



***Reliability of Diffusion weighted MRI for the diagnosis of residual & recurrent cholesteatoma***

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*Otorhinolaryngology*

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# List of Contents

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<b>Title</b>	<b>Page No.</b>
Table of contents	I
List of abbreviations	II
List of figures	III
List of table	VI
Introduction & Aim of the work	1
Anatomy of the Middle Ear and mastoid	7
Pathology Of Middle Ear Cholesteatoma	27
Imaging of Middle Ear Cholesteatoma	39
Patients and Methods	66
Results	70
Illustrative Cases	74
Discussion	87
Summary and conclusion	99
References	104
Arabic summary	-

<b>List of Abbreviations</b>	
IJV	Internal jugular vein
ICA	Internal carotid artery
CT	Computed Tomography
LSCC	Lateral semicircular canal
DWI	Diffusion Weighted Images
EPI	Echo-Planar Imaging
TSE	Turbo Spin Echo
HASTE	Half-Fourier Acquisition Single-Shot Turbo Spin-Echo
BLADE	Proprietary name for periodically rotated overlapping parallel lines with enhanced reconstruction (PROPELLER) in MR systems from Siemens Healthcare <sup>TM</sup>
SNR	Signal to Noise Ratio
MS	Multi-Shot
SS	Single Shot
RF	Radio-Frequency
TM	Trademark
ADC	Apparent Diffusion Coefficient
MRI	Magnetic Resonance Imaging
DPI	Delayed postcontrast imaging
ADC	Apparent diffusion coefficient

## List of Figures

Fig. No.	Title	Page No.
Fig. 1	Schematic drawing of the middle ear cavity showing its different dimensions. VII facial nerve, CP cochleariform process	7
Fig. 2	Diagram of the middle ear space boundaries.	8
Fig. 3	Coronal CT image of the middle ear showing the parts of the middle ear	9
Fig. 4	diagram showing the organization of the different compartments of the attic	11
Fig. 5	Axial computed tomography views of the anterior epitympanum	11
Fig. 6	Anatomic drawing of the middle ear showing the ridges and depressions on the posterior mesotympanum wall	13
Fig. 7	Schema of a right middle ear lateral wall compartments after removal of the pars tensa	14
Fig. 8	Lateral view of Prussak's space	15
Fig. 9	The protympanum and its parts.	16
Fig. 10	Endoscopic view of a left cadaveric middle ear showing the protympanum	18
Fig. 11	. Anterior attic bony plate	18
Fig. 12	View of retrotympanum	19
Fig. 13	Endoscopic view; the facial recess	20
Fig. 14	Schematic drawing of retrotympanum	21
Fig. 15	Superior view of a right middle ear showing the tympanic diaphragm and the tympanic isthmus.	22
Fig. 16	Photograph of an anatomic specimen showing the relationship between the three ossicles	23
Fig. 17	Anatomic drawing of the middle ear ossicles	23
Fig. 18	CT view passing by the antrum	25
Fig. 19	The four hypotheses for Pathophysiology of Cholesteatoma	31
Fig. 20	Otopscopic view of Epitympanic (attic) cholesteatoma	33
Fig. 21	Otopscopic view of large cholesteatoma :	38
Fig. 22	CT image of large cholesteatoma complicated by brain abscess	38
Fig. 23	CT axial and coronal cuts of large pars flaccida cholesteatoma	42

Fig. 24	CT axial and coronal cuts of pars tensa cholesteatoma	44
Fig. 25	CT of cholesteatoma complicated by facial canal and LSCC erosions.	45
Fig. 26	CT of cholesteatoma complicated by LSCC fistula	46
Fig. 27	CT of cholesteatoma complicated by tegmen erosion and brain abscess	46
Fig. 28	Coronal CT image of glomus tympanicum.	47
Fig. 29	Post-operative CT showing post-operative granulation tissue versus recurrent cholesteatoma	48
Fig. 30	Diagram of a spin echo sequence with diffusion gradients added	54
Fig. 31	Comparison of different DWI techniques	58
Fig. 32	MR study of a patient with a proven cholesteatoma	60
Fig. 33	. EPI DWI and DPI for residual cholesteatoma detection	61
Fig. 34	Chart Diagram of the number of positive and negative cases for cholesteatoma by MRI and intra-operative/ follow up.	74
Fig. 35	Case 1. Axial and Coronal T2 images: show diffuse T2 hyperintensity within the right middle ear cavity	78
Fig. 36	Case 1. Axial and Coronal DWIs: show a large area of diffusion restriction within the right middle ear cavity measuring 11 mm	78
Fig. 37	Case 1. Coronal ADC map: shows a corresponding area of low signal within the right middle ear cavity.	79
Fig. 38	Case 2. Axial and Coronal CT images: show non-specific soft tissue opacification of the right mastoidectomy region as well as the epitympanum and mesotympanum with total ossicular resorption and extensive osseous erosions	80
Fig. 39	Case 2. Axial and Coronal T2 images: show diffuse T2 hyperintensity within the right mastoid and middle ear regions	81
Fig. 40	Case 2. Coronal DWIs and ADC map: show a large area of bright DWI signal within the right middle ear cavity with corresponding low signal on ADC map, confirming true diffusion restriction.	81
Fig. 41	Case 3. Axial and Coronal CT images: show non-specific small mesotympanic soft tissue density.	82
Fig. 42	Case 3. Coronal T2 images: show a small area of T2 hyperintensity within the right middle ear region.	83
Fig. 43	Case 3. Axial DWIs and ADC map: show a small area of bright DWI signal within the right middle ear cavity	83

	measuring 4.5 mm with corresponding low signal on ADC map, confirming true diffusion restriction	
Fig. 44	Case 4. Coronal T2 images: show diffuse T2 hyperintensity within the left middle ear cavity	84
Fig. 45	Case 4. Axial and Coronal DWIs: show an area of diffusion restriction within the left middle ear cavity measuring 9 mm.	85
Fig. 46	Case 4. Axial and Coronal ADC map: show a corresponding area of low signal within the left middle ear cavity, confirming true diffusion restriction.	85
Fig. 47	Case 5. Axial and Coronal CT images: show the entire cavity is filled with soft tissue (asterisk) which cannot be differentiated on CT. Based on this CT examination, a cholesteatoma can neither be excluded nor confirmed.	86
Fig. 48	Case 5. Axial and Coronal T2 images: show diffuse T2 hyperintensity within the right mastoid and middle ear regions.	87
Fig. 49	Case 5. Axial and Coronal DWIs: show no evidence of diffusion restriction within the right middle ear cavity.	87
Fig. 50	Case 6. Axial and Coronal T2 images: show diffuse T2 hyperintensity within the left mastoid and middle ear regions.	88
Fig. 51	Case 6. Axial and Coronal DWIs: show no evidence of diffusion restriction within the left middle ear cavity..	89
Fig. 52		
Fig. 53		



## List of Tables

Table	Title	Page
Table 1	DWI features and artifacts when imaging near the skull base	58
Table 2	Sensitivity, specificity, and accuracy for the detection of cholesteatoma with SS-EPI and MS-EPI	62
Table 3	Differential diagnosis and imaging characteristics of cholesteatoma on MRI	63
Table 4	Distribution of gender and age of studied patients	70
Table 5	Distribution of the side of the lesion	71
Table 6	Table showing all results obtained from MRI imaging as well as Intra-operative and/or follow up data	72
Table 7	Distribution of positive cholesteatoma by surgical exploration and the MRI finding	73
Table 8	sensitivity and specificity of DWI in detection of cholesteatoma	75
Table 9	Table showing the diagnostic value of MS-EPI DWI in detection of cholesteatoma according to our study	75
Table 10	Proportion of agreement	76
Table 11	Summary of recent reports on the value of MRI for the detection of cholesteatomas	99



## ***Introduction***

Cholesteatoma is defined as the presence of collections of keratinized squamous epithelium within a sac in temporal bone & skull base, commonly involve the middle ear cavity & mastoid cavities. It may be congenital or acquired. Congenital cholesteatomas compose only 2% of middle ear cholesteatomas.

***(Swartz, 1996)***

Cholesteatomas involve Prussak's space and progressively erodes the adjacent structures such as the scutum and the ossicular chain. After growth, the cholesteatoma invades the antrum and the mastoid process, eroding further structures of the middle ear such as the facial nerve canal, the tegmen tympani and the posterior semicircular canal wall. ***(Semaan et al., 2006)***

It can erode and destroy important structures with potential for causing central nervous system (CNS) complications (eg, brain abscess, meningitis) makes it a potentially fatal lesion. ***(Gotz et al., 1999)***

It is usually diagnosed on basis of history, otoscopic examination with radiological and audiological assessment.

An understanding of the pathophysiology of aural cholesteatoma is important, due to its destructive nature which is responsible for the morbidities associated with its chronic nature. the lack of effective nonsurgical management add importance to

the understanding of this disease , otomicroscopic evaluation is the principal diagnostic tool for acquired cholesteatoma , an inflammatory polyp or granulation tissue might be obscuring the vision on examination by, as recurrent or residual disease is mainly attributed to hidden areas that cannot be seen using surgical microscope. otoendoscopic examination and surgical exploration is other tools to be used for such cases. **(Corrales C.& Blevins NH 2013).**

A cholesteatoma can only be eradicated from the temporal bone by surgical resection and is usually managed with radical or modified radical mastoidectomy. The choice of surgical approach depends upon the scoring of the anatomical extensio**n** of the cholesteatoma into the middle ear and mastoid cavity and the status of the ossicular chain and tympanic membrane,selection of the Optimal surgical approach results in Complete disease eradication .these procedures can be classified into canal wall up and canal wall down procedures. **(Li PM et al ,2013).**

Although canal wall-up procedures usually allow restoration of the conductive hearing mechanism after eradication of the cholesteatoma, a major disadvantage of performing them is the narrow surgical field, a feature that is associated with a high rate of residual and recurrent cholesteatomas (35% and 18%, respectively) . Excluding the cases in which a typical white mass can be clearly seen under the tympanic membrane, it is difficult to clinically diagnose a cholesteatoma in a closed postoperative cavity. Thus, second look procedures performed approximately 1 year after the

initial surgery are the accepted management in most otologic centers. Notably, both the initial and the revision procedures can be associated with such postoperative sequelae as infection, bleeding, delayed healing, disequilibrium, taste disturbances, hearing loss and facial nerve paralysis. In addition, both primary and second-look mastoidectomies require general anesthesia with the usual risks of anesthesia-related complications. **(Migirov L et al.,2009)** the incidence of recurrence of the chronic active disease vary from 3 to 18% of all surgical procedures and the failure most importantly attributed to residual or recurrent cholesteatoma with persistent suppuration of middle ear and mastoid.( **Migirov L,et al,2009**)

Residual cholesteatoma occurs as a consequence of growth of a fragmental remnant of the matrix inadvertently left behind at the time of primary surgery. Poor access ,failure to determine disease extent is the major reasons for residual disease, particularly in the sinus tympani (ST) in addition to the tegmen,facial recess ,mastoid tip,hypotympanium and infralabyrinthine cells.

Recurrent disease or disease due to de-novo retraction (i.e. retraction pocket cholesteatoma) caused by scutum defects leading to recurrence of the primary pathology

Confirming a diagnosis recurrent or recurrent cholesteatoma through imaging techniques remains a challenge for the otolaryngologist & head and neck radiologist.

Imaging procedures such as high resolution computed tomography (CT) and magnetic resonance imaging (MRI) may

suggest the presence of cholesteatomas within the temporal bone and may be used to complement the clinical examination.

Selection of the appropriate modality of imaging depends on clinical findings as each of them provide different anatomical and pathological information undetectable by the other modality.

High resolution computed tomography (HRCT) is still widely considered to be the primary imaging tool for diagnosing and documenting the extent and potential complications of middle ear cholesteatoma. HRCT provides good information on the presence of associated bony and ossicular erosion as well as on important pre-operative anatomical features, such as the delineation of the tympanic segment of the facial nerve, the tegmen position of dura the sigmoid sinus position, sinus plate, jugular bulb and the size of the mastoid cell structure and pneumatization aiming for correct surgical planning. (*Lemmerling , De Foer B., 2004*)

Advanced technology, as multidetector row scanning with submillimeter(0.5mm) section thickness and high rotation(0.5 second per rotation), has reinforced the value of CT scan for detecting temporal bone pathologies (*schwab SA ,2011*)

Unfortunately many studies have shown that HRCT is inaccurate in detecting post-operative residual and recurrent cholesteatoma, If used alone it can be misleading as it cannot differentiate between cholesteatoma, cholesterol granuloma, granulation, brain or fibrous tissue and mucoid secretion in the

post-mastoidectomy cavities and completely or partially opacified middle ears . This was the reason that clinicians sought alternative imaging modalities for better evaluation of the various types of tissues that may be present in ears that had undergone surgery. **(Migirov L,et al,2009).**

The MRI has an additional value in patients with prior cholesteatoma resection, particularly when CT findings are equivocal, is mainly due to its capacity to unequivocally confirm the diagnosis of cholesteatoma in cases of clinical doubt. It can distinguish cholesteatoma from other soft tissues, such as fibrosis, granulation tissue, inflammatory changes and cholesterol granuloma. It has the potential to document invasion of the labyrinth and of the intracranial space. **(De Foer et al., 2008)**

Newer Diffusion weighted imaging(DWI) techniques with thinner section acquisition and decreased susceptibility artifacts allow detection of small lesions. The DWI technique may be used in place of second-look surgery, sparing patients the morbidity of repeat exploration. **(Schwartz et al., 2011)**

Recent studies on diffusion-weighted magnetic resonance imaging scans reported high rates of sensitivity (85.2%–90%), specificity (92.6%–100%), positive predictive value (92.6%–100%) and negative predictive value (92%) in the diagnosis of cholesteatomatous tissue in patients who had undergone tympanomastoid surgery. **(Schwartz et al., 2011)**