

# Bilateral conductive hearing loss due to collapsed ear canals in a 35 years old female

## Abstract

We present a case study in which collapsed ear canals caused bilateral mild to moderate conductive hearing loss in a 35years old female, who was complaining of hearing difficulties, the audiometric test findings were misleading initially, but retesting with tympanometry tips in the ear canals, revealed bilateral normal hearing thresholds, stenting the ear canals with tympanometry tips initially and later on with custom made acrylic ear molds relieved the patient complaints.

**Keywords:** collapsed, ear, canal, conductive, hearing, loss

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**Abbreviations:** ANSI, american national standard institute; ART, acoustic reflex threshold; AC: Air Conduction; A-B, air-bone; C-VEMP, cervical-vestibular evoked myogenic potential; CT, computerized tomography; DB, decibel; KHZ, Kilo Hertz; PTA, pure tone audiometry; SCDs, superior canal dehiscence syndrome

## Introduction

Collapsed ear canals have been reported as a cause of inaccuracies during audiometric testing.<sup>1</sup> Were the first to describe the condition in 1961, when they noted a 15-30dB improvement in air conduction thresholds of two patients, when the ear canals were held patent during audiometry by plastic inserts.<sup>1,2</sup> reported that ear canal collapse was observed in four percent of their clinical population aged 8 to 76years, the majority of patients were over 65years old, but five cases were under 30years.<sup>2</sup> Ear canal collapse thought to be due to degenerative changes taking place in the elastic dermis of the external ear that is why it is more common in elderly population.<sup>3</sup> Incidence of ear canal collapse was reported to be as high as 36 per cent in the age- group between 60 and 79years.<sup>3</sup> however all age groups can be affected, anatomical factors either congenital or due to trauma may be predisposing factors in young patients.<sup>1,5</sup> Moreover,<sup>6</sup> had found impaired air conduction thresholds attributable to ear canal collapse, provoked by pressure from audiometric earphones, in 3.8 per cent of 282 children aged between six and nine years.<sup>6</sup>

## Case presentation

A 35years old Saudi women presented to ENT/Audiology clinic, King Abdul Aziz Medical City-Jeddah, Jeddah, Saudi Arabia with a complaint of decreased hearing of few months duration, with history of right ear discharge in the last month, otoscopic examination revealed right ear otomycosis and the condition was managed, two months later patient was seen for hearing assessment, where otoscopic examination was unremarkable, Audiometric assessment was carried out in an ANSI S12.2 standardized acoustic booth, using a calibrated Interacoustics AC40 Clinical Audiometer, using TDH39 supra-aural headphones for air conduction and Radio ear B-71 bone oscillator for bone conduction testing, the audiometer was calibrated according to the ANSI S3.6 standards, the test results revealed right moderate, left mild to moderate conductive hearing loss, Tympanometry was carried out using a GSI 38 tympanometer which was calibrated according to ANSI S3.6 standards, and the results showed type(As) tympanogram in right ear and type(A) tympanogram in the left ear, with partially present but elevated acoustic reflex thresholds.

Three months later patient was reassessed and audiometric testing was repeated again with the same supra-aural headphones and again revealed bilateral mild to moderate conductive hearing loss more at the high frequencies with A-B gap up to 50 dB at 4 KHZ frequency, Tympanometry also was repeated and showed bilateral type (A) tympanograms with partially present elevated ARTs in right ear and present mildly elevated ARTs in left ear, these findings were considered red flags to raise the suspicion of Superior Canal Dehiscence Syndrome, specially this patient had reported vague dizziness symptoms when asked about dizziness, so a C-VEMP testing using ER-3A insert phones was carried out for her, clear C-VEMP responses were obtained with larger response from the right ear compared to the left ear with a threshold down to 80 dB in both ears, these C-VEMP test findings increased the suspicion of SCDs, so a CT scan of temporal bones was ordered and surprisingly revealed no evidence of dehiscence or any other abnormalities of the temporal bones. During this time patient sought a second opinion in another medical facility, where amplification with hearing aids was prescribed for her, but the patient could not tolerate the amplification. At this point the suspicion of collapsed ear canals was generated and meticulous examination of the ear canals revealed narrowed slit like collapsed ear canals, which seems to be previously unnoticed; may be because the examiners rushed to pull the ear pinna upwards or immediately inserted the ear speculum into the ear canal.

Retesting PTA with appropriate size tympanometric tips inserted into the ear canals to keep their patency, revealed bilateral normal AC hearing thresholds. To figure out whether the collapsed ear canals caused a significant hearing impairment on daily life of this patient or only during audiometric testing with supra-aural headphones, a free field hearing test using warble tones was done and it confirmed the conductive hearing impairment but in average of 5dB less than that shown on PTA under supra-aural headphones. Patient was advised to use the tympanometry tips for few days until two acrylic custom made ear molds with large sound bores were manufactured for her with the use of ear molds patient's complaints were completely relieved.

## Discussion

Most of the reports on ear canal collapse focused on erroneous thresholds attributable to ear canal collapse, provoked by pressure from audiometric earphones.<sup>6,7</sup> However in our case presentation, the whole patient's symptoms were mainly due to ear canal collapse, being hard of hearing at home and on daily life, as confirmed by free field testing and could be successfully relieved with stenting of the

collapsed canals to keep them open, we even speculate that collapsed ear canals could hinder aeration and drainage of the external ear canal and might predispose to external otitis such as in this case.

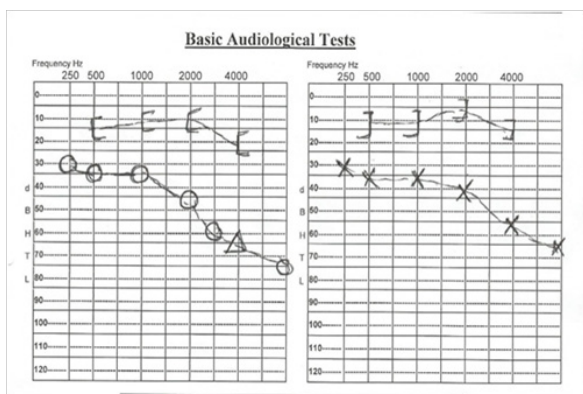


Figure 1 PTA thresholds with supra-aural headphone.

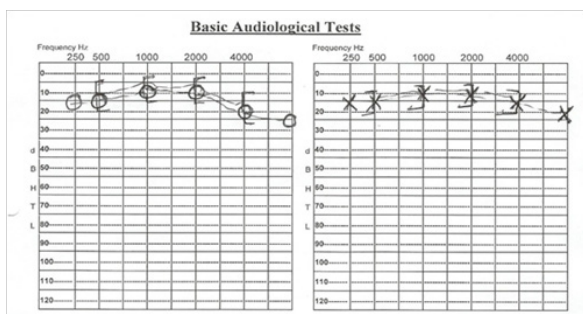


Figure 2 PTA thresholds with tympanometry tips in ear canal.

A-B gaps in this case have been observed bilaterally and across all frequencies with larger A-B gaps at high frequencies, this is in agreement with Marshall & Grossman who reported that air-bone gaps due to ear canal collapse, may be seen across the frequency range, although commonly more pronounced at high frequencies,<sup>8</sup> on the contrary to superior semicircular canal dehiscence syndrome where A-B gaps are commonly pronounced at frequencies lower than 1 KHz.<sup>9</sup> Inaccuracies in audiometric testing due to ear canal collapse, can lead to potential misdiagnosis and inappropriate management procedures such as unnecessary surgical exploration of middle ear or inappropriate amplification.<sup>7</sup> In the presented case costly investigations such as C-VEMPs and CT scan of the temporal bone were inappropriately requested, as well as the inappropriate amplification with hearing aids.

Various strategies were proposed for correction of ear canal collapse during audiometry such as use of circumaural earphones, which do not press on the pinna, and the insertion of tube, speculum, or an ear mold into the ear canal to keep it patent.<sup>7</sup> In this case we have used tympanometry tips to keep the ear canals patent during testing and afterwards at home for few days. We used opened custom made acrylic ear molds for long term use and they have been successful and convenient. Insert phone receivers such as the ER-3A can be used to alleviate collapsed ear canals during audiometric testing, in a study done by.<sup>10</sup> They reported that insert phones are effective for cases of collapsed ear canals in elderly individuals, reducing or even eliminating the A-B gap at higher frequencies.<sup>10</sup> When insert receivers are not available or inappropriate to use, another strategy can be used which is to test AC thresholds with the mouth open, this procedure was based on that the jaw movement in the wide opened position was reported to cause unblocking of collapsed ear canal.<sup>11</sup> Precautions

recommended to avoid thresholds inaccuracies due to ear canal collapse include otoscopic examination prior to audiometry in order to identify at risk or already collapsed ear canals and observing the effect of pressing the pinna against the head on canal patency.<sup>12</sup> Although our reported case has been otoscopically examined few times before diagnosis with different expertise levels, yet no body commented on collapsed ear canals initially, this could be due to many factors such as the young age of the patient with the unfamiliarity of collapsed ear canals at this age, rushing to pull the pinna upwards or inserting the otoscope speculum into the ear canal might opened the collapsed ear canals, another explanation is that examining the ear while mouth is open as during talking could unblock the collapsed ear canals and make the condition missed.<sup>11</sup>

Normal tympanometry results, specially the presence of acoustic reflexes associated with PTA thresholds suggestive of conductive hearing loss, contradicts the presence of true middle ear pathology, Acoustic Reflex is a considerably more sensitive indicator than A-B gap of hearing loss involving middle-ear abnormality.<sup>13</sup>

Clinicians should pay more attention to collapsed ear canals, identify them at beginning of ear examination, think about it when audiometric thresholds suggest conductive hearing loss especially at high frequencies, despite normal middle ear pressure and preserved acoustic reflex thresholds. Use of insert phone or test while keeping the ear canals patent with tympanometry tips, plastic tubes or ear specula can avoid the audiometric inaccuracies and the consequent misdiagnosis due to collapsed ear canals.

## Acknowledgments

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## Conflicts of interest

Author declares there are no conflicts of interest.

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