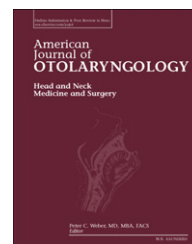


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# High rate of bilaterality in internal auditory canal metastases<sup>☆</sup>



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## ABSTRACT

**Purpose:** Presentation of three cases of metastatic carcinoma to the internal auditory canal bilaterally, as well as a systematic review of the literature regarding the characteristics of these lesions.

**Materials and methods:** Using a MEDLINE Ovid search (1946–2015), we identified and reviewed 102 cases of metastatic carcinoma to the internal auditory canal. Metrics recorded include: patient age, sex, tumor type, laterality, past oncologic history, co-occurring metastatic sites, clinical findings, radiographic findings, therapy received, and outcome. Cases of unilateral versus bilateral IAC were compared.

**Results:** Remarkably, 52.9% reported cases of internal auditory canal metastases have bilateral occurrence. The most common primary tumor sites for internal auditory canal metastases were lung (21.2%), skin (18.6%), and breast (16.7%), with lung and skin cancers having the highest rates of bilateral metastasis. Meningeal metastasis occurred at a much higher rate in bilateral cases (47.2%) versus unilateral cases (8.5%). Brain parenchymal metastasis also occurred at a higher rate in bilateral cases (38.2%) versus unilateral cases (19.2%). Outcomes for cases of internal auditory canal metastases are generally poor, with 56.3% of unilateral cases and 86.1% of bilateral cases reporting patient death within 5 years from diagnosis.

**Conclusions:** In cases of internal auditory canal metastasis, clinicians should carefully assess for not only contralateral disease but also additional metastatic disease of the central nervous system. Rapid-onset hearing loss, tinnitus, vertigo, or facial palsy should raise suspicion for internal auditory canal metastasis, particularly in patients with a known oncologic history.

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## 1. Introduction

Metastatic carcinoma in the internal auditory canal (IAC) or cerebellopontine angle (CPA) is uncommon, representing only

0.3%–0.7% of all lesions in this space [1,2]. However the IAC comprises roughly one quarter of metastatic sites in the temporal bone, second most after the petrous apex [3,4]. Metastasis from distant primary carcinomas to temporal bone

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sites most frequently occurs by hematogenous spread, cerebrospinal fluid (CSF) dissemination, or extension from adjacent meninges [5].

Here we present a systematic review of the international literature on IAC metastases from distant primary sites as well as introduce three new cases of metastatic carcinomas to the IAC bilaterally from prostatic carcinoma, pulmonary adenocarcinoma, and malignant melanoma. We focus on unique attributes of carcinomas that have bilateral IAC involvement, including tumor type, clinical features, radiographic features, and co-occurring sites of metastases.

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## 2. Materials and methods

### 2.1. Search strategy and criteria

We conducted a MEDLINE Ovid search (1946–2015) using the terms “metastasis” and “internal auditory canal” or “cerebellopontine angle.” By searching the references of the articles yielded by this search, we identified additional cases. Articles were included if they presented the original case descriptions of distant metastasis to the IAC or CPA. Articles were excluded if they were not written in the English language or if they were not available through a multi-institutional library search. All cases of primary malignancy arising from the IAC were excluded. Because we wanted to focus on distant metastases, cases were excluded if the IAC metastasis occurred by contiguous spread from an adjacent primary site. Cases were also excluded if they involved distant carcinomas metastasizing to primary tumors, known as collision tumors.

### 2.2. Data collection and analysis

Both authors independently reviewed relevant articles. The following metrics were recorded for each case when available: patient age, sex, tumor type, laterality, past oncologic history, co-occurring metastatic sites, clinical findings, radiographic findings, therapy received, and patient outcome. In addition to characterizing various properties of IAC metastases as a whole, we also compared characteristics between unilateral and bilateral cases of IAC metastasis. We used the student t test or chi-squared test to determine statistical significance, set at  $p < .05$ .

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## 3. Case reports

### 3.1. Case 1: metastatic melanoma

A 64 year-old male with a 20-year history of BRAF-mutant melanoma presented to an otolaryngologist after 10 days of acute onset bilateral hearing loss and 2 years of progressively worsening balance, headache, and tinnitus. Of note, ten years prior he had neck and axillary lymph node metastases requiring radical neck and axillary dissection with adjuvant chemotherapy and immunomodulatory agents. On exam he was noted to have severe difficulty with balance and decreased hearing bilaterally. Pure tone audiometry showed

profound sensorineural hearing loss bilaterally. Gadolinium-contrast magnetic resonance imaging (MRI) of the head revealed bilateral IAC enhancements, with a  $29 \times 4$  mm lesion on the right and a  $8 \times 3$  mm lesion on the left (Fig. 1A, B). Also of note was an extra-axial mass in the anterior fossa floor measuring  $2.1 \times 2.1 \times 2.8$  cm. CSF cytopathology revealed the presence of melanoma cells. The diagnosis of metastatic melanoma to bilateral IAC was made. Given the extent and growth rate of the lesion, the patient underwent whole brain radiation with chemotherapy and steroid treatment. While the patient gained some preservation of hearing on the left side, he experienced permanent loss of hearing on the right side. The patient continued to have a neurocognitive decline and ultimately died from complications related to extensive brain metastasis 4 months into treatment.

### 3.2. Case 2: metastatic prostate carcinoma

A 76-year-old male with a 3-year history of metastatic prostate cancer to the paranasal sinuses presented to his otolaryngologist after acute onset of right-sided facial weakness, and progressively worsening bilateral deafness and tinnitus. At the time he was being treated for prostate cancer by chemotherapy and yearly androgen suppression therapy. On exam he was found to have right-sided facial weakness (House-Brackmann grade 5) and saccadic motions with right head thrust. Audiometry evaluation revealed profound hearing loss on the right and moderate hearing loss on the left. Videonystagmography showed reduced vestibular function bilaterally. Gadolinium-contrast MRI showed a  $3.5 \times 1.7$  cm extra-axial lesion in the right IAC as well as a nodular enhancement in the left IAC. There was substantial infiltration of the facial nerve bilaterally. The diagnosis of metastatic prostate cancer to bilateral IAC was made. The patient subsequently underwent an orchiectomy to reduce tumor load. Because of the extent of his metastatic disease, a conservative approach was taken in management of his IAC metastases with steroids and palliative whole-brain radiation. The patient had mild hearing improvement on the left side but had no improvement in hearing or tinnitus on the right side. At 27-month follow up, the patient was alive and still undergoing systemic chemotherapy and androgen suppression therapy with no major radiographic changes in tumor size.

### 3.3. Case 3: metastatic lung adenocarcinoma

A 76-year-old female with a 20-pack year smoking history presented to her primary care physician after a fall. Upon further questioning, it was found that she was experiencing a rapid decline in balance and bilateral facial weakness. Physical examination by an otolaryngologist revealed sensorineural hearing deficit on the left side, bilateral facial weakness (House-Brackmann grade 3) delayed saccades bilaterally. Audiogram showed left profound sensorineural hearing loss with 0% speech discrimination and right normal hearing with 100% speech discrimination. Serial gadolinium-contrast MRIs revealed rapid expansion of a left IAC mass from  $0 \times 0$  cm to  $6 \times 6 \times 11$  cm over the course of three months. Additionally seen was a nodular enhancement

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