ORIGINAL ARTICLE

Imaging Diagnosis of Benign Lesions of the External Auditory Canal

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KEYWORDS
CT scan; External auditory canal; Exostosis; Osteoma; Cholesteatoma; Keratosis obturans; Haemangioma; Branchial cyst; Otitis externa

Abstract
Introduction and objectives: Benign lesions of the external auditory canal (EAC) are an infrequent cause of temporal bone CT scan requests. We are not usually well-versed in the different pathologies located in the EAC, perhaps because it is "only" a conduit and the relevant anatomical structures are located in the middle and inner ear. Our objective was to improve knowledge of this structure by reviewing the different benign conditions found in this location.

Methods: We reviewed the CT studies from 2 years (January 2010 through January 2012), selecting those containing lesions in the EAC. To complement this, due to the importance of these lesions, these medical histories were then analysed considering the presentation and otoscopic examination findings.

Results: The lesions were classified according to their diagnoses: exostosis, osteoma, cholesteatoma, keratosis obturans, haemangioma, non-neoplastic aural polyp, first branchial cyst and dermatologic disease (malignant external otitis). The presence of EAC occupation in the otological examination and chronic otorrhea as the symptom of presentation were the most relevant exploratory and clinical findings.

Conclusions: Benign EAC lesions are an uncommon and seldom studied cause of temporal bone CT scan requests. Knowing the most relevant clinical and radiological findings is necessary for their proper diagnosis.

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PALABRAS CLAVE
TC de hueso temporal; Canal auditivo externo; Exostosis;

Diagnóstico por imagen de las lesiones benignas del conducto auditivo externo

Resumen
Introducción y objetivos: Las lesiones benignas del conducto auditivo externo son una causa infrecuente de estudio en la TC de peñascos. Tal vez porque es «solo» un conducto, y las estructuras anatómicas relevantes se encuentran en el oído medio e interno, generalmente no están bien valoradas las diferentes afecciones que asientan en el conducto auditivo externo.

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Con el objetivo de mejorar el conocimiento de esta estructura se llevó a cabo una revisión de las lesiones benignas que podemos encontrar en esta localización. 

**Métodos:** Se trata de un estudio retrospectivo en el que se revisaron las imágenes de la TC de peñascos realizados en 2 años (enero de 2010 a enero de 2012). De ellos, se seleccionaron aquellos en los que el informe radiológico reportaba lesiones del conducto auditivo externo.

Posteriormente, y también de forma retrospectiva se realizó un análisis de las historias médicas de los pacientes, valorando los hallazgos clínicos y la exploración otoscópica. 

**Resultados:** Las lesiones fueron clasificadas según su diagnóstico en: osteoma, colesteatomatosa, queratosis obturans, hemangioma, pólipos aurales neoplásicos, quiste de primer arco branquial y enfermedades dermatológicas (otitis externa maligna). Los hallazgos clínicos más frecuentemente encontrados fueron la otorrea crónica como síntoma de presentación y la ocupación del conducto en la exploración otoscópica.

**Conclusiones:** Las lesiones que afectan al canal auditivo externo son estudiadas de forma infrecuente en la TC de peñascos. Es necesario conocer los hallazgos clínicos y radiológicos más relevantes para poder realizar su correcto diagnóstico y estudio.

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### Introduction

The external auditory canal (EAC), approximately 3.5 cm long, consists of an external cartilaginous part and an internal osseous segment. The cartilaginous part is shaped like an italic “S”, inclined with respect to the bony portion, which protects the middle ear from external intrusions.

The cartilaginous segment is joined to the osseous part by connective tissue. This union presents a physiological thinning called «isthmus», which traps most foreign bodies at this level.

The osseous part is covered by a fine skin layer tightly adhered to the periosteum, lacking glandular annexes. In contrast, the cartilaginous segment presents numerous sebaceous and ceruminous glands, as well as the fissures of Santorini; these allow bacterial infections to spread towards the parotid, the infratemporal fossa or even the skull base.

Embryologically, the EAC originates in the first branchial cleft (adjacent to the endoderm of the first pharyngeal pouch), which stems from the ectoderm, and is initially composed of dorsal and ventral sections. The dorsal part turns into the EAC and the ventral section disappears. At times, the ventral part can persist, producing the later appearance of developmental anomalies of the first branchial cleft: cyst, sinus or fistula.

The objectives of this study were to extend the knowledge of this anatomic structure and to revise the radiological characteristics of the benign lesions that can be found in this location.

### Methods

This was a retrospective study in which computed tomography (CT) images of the petrous bone taken between January 2010 and January 2012 were revised. From these, we chose those in which the radiological report indicated benign EAC lesions.

After that, we analysed the case histories of the patients retrospectively, collecting the clinical findings (presentation) and the otoscopic examination.

### Results

The lesions found were classified based on their diagnosis into the following: exostosis, osteoma, colesteatomatosa, kerato- sis obturans, haemangioma, non-neoplastic auricular polyp, first branchial arch cyst and dermatological diseases (malignant otitis externa) (**Table 1**).

The most frequent clinical findings were chronic otorhea as the presenting symptom and EAC occupation in the otoscopic examination.

#### Exostosis

In otoscopy, this is seen as multiple broadly based bony formations, covered by a fine, pale skin layer, only slightly vascularised.

In the petrous bone CT, it is seen as lesions emerging from the bony section of the EAC. It has bony density, a broad base and is generally bilateral (**Fig. 1**).

#### Osteoma of the External Auditory Canal

In the petrous bone CT (**Fig. 2**), this is seen as a lesion secondary to localised osseous growth, rounded and narrow-based, delimited by the cortical bone and emerging from the line adjacent to the tympanosquamosous suture, in the union of cartilage and bone.

### Table 1 Benign Lesions of the External Auditory Canal (EAC) According to Diagnosis and Frequency.

<table>
<thead>
<tr>
<th>EAC lesions</th>
<th>Total lesions: 26 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exostosis</td>
<td>9 (34.6)</td>
</tr>
<tr>
<td>Osteoma</td>
<td>3 (11.5)</td>
</tr>
<tr>
<td>Cholesteatomatosa</td>
<td>3 (11.5)</td>
</tr>
<tr>
<td>Kerato- sis obturans</td>
<td>3 (11.5)</td>
</tr>
<tr>
<td>Haemangioma</td>
<td>1 (3.8)</td>
</tr>
<tr>
<td>Non-neoplastic auricular polyp</td>
<td>4 (15.4)</td>
</tr>
<tr>
<td>First branchial arch cyst</td>
<td>1 (3.8)</td>
</tr>
<tr>
<td>Dermatological diseases</td>
<td>2 (7.7)</td>
</tr>
</tbody>
</table>
Cholesteatoma of the External Auditory Canal

In the otoscopy, a soft tissue lesion that erodes the canal can be seen, normally in the anterior or lower wall, without affecting the tympanic membrane.

In the petrous bone CT, it presents as an expansive, dense unilateral lesion in soft tissue, located in the bony section of the canal. It normally enlarges the EAC (Fig. 3A) due to light remodelling of its walls. However, it can sometimes be more aggressive (Fig. 3B) (which can lead to confusing it with other neoplastic or infectious canal lesions); osseous fragments can be seen inside the canal (Fig. 4), as well as periostitis secondary to necrosis of the adjacent osseous tissue. This finding, although less frequent, is fairly characteristic of this condition.

The lesion is generally limited to the EAC. However, it can sometimes invade the middle ear (Fig. 5), in which case it is radiologically indistinguishable from a cholesteatoma originating in the middle ear.

Keratosis Oblurans

In the petrous bone CT (Fig. 6), this can be seen as a soft tissue lesion, generally bilateral, that occupies the EAC. It is expansive and dilates the canal walls, without erosion of the underlying bone.

Haemangioma

In the petrous bone CT (Fig. 7), this presents as a rounded, well-defined soft tissue lesion, generally unilateral, which emerges from the tympanic membrane without erosion of the adjacent structures.

Non-Neoplastic Aural Polyp

The petrous bone CT (Fig. 8) shows an irregular soft tissue lesion at the bottom of the EAC, generally dependant on the tympanic membrane. It is usually associated with concentric increase of soft tissue density of the canal walls, without signs of bony erosion.

First Branchial Arch Cyst

In the petrous bone CT (Fig. 9), this is seen as a soft tissue lesion, originating in the floor of the cartilaginous section of the EAC. A fistulous tract that connects the lesion with the deep lobe of the parotid can sometimes be seen.

Malignant Otitis Externa

In the CT and magnetic resonance (MR) images, the early signs of malignant otitis externa are very subtle. Later on, there is soft tissue increase, fatty plane obliteration, bony.

Figure 1  (A) Axial CT: bilateral exostoses and (B) enlarged image of exostosis of the left ear.

Figure 2  Axial CT: osteoma of the left ear.

Figure 3  (A) Coronal CT section: cholesteatoma of the right ear (black arrow) with bony erosion limited to the EAC and (B) coronal CT section: cholesteatoma of the EAC, with irregular bony erosion (white arrow).
Figure 4  (A) Oblique sagittal CT. Cholesteatoma of the EAC showing bony fragments inside; (B) oblique sagittal CT of the contralateral healthy ear, for comparison, showing intact EAC walls and (C) Coronal CT of the same ear as in section A.

Figure 5  Coronal CT of the left ear: cholesteatoma of the EAC with invasion of the middle ear.

Figure 7  Coronal CT: haemangioma of the left ear.

Discussion

This article presents a revision of the benign conditions that affect the EAC, which vary widely and are seldom studied in imaging tests, carrying out a correlation between the radiological findings and clinical examination.

Figure 6  Axial (A) and coronal (B) CTs: bilateral keratosis obturans, active in the right ear (white arrow) and treated in the left ear (black arrow).
exostosis). The CT of the EAC makes us consider the differential diagnosis between exostosis and osteoma of the canal. To distinguish between them, 2 factors can be assessed: the location (unilateral in the case of osteoma and bilateral in exostosis) and the base of bony implantation (narrow in the osteoma and wide in the exostosis).²,⁶

If we observe a soft tissue lesion in the EAC, we can initially think of a keratosis obturans or in a cholesteatoma of the EAC. More rarely, it could be a haemangioma, non-neoplastic aural polyp or first branchial arch cyst.

The main radiological differences between the EAC cholesteatoma and the keratosis obturans are their location (generally bilateral in keratosis and unilateral in cholesteatoma) and the bony erosion of the canal walls (absent in keratosis and present in cholesteatoma).⁷,⁸ The fact that the treatment is different for the 2 conditions (out-patient cleaning in the case of keratosis obturans and surgical for cholesteatoma) makes correct differential diagnosis between these conditions essential.

A non-neoplastic aural polyp is sometimes difficult to differentiate radiologically from a middle ear cholesteatoma with extension to the EAC, with the bony erosion of the canal walls being the key for distinguishing them.

Malignant otitis externa is an EAC infection that normally affects very elderly immunocompromised or diabetic patients; the organism most frequently involved is Pseudomonas aeruginosa. In the radiological study of this condition, it is important to assess the extension of the infectious process towards the adjacent anatomic structures. The infection can spread towards the auricle and soft tissues, as well as towards the parotid, retromandibular and skull base regions (producing skull base osteomyelitis, affection of the lateral sinus and cranial nerves).³,⁴

It is important to correlate the patient’s clinical symptoms with the radiological findings to establish the diagnosis.

**Figure 8** Non-neoplastic aural polyp of the right ear.

**Figure 9** Axial (A) and coronal (B) CTs: first branchial arch cyst (white arrow).

**Figure 10** (A) Coronal projection CT. Concentric increase of soft tissues in the EAC. Non-contrasted (B) and gadolinium-enhanced axial T1-weighted MRI (C): malignant otitis externa of the right ear, with extension to the skull base affecting the jugular foramen with soft tissue component extending in the superior parapharyngeal space up to the pharyngeal recess. (*) The mastoid and the occipital condyle are also affected.
of malignant otitis externa as quickly as possible, given that the prognosis of the disease depends on early treatment and on the existence or absence of facial paralysis or venous sinus thrombosis.

Conclusions

The lesions affecting the EAC are rarely studied in petrous bone CTs.

It is important to carry out a radiological–clinical correlation on such lesions to be able to correctly diagnose, study and treat them.

Conflict of Interests

The authors have no conflict of interests to declare.

References


