The Audiology of Otosclerosis

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KEYWORDS

• Carhart notch • Immittance measurement and otosclerosis • Reflectance
• Wideband acoustic immittance and otosclerosis • Middle ear muscle reflex
• Power absorbance and otosclerosis • Hearing aids and otosclerosis
• Tinnitus and otosclerosis

KEY POINTS

- For most patients with otosclerosis, audiologic biomarkers include reduced middle ear compliance as revealed by tympanometry, and a 10- to 15-dB reduction in sound transmission via bone conduction most often in the vicinity of 2000 Hz (known as Carhart notch).
- Wideband acoustic immittance is an effective technique in identifying middle ear pathologies, such as otosclerosis; it can provide all the useful information that could be obtained from conventional and multifrequency tympanometry and additional information on the transfer of energy into the middle ear system across much wider range of frequencies.
- Middle ear resonance frequency shifts to higher frequency regions in most of the otosclerotic ears.
- In addition to middle ear ossicular surgery, hearing aids and implantable hearing devices are alternative approaches for the management of hearing loss in patients with otosclerosis.
- Tinnitus sound therapy and cognitive behavioral therapy are successfully used for the management of tinnitus in the otosclerotic population.

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INTRODUCTION

For many otologists and audiologists, otosclerosis is not a puzzling condition anymore. Advances in diagnostic and therapeutic procedures have provided a vast number of patients with otosclerosis with proper management. This article is designed in a fashion that enables otologists in better diagnosis and management of otosclerosis with the use of audiologic procedures. The accuracy of audiometric air-bone gap, appropriate use of masking techniques, and immittance measurements can completely influence the decisions made by otologists for the surgical management of otosclerosis. Otologists rely on the precision of the audiologic results and determination of the degree of the conductive component. Therefore, a precise audiologic work-up is a crucial part of the diagnostic protocol for otosclerosis. This article reviews the audiologic diagnostic test battery and the audiologic management of auditory effects of otosclerosis.

AUDIOMETRIC PATTERNS

As with other middle ear disorders, otosclerosis reduces sound-related energy passing from the tympanic membrane to the inner ear. Fixation and resultant stiffening of the ossicular chain almost always produces a hearing loss, particularly for lower-frequency sounds. The characteristic pattern of hearing loss in otosclerosis is useful in diagnosing the disease.[1–3] The diagnostic value of hearing assessment is enhanced when such test procedures as pure tone audiometry, tympanometry, and acoustic reflexes are combined into a test battery. Indeed, for most patients with otosclerosis, a unique pattern of findings for an appropriate collection of auditory tests almost always contributes to early and accurate diagnosis. Basic hearing test findings in patients with otosclerosis are summarized in **Table 1**.

Table 1
Patterns of basic auditory findings in patients with the diagnosis of otosclerosis

Procedure	Findings
Pure tone audiometry	
Air conduction	Hearing loss greater for low frequencies.
Bone conduction	Apparent decrease in bone conduction thresholds sometimes with a notching deficit at 2000 Hz (Carhart notch). Actual bone conduction hearing is typically normal.
Audiometric Weber test	Perception of low-frequency pure tone stimuli in the ear with conductive hearing loss.
Sensorineural acuity level test	Presence of an air-bone gap and confirmation of normal bone conduction hearing.
Acoustic immittance measures	
Tympanometry	Shallow type A tympanogram reflecting increased stiffness of the ossicular chain (see immittance measurement section for further discussion).
Acoustic reflexes	Absence of stapedial acoustic reflex activity even in patients with minimal air-bone gap and conductive hearing loss. Atypical acoustic reflex pattern in patients with very early subclinical otosclerosis.
Otoacoustic emissions	Otoacoustic emissions cannot be detected in patients with otosclerosis and conductive hearing loss. Recovery of detectable otoacoustic emissions is possible in patients following microtraumatic stapedotomy.