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Case Report

# Cholesteatoma: diagnosis, management and follow-up, and an interesting case report

Aikaterini Lianou[1], Magdalini Bizoglou[1], Dimitra Simou[1], Georgios Psychogios[1]

1 *Department of Otorhinolaryngology, Head and Neck Surgery, Faculty of Medicine, School of Health Sciences, University of Ioannina, Ioannina, Greece*

**Corresponding author:** Aikaterini Lianou, Department of Otorhinolaryngology, Head and Neck Surgery, Faculty of Medicine, School of Health Sciences, University of Ioannina, Ioannina, Greece; Email: lianoynikoletta@yahoo.gr

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## Abstract

Cholesteatomas are benign tumors composed of skin-related substances. They can extensively infiltrate the ear and compromise surrounding structures, requiring surgical removal. Computed tomography can assist with surgical planning by illustrating the position and impact of the cholesteatoma. Recent advancements in magnetic resonance imaging have demonstrated enhanced visualization of cholesteatomas. Whereas additional surgical intervention was formerly necessary to identify cholesteatoma recurrence, magnetic resonance imaging can now often serve as an alternative. This paper reviews the current evidence on diagnosing, managing, and following up with patients with cholesteatoma. It also presents an interesting case that highlights the value of diffusion-weighted imaging (DWI), even in cases of initial diagnosis.

## Keywords

cholesteatoma of middle ear, imaging techniques, non-echoplanar diffusion-weighted MRI (non-EP DW-MRI)

## Introduction

Cholesteatoma is a rare but serious condition where an abnormal collection of skin cells forms in the middle ear, often as a result of chronic ear infections or poor eustachian tube function.[1] Cholesteatomas are classified into two main types: congenital and acquired. Congenital cholesteatomas are uncommon (4%–24% of cholesteatomas overall), develop in children and are typically found incidentally as a white mass behind an intact eardrum.[2-4] Acquired cholesteatomas are more prevalent and develop later in life. They predominantly arise from chronic suppurative otitis media (CSOM), characterized by persistent ear discharge (otorrhea). They can be further categorized into those associated with a retraction pocket (primary acquired cholesteatoma) or those associated with a perforation (secondary acquired cholesteatoma). Acquired cholesteatomas can be characterized based on their sites of origin as either pars flaccida (about 80% of cases) or pars tensa (approximately 20% of cases), which can erode local structures if left untreated.[5]

Diagnosing cholesteatoma requires ruling out other conditions that might cause similar symptoms, such as chronic otitis media, tympanic membrane retraction without cholesteatoma, and tumors in the ear or temporal bone.[6]

Thus, the diagnosis of cholesteatoma involves a combination of clinical evaluation, imaging studies, and, in some cases, audiometric testing. Treatment is always surgical and post-operative follow-up is necessary. Here is an overview of the diagnostic process, treatment, and follow-up of these patients.

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## Diagnostic procedure

### *Clinical history and physical examination*

Patients often present with symptoms like chronic ear drainage (otorrhea with bad smell), recurrent otitis media, hearing loss, a feeling of pressure or fullness in the ear, tinnitus, dizziness, or even balance problems. Sometimes, facial weakness or paralysis may occur in more advanced cases due to involvement of the facial nerve. An otoscopy is essential to inspect the ear canal and eardrum (tympanic membrane). A cholesteatoma may appear as a white or yellowish mass behind the eardrum or in the middle ear space. The eardrum may be retracted or perforated.[7]

### *Imaging*

A high-resolution computed tomography (CT) scan of the temporal bone is the primary imaging tool for cholesteatoma diagnosis. The CT scan helps assess the extent of the disease and its correlation to important anatomical structures, showing erosion of the bony structures in the middle or inner ear (like the ossicles, mastoid bone, horizontal semicircular canal, or even the facial nerve canal). Therefore, CT is essential for surgical planning. The negative predictive value is high when the middle ear and mastoid are well aerated and clear of bone erosion.[8] But opacification of the middle ear can complicate the differentiation of cholesteatoma from other middle ear substances, such as granulation tissue, fibrosis, or fluid.

Magnetic resonance imaging (MRI) is not usually the first-line diagnostic tool but may be used in certain situations to differentiate cholesteatoma from other middle ear masses or when recurrence is suspected after surgery. Cholesteatomas are of high T2W signal and intermediate to low T1W signal. Nonetheless, distinction from other middle ear disorders is constrained on typical anatomical processes. Diffusion-weighted MRI (DWI) is particularly useful in detecting cholesteatomas and postoperative recurrences without exposing the patient to radiation. Furthermore, DW-MRI is particularly effective in identifying small cholesteatomas, as small as 3-4 mm, which can be missed on standard imaging techniques like CT or T1/T2-weighted MRI. This is particularly important for congenital cholesteatomas, which can be present even in asymptomatic children or in those with minimal symptoms **(Fig. 1)**.[9]

### *Audiometry*

A formal audiometric evaluation can assess the degree and type of hearing loss associated with cholesteatoma. Typically, the hearing loss is conductive, meaning that sound

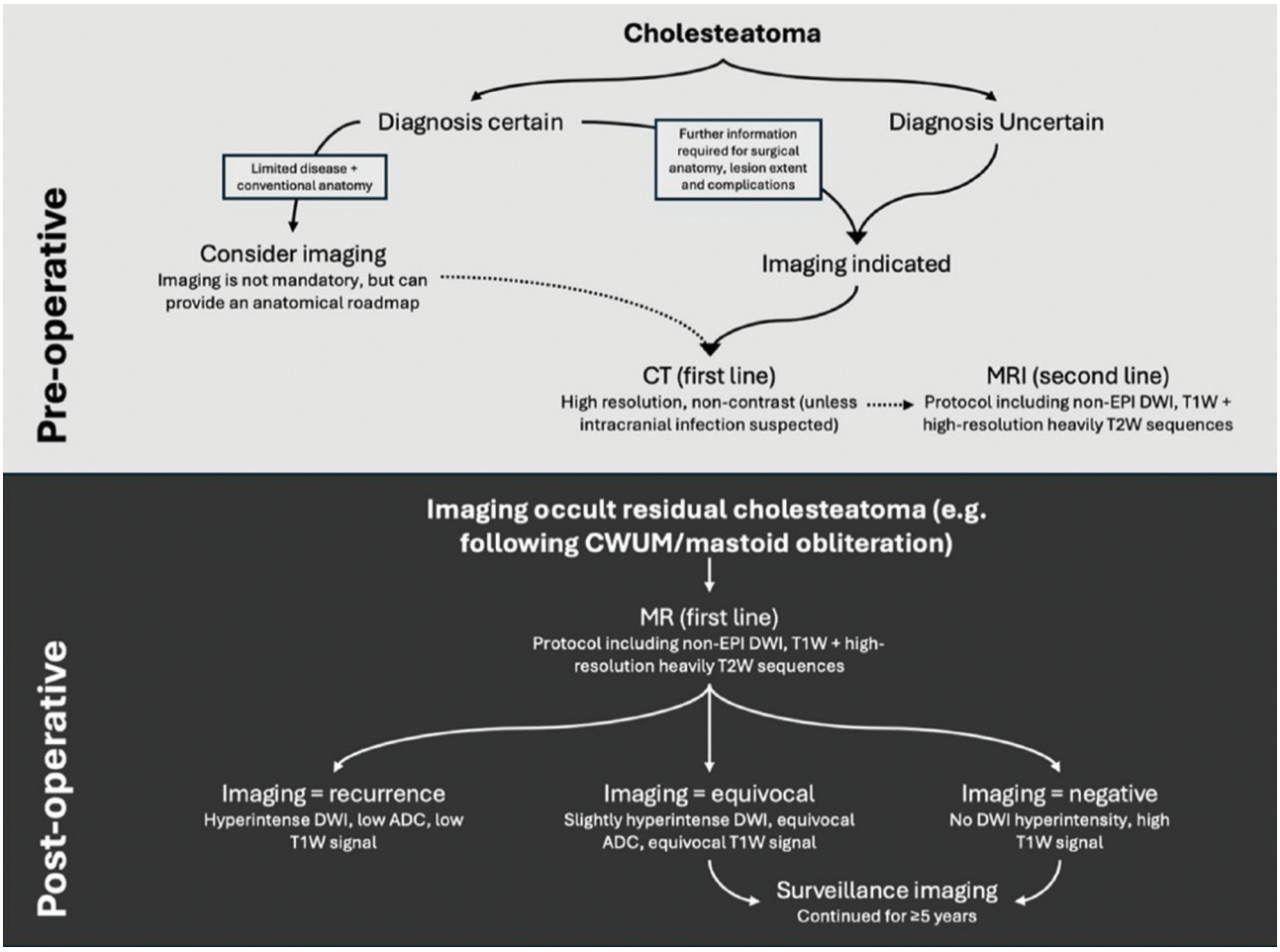


**Figure 1.** Flow chart indicating pre-operative and post-operative imaging strategies for the evaluation of cholesteatoma.[16]

is blocked from passing through the middle ear structures. However, in more advanced cases, sensorineural hearing loss can occur if inner ear structures are affected.[7]

### *Surgical management*

In some cases, definitive diagnosis may require direct visualization during surgery. If the cholesteatoma is suspected but not definitively confirmed by imaging, an exploratory tympanomastoidectomy may be performed, allowing the surgeon to see and remove the cholesteatoma. Histopathological examination should confirm the diagnosis of cholesteatoma if the mass is removed surgically.

The predominant method for excising a cholesteatoma is through a retro-auricular route. This is classified based on the removal of the posterior external auditory canal (EAC) wall, either as canal wall down mastoidectomy (CWDM) or canal wall up mastoidectomy (CWUM). Minimally invasive endaural or transcanal techniques can be utilized for smaller cholesteatomas, involving restricted bone excision such as atticotomy or atticoantrostomy. Endoscopic procedures are increasingly utilized, and precise definition of lesion extent is essential for optimum patient selection and to prevent conversion to open surgery.[10]

In adults, the surgical method markedly affects the likelihood of residual disease, with elevated rates observed after CWUM (9%–70%) in contrast to CWDM (5%–17%).[11] In pediatric patients, the incidence of residual disease is notably elevated (16%–54%); however, the surgical method does not seem to have a substantial impact.[12] However, when the EAC wall is intact, any remaining cholesteatoma is generally clinically undetectable. Consequently, until the extensive implementation of MRI surveillance, patients receiving CWUM necessitated a secondary surgical procedure 9–12 months post-initial surgery to detect and excise any remaining disease. The incidence of residual disease can be diminished by employing endoscopic techniques, which offer visibility of surgical 'blind spots'.[13]

## Follow-up

Cholesteatoma is a condition that requires surgery, but due to the risk of incomplete removal or recurrence, postoperative imaging is crucial for long-term management. Non-echoplanar diffusion-weighted MRI (non-EP DW-MRI) plays a significant role in detecting recurrent or residual cholesteatoma after surgery. Non-EP DW-MRI is preferred over traditional echoplanar (EP) MRI for its superior ability to visualize small residual lesions with fewer artifacts.[14]

Cholesteatoma tissue shows restricted diffusion due to its dense keratin content. Diffusion-weighted imaging (DWI) takes advantage of this property by highlighting cholesteatomas as hyperintense (bright) areas on imaging. Traditional EP DWI can suffer from artifacts, especially in regions with complex anatomy like the middle ear, due to the presence of air-bone interfaces. Non-EP DW-MRI overcomes these limitations by providing higher spatial resolution and reducing susceptibility artifacts, allowing for better visualization of the small anatomical structures in the middle ear. Studies have shown that non-EP DW-MRI can detect residual or recurrent cholesteatomas as small as 3-4 mm. It has a sensitivity range of 90-94% and a specificity close to 100%, making it one of the most reliable imaging tools for postoperative follow-up.[15]

## Case presentation

*An intriguing case is an 8-year-old boy who had undergone a thorough examination elsewhere. Otomicroscopy revealed a white mass beneath an intact eardrum in the left ear. Nevertheless, in the absence of tympanic perforation, otorrhea, and hearing loss, the physicians thought it was tympanic sclerosis* ***(Fig. 2)****. A CT scan of the temporal bone revealed a mass in the left middle ear and mastoid. However, it could not ascertain if it was a congenital cholesteatoma* ***(Fig. 3)****.*

*An MRI scan subsequently revealed fluid in the mastoid bone, but it could not confirm the presence of a cholesteatoma* ***(Fig. 4)****. Conversely, non-EP DW-MRI revealed a small cholesteatoma (4 mm) in the left middle ear* ***(Fig. 5)****. The absence of perforation, together with this finding, indicated the diagnosis of congenital cholesteatoma. This case underscores the significance of DWI in initial diagnosis, since only DW-MRI facilitated the identification of congenital cholesteatoma.*

## Discussion

Residual cholesteatomas can occur from incomplete removal of the cholesteatoma matrix during surgery, often because of the complex anatomy of the middle ear and mastoid. Non-EP DW-MRI can detect these residual lesions early, preventing further complications like hearing loss or the need for additional extensive surgery. Although, even after complete removal, cholesteatomas can recur. Recurrent cholesteatoma results from the reformation of a retraction pocket. Non-EP DW-MRI is highly effective in identifying these recurrences months or years after the initial surgery. Cholesteatomas typically need time to regrow (2.7–4 mm per year) and reach a size detectable on imaging, so non-EP DW-MRI is usually performed 12 months postoperatively, and then periodically thereafter for at least 5 years.[16]

While CT is excellent for evaluating bony erosion caused by cholesteatoma, it cannot reliably differentiate cholesteatoma from other soft tissue masses or postoperative changes, like scar tissue. Non-EP DW-MRI, however, is specifically sensitive to the restricted diffusion characteristics of cholesteatoma, making it more accurate for detecting residual disease. Traditional MRI, even with contrast, is less sensitive for small cholesteatomas. EP-DWI, though useful, is often plagued by distortion artifacts due to the nearby air-bone interfaces in the middle ear, making non-EP DW-MRI the preferred technique due to its reduced artifact profile and higher diagnostic accuracy.[17]



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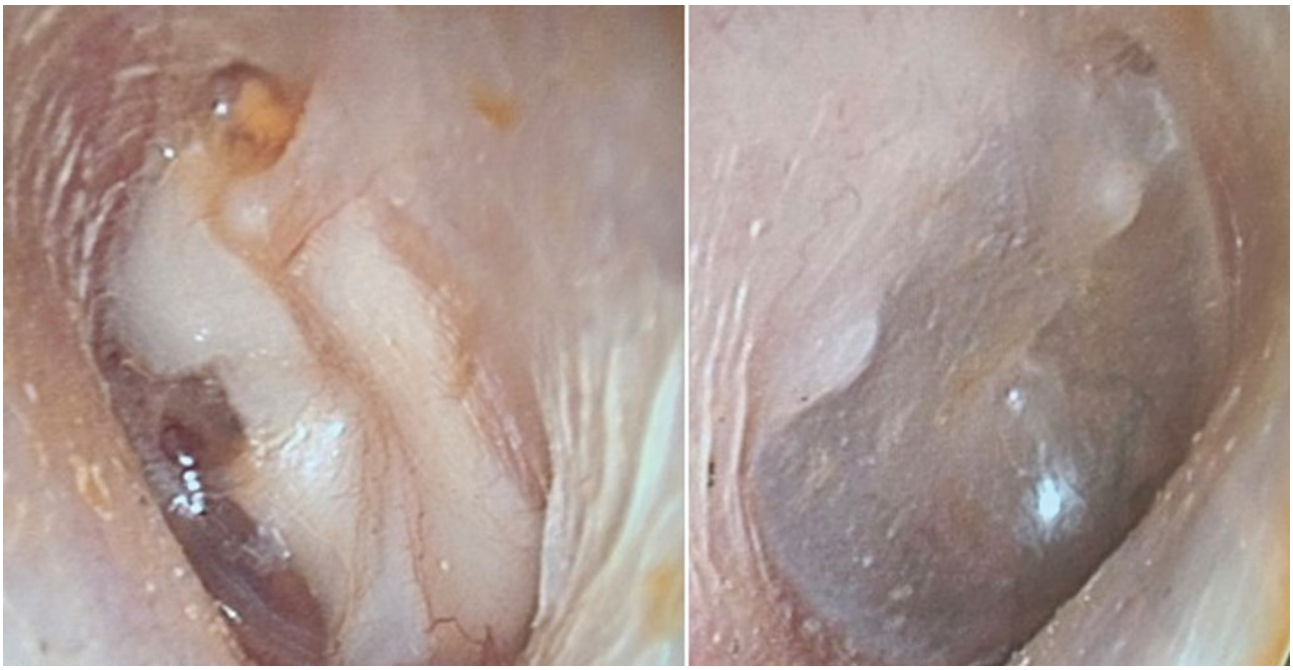

**Figure 2.** Otoscopic image of left and right ear.

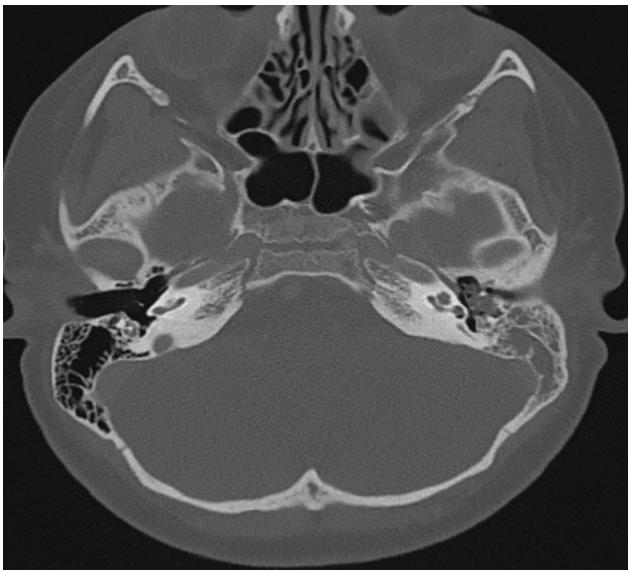

**Figure 3.** CT scan image of the temporal bone shows a mass in the left middle ear and mastoid bone.

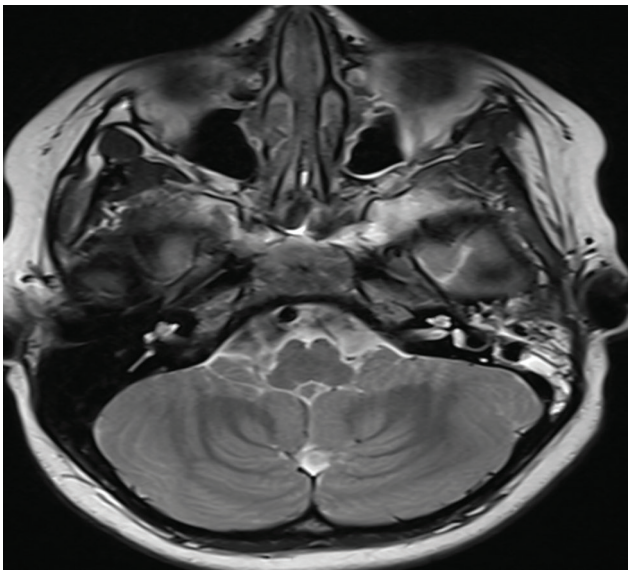

**Figure 4.** MRI scan image showing the presence of fluid in the left mastoid bone (T2 TSE Tra).

The clinical utility of non-EP DW-MRI is great. Before the advent of non-EP DW-MRI, patients usually underwent routine second-look surgery (a second operation to ensure that all cholesteatoma tissue had been removed). Non-EP DW-MRI has reduced the need for these invasive procedures by providing a non-invasive, reliable way to check for residual disease. Also it improves surgical planning.[18] When residual or recurrent disease is detected, non-EP DW-MRI helps in precisely localizing the cholesteatoma, aiding in better pre-surgical planning for any necessary reoperation. Furthermore, non-EP DW-MRI is typically performed between 12 and 18 months after surgery, depending on the patient's clinical course. If no disease is found, repeat imaging is done periodically (e.g., in 3 and 5 years), allowing for early detection of any recurrence.[19]

Undoubtedly there are limitations to its use. While non-EP DW-MRI is highly sensitive, very small cholesteatomas (less than 3 mm) may still escape detection. Repetition of the examination after time can overcome this problem. Furthermore, close clinical follow-up remains essential in patients at high risk for recurrence. Also, non-

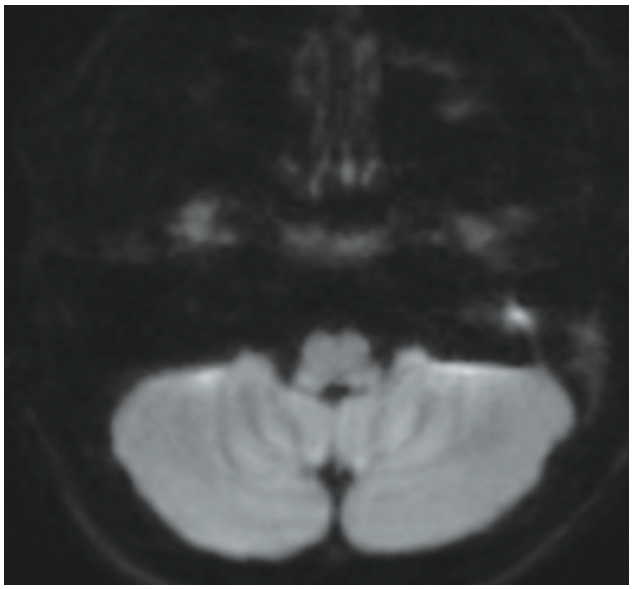

**Figure 5.** Non-EP DW-MRI image (serolve 4 scan trace Tra p2 s2 trace) shows left middle ear cholesteatoma as hyperintense (bright) area.

EP DW-MRI is not universally available and the technology may be more expensive than other imaging modalities. However, its high sensitivity and specificity make it a cost-effective tool in the long run by reducing the need for unnecessary surgeries.[20]

## Conclusion

Diagnosing cholesteatoma involves a combination of careful history-taking, clinical examination (otoscopy), imaging (mainly CT scans), and, if necessary, hearing tests or surgery for confirmation. Early detection is crucial to prevent complications, such as hearing loss, facial nerve damage, or even the spread of infection to the brain. Non-EP DW-MRI is a valuable tool in the follow-up of patients with cholesteatoma, offering high sensitivity and specificity for detecting residual or recurrent disease and also, in initial diagnosis of congenital cholesteatomas. By minimizing artifacts and providing better image resolution than echoplanar DWI, it significantly reduces the need for second-look surgeries and helps in early identification of disease, ensuring better outcomes for patients.

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## Author contributions

Conceptualization: A.L. and G.P.; methodology: A.L. and G.P.; formal analysis: A.L.; data curation: A.L. and G.P.; writing—original draft preparation: A.L.; writing—review and editing: A.L., M.B., and D.S.; supervision: A.L. and G.P.

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## References

1. World Health Organization (WHO). Cholesteatoma and middle ear conditions. WHO, 2021.
2. Bonnard Å, Berglin CE, Wincent J, et al. The risk of cholesteatoma in individuals with first-degree relatives surgically treated for the disease. JAMA Otolaryngol Head Neck Surg 2023; 149:390–6.
3. Yung M, Tono T, Olszewska E, et al. EAONO/JOS joint consensus statements on the definitions, classification and staging of middle ear cholesteatoma. J Int Adv Otol 2017; 13:1–8.
4. Bluestone CD. Pediatric Otolaryngology. Elsevier, 2021.
5. Juliano AF, Ginat DT, Moonis G. Imaging review of the temporal bone: Part I. Anatomy and inflammatory and neoplastic processes. Radiology 2013; 269:17–33.
6. Tos M. Cholesteatoma and its management. Lippincott, 2020.
7. Castle JT. Cholesteatoma pearls: practical points and update. Head Neck Pathol 2018; 12:419–29.
8. Baráth K, Huber AM, Stämpfli P, et al. Neuroradiology of cholesteatomas. AJNR Am J Neuroradiol 2011; 32:221–9.
9. Kuo CL, Shiao AS, Yung M, et al. Updates and knowledge gaps in cholesteatoma research. Biomed Res Int 2015; 2015:854024.
10. Saxby AJ, Jufas N, Kong JHK, et al. Novel radiologic approaches for cholesteatoma detection: implications for endoscopic ear surgery. Otolaryngol Clin North Am 2021; 54:89–109.
11. Tomlin J, Chang D, McCutcheon B, et al. Surgical technique and recurrence in cholesteatoma: a meta-analysis. Audiol Neurotol 2013; 18:135–42.
12. Solis-Pazmino P, Siepmann T, Scheffler P, et al. Canal wall up versus canal wall down mastoidectomy techniques in the pediatric population with cholesteatoma: a systematic review and meta-analysis of comparative studies. Int J Pediatr Otorhinolaryngol 2023; 173:111658.
13. Li B, Zhou L, Wang M, et al. Endoscopic versus micro scopic surgery for treatment of middle ear cholesteatoma: a systematic review and meta-analysis. Am J Otolaryngol 2021; 42:102451.
14. Cimsit NC, Cimsit C, Baysal B, et al. Diffusion-weighted MR imaging in postoperative follow-up: reliability for detection of recurrent cholesteatoma. Eur J Radiol 2010; 74:121–3. doi: 10.1016/j.ejrad.2009.01.025
15. Ayyaril NA, Jayasankaran SC, Menon U, et al. Role of diffusion-

weighted magnetic resonance imaging in the evaluation of clinically suspected cholesteatoma cases. Indian J Otolaryngol Head Neck Surg 2022; 74:719–23. doi: 10.1007/s12070-021-02526-8

16. Touska P, Connor SEJ. ESR essentials: imaging of middle ear cholesteatoma – practice recommendations by the European Society of Head and Neck Radiology. Eur Radiol 2024; 26. doi: 10.1007/s00330-024-11021-x
17. Dubrulle F, Souillard R, Chechin D, et al. Diffusion-weighted MR imaging sequence in the detection of postoperative recurrent cholesteatoma. Radiology 2006; 238:604–10. doi: 10.1148/radiol.2381041649
18. De Foer B, Vercruysse JP, Bernaerts A, et al. Middle ear cholesteatoma: non-echo-planar diffusion-weighted MR imaging versus delayed gadolinium-enhanced T1-weighted MR imaging-value in detection. Radiology 2010; 255:866–72. doi: 10.1148/radiol.10091140
19. Lingam RK, Nash R, Majithia A, et al. Non-echoplanar diffusion weighted imaging in the detection of post-operative middle ear cholesteatoma: navigating beyond the pitfalls to find the pearl. Insights Imaging 2016; 7:669–78. doi: 10.1007/s13244-016-0516-3
20. Amoodi H, Mofti A, Fatani NH, et al. Non-echo planar diffusion-weighted imaging in the detection of recur rent or residual cholesteatoma: a systematic review and meta-analysis of diagnostic studies. Cureus 2022; 14:e32127.