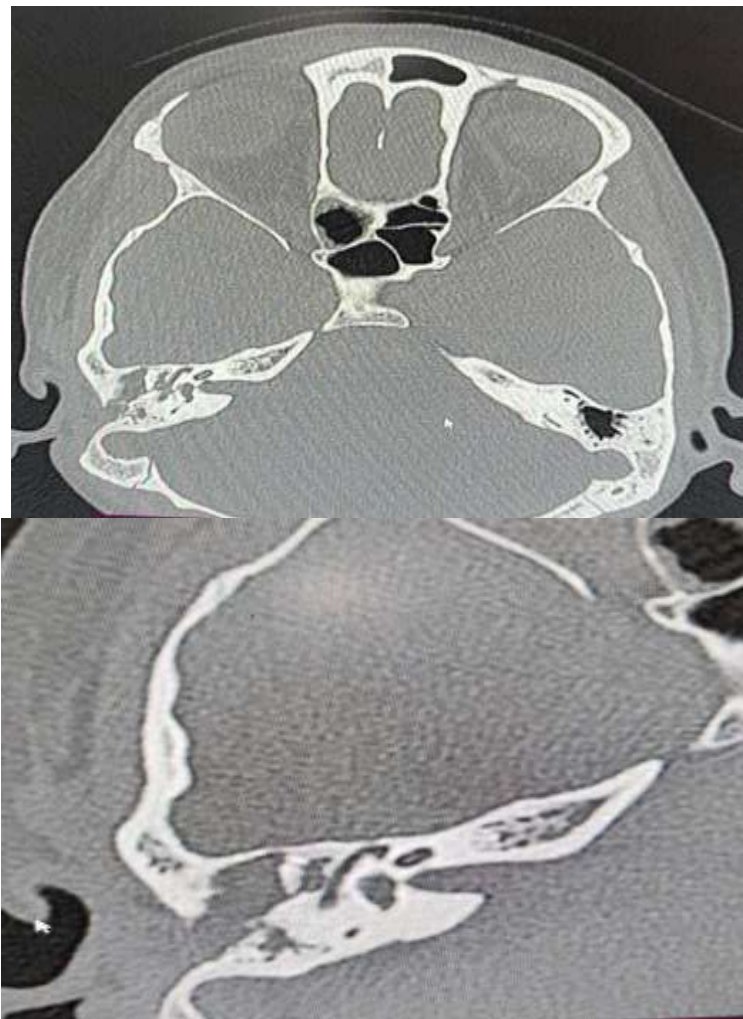
The postoperative recovery of the patient was marked by a highly successful clinical outcome. Following the detailed and anatomically precise surgical clearance of the sclerotic disease, the patient's hearing improved significantly.

This case serves as a vital focal point in the broader otological discussion regarding the management of tympanosclerosis. The condition is a well-documented and frequently encountered manifestation in patients with chronic otitis media.[11-13] However, the fundamental clinical controversy revolves around the risk-to-benefit ratio of surgical intervention. Because the complete excision of these dense plaques risks causing irreversible iatrogenic trauma to the delicate ossicular chain or the inner ear, many practitioners debate whether such removal will reliably result in auditory improvement.

The findings from this specific surgical intervention provide compelling evidence regarding this controversy. Similar uncertainty has been reported in surgical series of tympanosclerosis; Yetiser et al. noted that long-term success depended on the extent and location of tympanosclerotic involvement, and only a proportion of patients achieved closure of the air-bone gap to a satisfactory level, highlighting the variability of hearing outcomes after surgery. [14] In a larger intratympanic series, Ho et al. observed postoperative hearing improvement in 57.5% of ears, suggesting that meaningful auditory gain is possible when ossicular mobility can be restored, as in the present case. [4].

The surgical presentation was highly atypical and formidable, characterized by a "stony hard" mass of tympanosclerosis that caused total ossicular fixity and obstructed major middle ear pathways. The success of this procedure highlights the critical importance of surgical technique. It demonstrates that when armed with high-resolution preoperative mapping and utilizing exceptionally precise intraoperative drilling techniques, a surgeon can safely navigate the complex removal of these stony hard plaques without destroying the underlying structures.

POST OPERATIVE HRCT TEMPORAL BONE ON RIGHT SIDE:



CONCLUSION

In conclusion, this case strongly signifies that the precise surgical clearance of severe, stony hard tympanosclerosis can yield excellent clinical results. Despite the profound intraoperative challenges associated with severe ossicular fixity caused by extensive disease, meticulous surgical intervention can successfully restore the mechanical mobility of the middle ear and result in significant hearing improvement for the patient.

Conflicts of Interest: None declared.

ACKNOWLEDGEMENTS:

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