Original Research Article

Correlation between high resolution computed tomography of temporal bone and intra-operative findings in chronic otitis media

Varsha Rathi[1], Gargi A Barelikar[2*]

[1]Professor, [2]Junior Resident, Department of Radiodiagnosis, Grant Medical College & JJ Hospitals, Mumbai, Maharashtra, INDIA.
Email: drvpr@hotmail.com, gargi.a.b@gmail.com

Abstract

Background: This study was conducted to compare the radiological findings with the intra-operative findings of Chronic Otitis media and thus assess the efficiency of HRCT temporal bone in evaluating cases of chronic otitis media. **Methods:** This was hospital based retrospective study conducted on 60 eligible patients in the Department of Radiology in collaboration with the Department of ENT in a tertiary care centre and teaching hospital in a city of Maharashtra. They were examined and investigated with the help of prestructured case record form. Sensitivity and Specificity of HRCT Temporal Bone in assessing the middle ear structures was calculated. **Results:** In this study, it was found that majority (28.33%) of patients were aged between 21-30 years with the mean age of 36.5±16.96 years; 68.33% were males. 93.33% patients presented with complaints of otorrhoea. In this study, HRCT showed 100% sensitivity, 90.38% specificity to detect cholesteatoma in the protympanum; 90.9% sensitivity and 89.89% specificity in mesotympanum; 100% sensitivity and 89.58% specificity in posterior tympanum; 96.55% sensitivity and 100% specificity for epitympanum; 100% sensitivity and 84.9% specificity for hypotympanum. HRCT is 100% sensitive and specific to detect scutum erosion, pneumatisation of mastoid, cochlear promontory fistula, complications like mastoiditis and mastoid abscess.as per this study. So, HRCT is 100% sensitive and specific to diagnose Malleus erosion; 84.37% sensitive, 100% specific in Incus erosion; 73.91% sensitive, 100% specific for Stapes Erosion; 42.85% sensitive, 100%specific for facial canal dehiscence; 33.33% sensitive,100% specific for Tegmen mastoideum dehiscence; 25% sensitive, 100 % specific for lateral semicircular canal. **Conclusion:** CT is the modality of choice for evaluation of bony middle ear and mastoid structures. We conclude that, Pre-operative HRCT scan is an important contributing factor in decision of the surgery and is indispensable in deciding the surgical approach.

Key words: temporal bone, HRCT, chronic otitis media.

[*]**Address for Correspondence:**
Dr Gargi Barelikar, Junior Resident, Department of Radiology, Grant medical College and JJ group of Hospitals, Mumbai 400008, INDIA.
Email: gargi.a.b@gmail.com

Received Date: 03/01/2021 Revised Date: 08/02/2021 Accepted Date: 11/03/2021
DOI: https://doi.org/10.26611/10131816

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 19 April 2021

INTRODUCTION

Chronic Otitis Media is a major problem in Otolaryngology, taking considerable amount of clinical assessment and operating time. Chronic otitis media is also a significant international health problem in terms of its prevalence, economics, and sequelae. It is one of the leading causes of hearing impairment especially in the developing countries.

It becomes very important to know the location and extent of the disease before proceeding to surgical treatment. HRCT examination of the temporal bone helps us to achieve this objective. Hearing impairment is the most common sequela of CSOM. CSOM can cause conductive hearing loss (CHL) as well as sensorineural hearing loss

How to cite this article: Varsha Rathi, Gargi A Barelikar. Correlation between high resolution computed tomography of temporal bone and intra-operative findings in chronic otitis media. *MedPulse International Journal of Radiology.* April 2021; 18(1): 22-28.
http://www.medpulse.in/Radio%20Diagnosis/

(SNHL). The degree to which hearing is compromised has also been demonstrated to be directly proportional to the damage caused to the structures of the middle ear.[1] Surgery is mainstay of treatment in CSOM with cholesteatoma[2]. HRCT gave valuable information of disease extent in hidden areas like sinus tympani and facial recess of mesotympanum. HRCT satisfactorily delineated malleus and incus erosion but had 75% sensitivity for detecting erosion of stapes suprastructure, though specificity was of 97%. For bony anatomical landmarks HRCT showed very high sensitivity and specificity for detecting erosion of lateral semi-circular canal, tegmen tympani and sinus plate. Detection of facial canal erosion on HRCT had moderate sensitivity of 75%. Thus, the routine use of HRCT is justified as a reliable preoperative tool in patients with Chronic otitis media.[3]This study was conducted to compare the radiological findings with the intra-operative findings and thus assess the efficiency of HRCT temporal bone in evaluating the destruction of middle ear structures in cases of chronic otitis media.

MATERIALS AND METHODS

This was hospital based retrospective study conducted on 60 eligible patients in the Department of Radiology in collaboration with the Department of ENT in a tertiary care centre and teaching hospital in a city of Maharashtra. These 60 patients with the diagnosis of COM who were eligible as per the study criteria and had given written informed consent were included in the study.

1. **Study duration**: 13 Months
2. **Study design:** Retrospective study.
3. **Sample size**: 60
4. **Selection Criteria**:

Inclusion criteria:

i. Clinically diagnosed case of COM who were referred to radiology department for High resolution computed tomography- Temporal bone.
ii. Cases of Chronic otitis media who were potential candidate to undergo surgical management.

Exclusion criteria:

i. Patients who were not willing to participate in the study.

5. **Study Procedure:**

The data was collected from the radiology department PACS (Picture Archiving and communication system) system and from ENT department through HMIS (Health Management Information System) and was filled in the structured case record sheet.

All the HRCT scans were performed at our institute

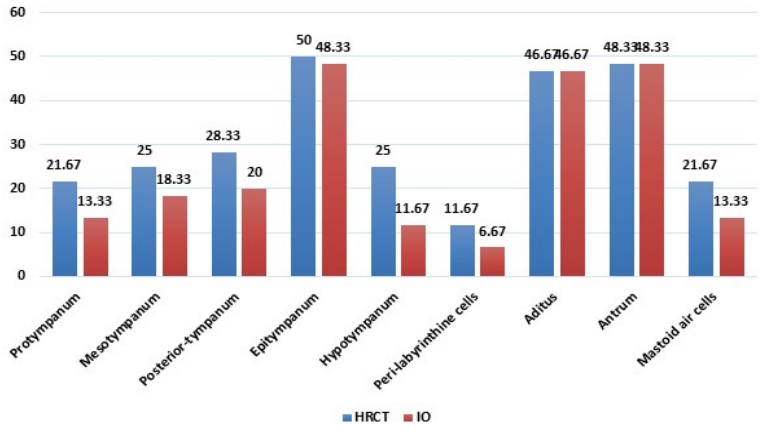
6. **Ethical declaration:** All ethical considerations and necessary approvals were taken.
7. **Statistical analysis:**

Sensitivity and specificity of HRCT was calculated. Analysis was performed with a SPSS software, 20.0 version.

OBSERVATION AND RESULTS

In this study, it was found that majority (28.33%) of patients were aged between 21-30 years and the mean age was 36.5±16.96 years. There was male predominance in the study and 68.33% of the study patients were male. 93.33% patients presented with otorrhoea which was the most common symptom, other symptoms were hearing loss, otalgia, fever with chills, vertigo, headache, facial weakness, tinnitus in decreasing order of frequency. Left ear disease was seen in 48.33%

patients, right in 28.33% and bilateral disease in 23.33% patients.



Graph 1: Graph showing sites and extent of involvement of the middle ear and mastoid air cell system:

Table 1: Sensitivity and Specificity of the HRCT temporal bone in extent of disease in middle ear and mastoid

Extent	HRCT	IO	FP	FN	Sensitivity	Specificity
Protympanum	13	8	5	0	100	90.38
Mesotmpanum	15	11	5	1	90.90	89.89
Posterior tympanum	17	12	5	0	100	89.58
Epitympanum	30	29	0	1	96.55	100
Hypotympanum	15	7	8	0	100	84.9
Perilabyrinthine cells	7	4	3	0	100	94.64
Aditus	28	28	2	2	92.85	93.75
Antrum	29	29	2	2	93.1	93.93
Mastoid air cells	26	29	0	3	89.66	100

Table 2: Sensitivity and Specificity of the HRCT Temporal Bone in scutum and ossicular erosion

OSSICLES	HRCT	IO	FP	FN	SENSITIVITY	SPECIFICITY
Scutum	25	25	0	0	100	100
Malleus	17	17	0	0	100	100
Incus	27	32	0	5	85.71	100
Stapes	17	23	0	6	73.91	100

Table 3: Sensitivity and Specificity of HRCT Temporal Bone in Complications of COM

COMPLICATIONS	HRCT	IO	FP	FN	Sensitivity	Specificity
Facial canal dehiscence	3	7	0	4	42.85	100
Tegmen tympani erosion	0	1	0	1	0	100
Cochlea erosion	1	1	0	0	100	100
Erosion mastoid cortex	5	5	0	0	100	100
Sinus plate erosion	8	10	0	2	80	100
Tegmen mastoideum erosion	2	5	0	3	40	100
Posterior fossa dural plate	1	3	0	2	33.33	100
LSCC erosion	1	4	0	3	25	100
Mastoiditis and mastoid abscess	6	6	0	0	100	100
Intracranial	5	5	0	1	100	100

Case 1 – Case of left sided COM with tympanic membrane perforation and blunting of scutum.

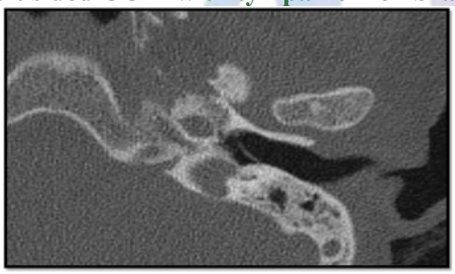


Figure 1

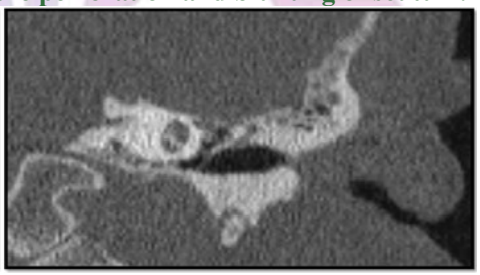


Figure 2

Figure 1: Axial section of left temporal bone- showing discontinuity of tympanic membrane; **Figure 2:** Coronal section of left Temporal bone showing blunting of scutum with soft tissue in Prussack's space

Case 2- Case of CSOM- showing erosion of malleus and incus.

Figure 3: Coronal section of left Temporal Bone showing erosion of malleus and incus

Case 3- Case of CSOM with erosion of lateral semicircular canal, tympanic part of facial canal, posterior wall of mastoid antrum.

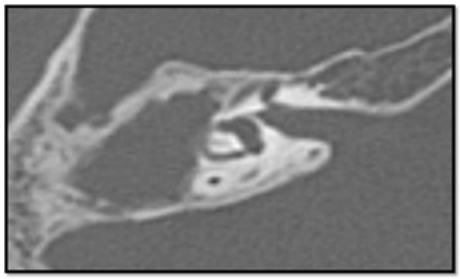


Figure 4

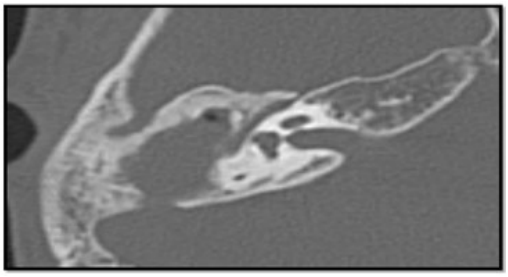


Figure 5

Figure 4: Axial section of left Temporal bone showing erosion of lateral semicircular canal and soft tissue in the middle ear and mastoid antrum; **Figure 5:** Axial section of right Temporal bone showing soft tissue in middle ear and mastoid with erosion of Tympanic segment of facial canal, posterior wall of mastoid antrum

Case 4- Case of CSOM showing erosion of scutum, head of malleus and entire incus

Figure 6: Coronal section of left Temporal Bone showing erosion of scutum, head of malleus and entire incus

Case 5- Case of CSOM with soft tissue in middle ear, attic, aditus and retraction of Tympanic membrane

Figure 7

Figure 8

Figure 7: Axial section of left temporal bone showing soft tissue in middle ear and mastoid with retraction of Tympanic membrane; **Figure 8:** Axial section of left Temporal bone showing soft tissue in attic and aditus

Case 6- Case of CSOM with soft tissue in epitympanum and thinning of Tegmen tympani.

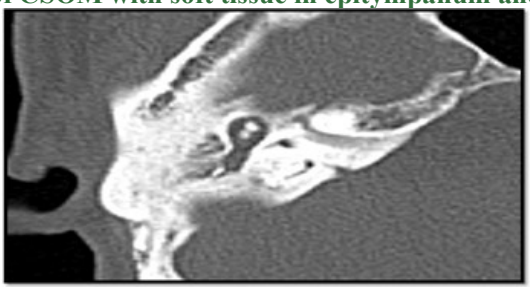


Figure 9

Figure 10

Figure 9: Axial section of right Temporal bone showing soft tissue in epitympanum; **Figure 10:** Coronal section of right temporal bone showing soft tissue in Prussack's space and thinning of Tegmen tympani with soft tissue in Prussack's space

Case 7 – Case of CSOM with left Temporal lobe abscess.

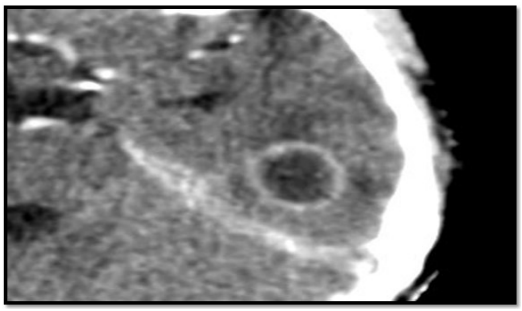


Figure 11: Axial section showing contrast enhanced CT brain showing abscess in left temporal lobe.

Case 8- Case of CSOM with left transverse sinus and sigmoid sinus thrombosis

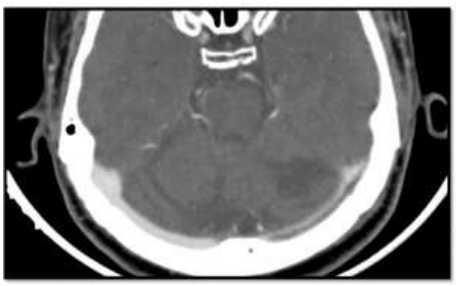


Figure 12

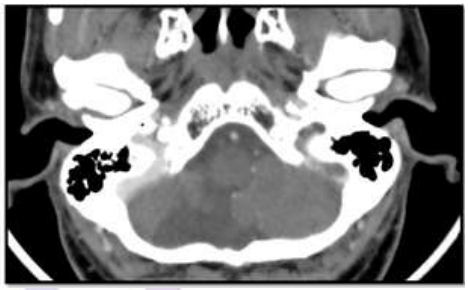


Figure 13

Figure 12: Axial section showing contrast enhanced CT Brain showing filling defect in left transverse sinus- left transverse sinus thrombosi;
Figure 13: Axial section showing contrast enhanced CT Brain showing filling defect in left sigmoid sinus- left sigmoid sinus thrombosis

DISCUSSION

This was hospital based retrospective study conducted on 60 eligible patients in the Department of Radiology in collaboration with the Department of ENT in a tertiary care centre and teaching hospital in Mumbai. All the ethical permissions were taken. In this study, the mean age was 36.5±16.96 years; similar to study by Gerami H. *et al.* (2009).[8] In the study by Gerami H. *et al.* (2009).[8] the average age of presentation was 27.9 ± 16.3 years. There was male predominance in the study. 68.33% of the study patients were male and rest 31.67% were female and male: female ratio was 2.11:1. It was comparable to study by Gerami H. *et al.* (2009).[8] in which it was 2.44:1.

93.33% patients presented with otorrhoea which was the most common symptom, other symptoms were hearing loss, otalgia, fever with chills, vertigo, headache, facial weakness, tinnitus in decreasing order of frequency. Left ear disease was seen in 48.33% patients, right in 28.33% and bilateral disease in 23.33% patients. In this study, HRCT showed 100% sensitivity but 90.38% specificity to detect cholesteatoma in the protympanum. This was in agreement with study by Ranga Reddy Sirigiri *et al.* (2011) [10] but 90.38% specificity was higher than 84% as given by Ranga Reddy Sirigiri *et al.* (2011) [19] In mesotympanum, HRCT showed 90.9% and 89.89% specificity which was very similar to the findings by Walshe P (2002)[11] with 90% sensitivity and specificity of 87.5%. In posterior tympanum, HRCT showed 100% sensitivity which was similar to study by Walshe P (2002)[11] whereas specificity was 87.1% which is slightly higher than 75% as given by Ranga Reddy Sirigiri *et al.* (2011) [10] In epitympanum, HRCT showed sensitivity of 96.55% and specificity of 100% which were similar to findings by Ranga Reddy Sirigiri *et al.* (2011) [10] In hypotympanum, sensitivity was 100% same as the study by Ranga Reddy Sirigiri *et al.* (2011) [10] whereas specificity in our study was 84.9% which was higher than the study by Ranga Reddy Sirigiri *et al.* (2011) [10] which showed only 70% specificity. In the peri-labyrinthine cells, sensitivity was 100%, while specificity was 94.64%. Study by Ranga Reddy Sirigiri *et al.* (2011) [10] showed sensitivity of 100%, while specificity was 86%lesser than our study. In extension of disease to aditus, HRCT showed sensitivity of 92.85% and specificity of 93.75%. Regarding aditus, study by Ranga Reddy Sirigiri *et al.* (2011) [10] showed sensitivity of 95%, while specificity was 75%. Thus sensitivity of this study was slightly more but specificity was much lower as compared to our study. In extension of disease in antrum HRCT showed sensitivity of 93.1% whereas specificity of 93.93%. Regarding antrum, study by Ranga Reddy Sirigiri

et al. (2011) [10] showed sensitivity of 95%, while specificity was 66%. Thus, sensitivity of this study was slightly greater but specificity was much lower as compared to our study.

In extension of disease in mastoid air cells HRCT showed sensitivity of 89.66%, specificity of 100%. This was in accordance with the by Ranga Reddy Sirigiri *et al.* (2011) [10] showed sensitivity of 86%, while specificity was 100%. In this study, HRCT is 100% sensitive and specific to detect scutum erosion. This is in accordance to study by Rocher P *et al.* (1995)[13] but contrasts with study by Vlastarakos PV *et al.* (2010) [9] and was greater than that seen by Gaurano JL *et al.* (2004)[12] who found it in 86%. In this study, HRCT is 100% sensitive and specific to diagnose Malleus erosion. This is correlating with studies by Rocher P *et al.* (1995)[13] Zhang X *et al.* (2004),[14] and Chee NW *et al.* (2001).[15] In case of Incus erosion, HRCT showed sensitivity of 84.37%, specificity of 100 which correlates with studies by Zhang X *et al.* (2004)[14] and Chee NW *et al.* (2001).[15] In case of stapes erosion, HRCT showed sensitivity of 73.91% and specificity of 100%. This is similar to studies by O'Donoghue *et al.* (1987)[7] but contrasts to studies by Chee NW *et al.* (2001)[15] where excellent correlation was found and Zhang X *et al.* (2004)[14] who found that HRCT was poor in detecting Stapes erosion.

In this study, facial canal dehiscence HRCT showed sensitivity of 42.85% and specificity of 100%. Similar study results were observed in the study by Firas Q. Alzoubi *et al.* (2008)[16] and Garber *et al.* (1994)[17] but poor and insignificant correlation was observed by Rocher P *et al.* (1995)[13], Chee NW *et al.* (2001),[15] Zhang X *et al.* (2004),[14] Gerami H. *et al.* (2009)[8] and Jackler RK (1984)[18] but Mafee *et al.*(1988)[19] found HRCT to be 100% accurate. Tegmen tympani dehiscence was not seen in HRCT but intra-operatively it was seen in 1.67% patients. So with 1 false negative case, sensitivity was 0 and specificity was 100% which agrees with results by Jackler RK (1984),[18] and Gerami H *et al.* (2009)[8] but contradictory to the results of the studies by Rocher P *et al.* (1995),[13] Zang X *et al.* (2004)[14] and Firas Q. Alzoubi *et al.* (2008)[16] who found it 100% sensitive. In case of Cochlear promontory fistula, HRCT was highly (100%) sensitive and specific for detecting cochlear promontory fistula similar to study by Firas Q. Alzoubi *et al.* (2008)[16] For Mastoid cortex erosion HRCT was 100% sensitive and specific. This was much higher when compared with the findings of Ranga Reddy Sirigiri *et al.* (2011) [10] where it was only 75% sensitive. For, Sinus plate dehiscence was seen in 13.33% cases in HRCT but intraoperatively it was present in 16.67% cases. Hence 2 false negative makes sensitivity of 80% and specificity 100%.

Tegmen mastoideum dehiscence was seen in 3.33% and 8.33% patients in HRCT and intra-operatively respectively. Hence sensitivity was 33.33% and specificity 100%. For Lateral semicircular canal dehiscence HRCT showed sensitivity of 25% and specificity of 100%. This is similar to study by Vlastarakos *et al.* (2010)[9] and Zhang X *et al.* (2004)[14] but in contrast to studies Firas Q. Alzoubi *et al.* (2008),[16] Chee NW *et al.* (2001),[15] Mafee *et al.*[19] and Rocher P (1995)[13] where it was 100% sensitive. HRCT correctly detected all the other complications like mastoiditis and mastoid abscess in with 100% sensitivity and specificity.

CONCLUSION

This study concludes that HRCT Temporal bone and Intra-operative findings have good correlation in cases of Chronic Otitis Media. HRCT is comparable to Intra-operative observations especially in detecting disease extent, complications and important anatomic variations.

All the middle ear and mastoid structures cannot be assessed clinically before the operative procedures. The bony structures are poorly demonstrated even on MRI. Thus, CT is the modality of choice for evaluation of thin bony middle ear and mastoid structures. It can be recommended not only in cases which are suspected of having potential complications, but also in all cases of COM. Pre-operative HRCT scan thus is an important contributing factor in decision of the surgery and is indispensable in deciding the surgical approach.

REFERENCES

1. Mahmutoglu AS, Çelebi I, Sahinoglu S, Çakmakçi E, Sözen E. Reliability of preoperative multidetector computed tomography scan in patients with chronic otitis media. Journal of Craniofacial Surgery. 2013 Jul 1;24(4):1472-6.
2. Gomaa MA, Karim AR, Ghany HS, Elhiny AA, Sadek AA. Evaluation of temporal bone cholesteatoma and the correlation between high resolution computed tomography and surgical finding. Clinical Medicine Insights: Ear, Nose and Throat. 2013 Jan;6:CMENT-S10681.
3. Mittal R, Lisi CV, Gerring R, Mittal J, Mathee K, Narasimhan G, Azad RK, Yao Q, Grati MH, Yan D, Eshraghi AA. Current concepts in the pathogenesis and treatment of chronic suppurative otitis media. Journal of medical microbiology. 2015 Oct;64(Pt 10):1103.
4. Sengupta A, Anwar T, Ghosh D, Basak B. A study of surgical management of chronic suppurative otitis media with cholesteatoma and its outcome. Indian J Otolaryngol Head Neck Surg. 2010 Jun;62(2):171-6.
5. Wallis S, Atkinson H, Coatesworth AP. Chronic otitis media. Postgrad Med. 2015 May;127(4):391-5.
6. Bathla M, Doshi H, Kansara A. Is Routine Use of High Resolution Computerized Tomography of Temporal Bone in Patients of Atticoantral Chronic Suppurative Otitis Media without Intracranial Complications Justified?

Indian Journal of Otolaryngology and Head and Neck Surgery. 2018 Mar 1;70(1):79-86.
7. Aljehani M, Alhussini R. The Correlation Between Preoperative Findings of High-Resolution Computed Tomography (HRCT) and Intraoperative Findings of Chronic Otitis Media (COM). Clin Med Insights Ear Nose Throat. 2019 Aug 19;12:1179550619870471.
8. Gerami H, Naghavi E, Wahabi-Moghadam M, Forghanparast K, Akbar MH. Comparison of preoperative computerized tomography scan imaging of temporal bone with the intra-operative findings in patients undergoing mastoidectomy. Saudi Med J. 2009 Jan;30(1):104-8.
9. Petros V Vlastarakos, Catherine Kiprouli, Sotirios Pappas, John Xenelis, Paul Maragoudakis, George Troupis, *et al.* CT scan CT scan versus surgery: how reliable is the preoperative radiological assessment in patients with chronic otitis media? Eur Arch Otorhinolarynogol 2012 Apr;269:81-6.
10. Ranga Reddy Sirigiri, Dwarakanath K. Correlative Study of HRCT in AtticoAntral Disease. Indian J Otolaryngol Head Neck Surg 2011 Apr-Jun; 63(2):155-8.
11. Walshe P, McConn Walsh R, Brennan P, Walsh M. The role of computerized tomography in the preoperative assessment of chronic suppurative otitis media. Clin Otolaryngol Allied Sci 2002 Apr;27(2):95-7.
12. Gaurano JL, Joharjy IA. Middle ear cholesteatoma: characteristic CT findings in 64 patients. Ann Saudi Med 2004 Nov-Dec;24(6):442-7
13. Rocher P, Carlier R, Attal P, Doyon D, Bobin S. Contribution and role of the scanner in the preoperative evaluation of chronic otitis. Radiosurgical correlation apropos of 85 cases. Ann Otolaryngol Chir Cervicofac 1995; 112(7):317-23.
14. Zhang X, Chen Y, Liu Q, Han Z, Li X. CT scan versus surgery: how reliable is the preoperative radiological assessment in patients with chronic otitis media? Lin Chuang El Bi Yan Hors He Za Zhi 2004 Jul;18(7):396-8.
15. Chee NW, Tan TY. The value of pre-operative high resolution CT scans in cholesteatoma surgery. Singapore Med J 2001 Apr;42(4):155-9.
16. Firas Q Alzoubi, Haaitham A Odat, Hassan A Al-balas, Saeed SR. The role of preoperative CT scan in patients with chronic otitis media European Archives of Oto-rhino-laryngology 2009 Jun;266(6):807-9.
17. Garber LZ, Dort JC. Cholesteatoma: diagnosis and staging by CT scan. Otolaryngol 1994 Apr;23(2):121-4.
18. Jackler RK, Dillon WP, Schindler RA. Computed tomography in suppurative ear disease: a correlation of surgical and radiographic findings. Laryngoscope 1984 Jun;94(6):746-52.
19. Mafee MF, Levin BC, Applebaum EL, Campos M, James CF. Cholesteatoma of the middle ear and mastoid. A comparison of CT scan and operative findings. Otolaryngol Clin North Am. 1988;21(2):265-93.

Source of Support: None Declared
Conflict of Interest: None Declared