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Role of High Resolution Computed Tomography of Temporal Bones in Squamosal CSOM and their clinical/intra-operative correlation

1. Dr. Sonith Peter George, M.S ENT
Senior Resident
Department of Otorhinolaryngology, Amaltas Institute of Medical Sciences, Dewas, M.P, India
2. Dr. Yamini Gupta, M.S ENT
Professor and Head
Department of Otorhinolaryngology, M.G.M Medical College, Indore M.P, India
3. Dr. Jagram Verma, M.S ENT
Associate Professor
Department of Otorhinolaryngology, M.G.M Medical College, Indore M.P, India
4. Dr. Lokesh Bhalot, M.S ENT
Assistant Professor
Department of Otorhinolaryngology, Government Medical College, Ratlam, M.P, India
5. Dr. Anshul Sharma *(Corresponding Author) , M.S ENT*
Senior Resident
Department of Otorhinolaryngology, Gandhi Medical College, Bhopal, M.P, India
Corresponding Author: *Dr. Anshul Sharma*

ABSTRACT:
AIMS:
To evaluate the role of High Resolution Computed Tomography in identifying pathological changes in Temporal Bone in Chronic Suppurative Otitis Media squamosal type and their clinical/intraoperative correlation.
MATERIALS AND METHODS:
A prospective study conducted for one year in 30 patients showing symptoms and signs of unsafe CSOM. Detailed history and clinical ENT examination was done. HRCT Temporal Bone was exposed and the findings were carefully observed and evaluated using a checklist. Appropriate surgery was performed. Intraoperative findings were compared with radiological findings. The correlation between HRCT and intra-operative findings was established using kappa correlation coefficient(κ). The p-value<.05 was considered statistically significant.
RESULTS:
The most common age group was 11-20 years and least common was 51-60 years. Male:female ratio was 1.7:1. Otorrhoea was the most common symptom, seen in 28 cases, followed by hearing loss (n=24) and headache (n=14). The most common endoscopic findings were Pars flaccida retraction pocket, in 60% cases and retracted pars tensa, in 36.7% cases, followed by EAC polyp in 30% cases. HRCT and intraoperative findings showed statistically significant correlation in EAC, scutum, Hypotympanum, Tegmen, Ossicles, Oval window niche, sinus plate, facial recess, sinus tympani, facial canal, Lateral SCC, and Koerner's septum, Prussak's space, Eustachian tube opening and Promontory.
CONCLUSION:
HRCT should be recommended in all suspected cases of atticoantral disease to know the extent of the disease, to look for bony erosions in adjacent structures so that adequate preoperative planning can be done, adequate clearance of disease may be achieved and intraoperative complications may be minimized.
KEY WORDS: *High Resolution Computed Tomography, Temporal Bone, Atticoantral disease, Cholesteatoma, Granulation, Bony erosion*

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I. INTRODUCTION:

The temporal bone is one of the most complex anatomical structures of the body and is made up of five osseous components: the squamous, mastoid, petrous, tympanic and styloid portions of the temporal bone. The anatomical sub divisions of the temporal bone are: the external ear; the middle ear and mastoid; the inner ear; the internal auditory canal(IAC); and the facial nerve canal. **The tympanic cavity** is a space within the temporal bone that contains air, which communicates with the nasopharynx through the eustachian tube and with the mastoid air cells through the aditus. Diseases of the middle ear is the third most common reason of visiting an otorhinolaryngologist.(1)

Chronic suppurative otitis media(CSOM) is a common pathology of the middle ear cleft and commonly involves the mastoid and can cause extensive destruction and irreversible sequelae.(2) The global burden of illness from CSOM involves 65–330 million individuals with draining ears, 60% of them(39–200 million) suffer from significant hearing impairment. India is one of the high endemic areas with a prevalence of 7.8%.(3) It is clinically categorized into tubotympanic and atticoantral. Tubotympanic, also called safe or benign type, involves the anteroinferior part of middle ear cleft and is associated with central perforation. Atticoantral, aka unsafe/ dangerous type, involves the posterosuperior part of middle ear cleft, that includes the mastoid, attic, aditus and antrum and is associated with an attic or marginal perforation. Cholesteatoma, osteitis or granulation tissue are seen in the atticoantral type of Chronic Otitis Media.(4–6)

High-resolution computed tomography(HRCT) excels in the evaluation of middle ear disease process and in identifying extent of disease. Its advent has significantly increased the role of radiological imaging in the preoperative evaluation of middle ear and temporal bone disease. Amongst the middle ear structures, HRCT is of especially valuable in the detection of early erosive changes in the ossicles, as well as in the detection of non-dependant soft tissue opacification that is most often suggestive of cholesteatoma.(7)

In this study, we studied the role of HRCT Temporal Bone in Squamosal type of CSOM in planning surgery by looking at its correlation with the intra-operative findings.

II. MATERIALS AND METHODS:

This was a prospective study conducted in M.G.M Medical College & M.Y Hospital, Indore for one year from August 2020 to September 2021. We included 30 patients attending OPD and undergoing admissions under the Department of ENT and showing symptoms of unsafe CSOM like purulent foul smelling ear discharge, bloody discharge, signs of impending intracranial complications like headache, dizziness, vomiting, meningeal symptoms as well as signs like attic retraction pocket, scutum erosion or cholesteatoma in middle ear. A detailed history and clinical ENT examination was done. A detailed and written Informed consent was taken. HRCT Temporal Bone was exposed and the findings were carefully observed and evaluated using a checklist. We used 128 slice 5th generation Multi Detector Computed Tomography machine with 64 ring based detector. A scout film is taken and slide thickness of 0.625mm is taken. Axial scanning is performed in planes parallel to the infraorbitomeatal line. A 512 x 512 matrix is used, and the images are reviewed with a high resolution bone algorithm and a small field of view(9 cm) for separate documentation of the right and left ears.

Appropriate surgery was performed after written and explained consent. Intraoperative findings were compared with radiological findings. The data was entered into the excel sheet and analysed using SPSS(Statistical Package for Social Sciences) 20.0 version and descriptive statistics was performed. The correlation between HRCT and intra-operative findings was established using kappa correlation coefficient(κ). The p-value<.05 was considered statistically significant.

Inclusion criteria:

Patients of age group 1–60 yrs who were clinically diagnosed with unsafe type of CSOM, giving consent to be part of the study and to undergo HRCT Temporal bone and surgery.

Exclusion criteria:

Patients not giving consent to be part of study, patients with electric devices at the skull base, such as cochlear implants, patients not giving consent to undergo HRCT Temporal bone or surgery.

III. RESULTS:

The most common age group of patients presenting with unsafe CSOM (out of 30) was 11-20 years having 10 cases, followed by 21-30 years with 8 cases, followed by 41-50 years with 6 cases, followed by 1-10 years with 3 cases, followed by 31-40 years with 2 cases and 51-60 years with 1 case **(Figure 1).** 63.3% of cases were male and 36.7% were female with male:female ratio of 1.7:1 **(Figure 2).** Otorrhoea was the most common symptom, seen in 93.3% cases(n=28), followed by hearing loss in 24 cases, headache in 14 cases, tinnitus in 8 cases and vertigo in 7 cases **(Table 1).** The most common endoscopic findings were Pars flaccida retraction with cholesteatoma, seen in 60% cases and retracted pars tensa, seen in 36.7% cases, followed by polyp in the EAC, seen in 30% cases **(Table 2).** Out of 30 patients, 27 underwent Canal Wall Down Mastoidectomy and 3

underwent Intact Canal Wall Mastoidectomy **(Table 3).** The correlation between HRCT findings and intraoperative findings **(Table 4)** are evaluated and discussed in detail in the next section.

IV. DISCUSSION:

High Resolution Computed Tomography of temporal bone has become a tool of paramount importance in Otology. Before subjecting a patient for surgery, the location, extent and type of the pathology needs to be delineated to improve outcomes and reduce complications or recurrence. HRCT also has some weaknesses. The biggest disadvantage is that it cannot differentiate between cholesteatoma, granulation or other soft tissue pathologies, which are better demonstrated and differentiated on MRI.

In our study, otorrhea was the most common symptom, seen in 93.3% patients, most having moderate-profuse discharge. Foul odour was seen in 100% patients with otorrhea. Hearing loss was present in 80.0% patients and headache in 46.7% patients **(Table 1)**. In the study by **Chavada et al**, they reported similar findings with most of the patients having ear discharge(98%) and reduced hearing(83%) as chief complaints.(8)

The most commonly performed surgical procedure was Canal wall down mastoidectomy, done in 27 cases(90%) and intact canal wall mastoidectomy was done in 3(10%) cases **(Table 3)**.

In our study, HRCT showed normal ***EAC*** in 16 cases, out of which 13(81.2%) were normal intraoperatively and 3(18.8%) had erosion over posterosuperior EAC. Soft tissue density was seen in 9 cases on HRCT, out of which all 9 cases were found to have polypoidal mass in the EAC intraoperatively. EAC wall thickening was reported in 5 cases but in all those cases, we couldn't find any wall thickening intraoperatively. Kappa correlation coefficient (κ) was 0.548 with p-value<.05, implying that the HRCT findings and intra-operative findings of EAC were in statistically significant moderate agreement with each other. Compared to our results, the study by **S. Ranjith Kumar et al** shows that EAC involvement is detected by HRCT in 26 cases; the intraoperative findings show EAC involvement in 26 cases; the sensitivity and Positive Predictive Value(PPV) of HRCT in diagnosing EAC involvement was 100% and specificity of HRCT in their study came out to be 90% and NPV was 100%.(9)

Mastoid cells were reported to be completely sclerosed on HRCT in 4 cases, of which all 4 were found to have purely sclerotic bone intraoperatively. Soft tissue density was seen in 11 cases, out of which the mastoid bone was sclerosed in 4 cases and had cholesteatoma/granulation tissue in 7 cases. κ=0.009 with p-value>0.05, so there was no statistically significant agreement between the HRCT findings and intra-operative findings of Mastoid cells. **S. Ranjith Kumar et al** reported similar findings where HRCT detected 2 cases with normal mastoid air cells, 12 cases with soft tissue density lesion and 16 cases had sclerosed partially pneumatized cells but intraoperatively, 3 cases were found to have normal mastoid, 13 cases with exudate infiltration in the mastoid and 14 cases with partially pneumatized sclerosed mastoid.(9)

Aditus was normal on HRCT in 11 patients, of which 5 were found to be normal and 6 were found to have Cholesteatoma/granulation intraoperatively. There was no statistically significant agreement between the HRCT findings and intra-operative findings of Aditus with κ=0.139 and p-value>0.05. This slightly differed from study by **Jose et al**, which reported very good radiologic–surgical correlation(i.e, κ=0.80–1.00) in the antrum and aditus with respect to the presence/absence of soft tissue attenuation.(10)

In our study, HRCT picked up ***scutum*** erosion in 26 cases(86.7%) and intraoperatively, we found scutum erosion in those 26 cases and no scutum erosion in the remaining 4 cases, suggesting statistically significant perfect agreement between the HRCT and intra-operative findings of scutum with κ=1.000 and p-value<0.05. In the study done by **S. Ranjith Kumar et al** (9), they found that Scutum erosion is detected by HRCT in 12 cases and 18 cases are found to have normal Scutum; intraoperatively, scutum involvement is seen in 10 cases and 20 cases showed normal Scutum; the sensitivity of HRCT in diagnosing Scutum involvement is 96%, specificity is 80% with a PPV of 96%.

In our study, soft tissue density was observed in ***epitympanum*** in all 30 cases, out of which soft tissue density was seen intraoperatively in epitympanum in 26 cases and was found to be normal in the remaining 4 cases. There was no statistically significant correlation between the HRCT and intra-operative findings of Epitympanum with κ=0.000 and p-value>0.05.

Mesotympanum was reported to be normal on HRCT in 11 cases, out of which 8 cases were found to have normal mesotympanum intraoperatively and 3 cases were found to have Cholesteatoma/granulation in mesotympanum. 19 cases were reported to have soft tissue density in mesotympanum on HRCT, out of which 13 cases were found to have no disease in mesotympanum and in 6 cases, cholesteatoma/granulation tissue was found intraoperatively. There was no statistically significant correlation between the HRCT and intra-operative findings of mesotympanum with κ=0.036 and p-value>0.05.

Hypotympanum was normal on HRCT in 23 cases, of which 21 cases were found to have no disease in hypotympanum intraoperatively and 2 cases had cholesteatoma/granulation tissue in hypotympanum. 7 cases were reported to have soft tissue density in the hypotympanum, of which 4 cases were found to have no disease intraoperatively, and 3 cases had cholesteatoma/granulation in hypotympanum. There was statistically

significant fair agreement between the HRCT and intra-operative findings of Hypotympanum with κ=0.379 with p-value<0.05. As per the study by **Jose et al**, good agreement(κ=0.60–0.80) was noted in the absence/presence of soft tissue attenuation in the mesotympanum, hypotympanum as well as the epitympanum.(10)

Tegmen tympani was eroded in 5 cases on HRCT, and intraoperatively, only 1 case was found to have tegmen tympani erosion. All the cases with normal tegmen tympani on HRCT were found to have normal tegmen tympani intraoperatively as well. Thus based on our study, HRCT can be said to have excellent sensitivity, but reduced specificity in diagnosing tegmen tympani erosion. The HRCT and intra-operative findings of tegmen tympani were in fair agreement with each other and this agreement was statistically significant with κ=0.294 and p-value<0.05. The study by **Keskin et al** (11) reported similar findings that none of the 11 patients who were diagnosed to have tegmen erosion in CT showed tegmen erosion in surgery. In 44 patients there was no tegmen erosion in either surgery or CT. In 1 case, it was reported to have tegmen erosion in surgery but it was not detected in CT.

In our study, ***malleus*** was intact in 10 cases(33.33%) both on HRCT and intraoperatively. Malleus was eroded in 18 cases(60%) on HRCT, of which, intraoperatively, 3 were found to be intact, 11 eroded and 4 absent. There was statistically significant substantial agreement between the HRCT and intra-operative findings of malleus with κ=0.625 and p-value<0.05.

Incus was intact on HRCT in 4 cases(13.33%), of which 2 were found to intact and 2 eroded intraoperatively. Incus was eroded on HRCT in 22 cases, out of which, erosion was found in 20 cases, intact in 1 case and absent in 1 case. So, there was statistically significant substantial agreement between the HRCT and intra-operative findings of incus with κ=0.688 and p-value<0.05.

Stapes was intact on HRCT in 13 cases, of which stapes was found to be absent intraoperatively in 2 cases and found to be intact with granulation tissue over it in 1 case. Stapes erosion was seen on HRCT in 15 cases, of which erosion was seen intraoperatively in 9 cases, absent in 4 cases and intact in 2 cases. There was statistically significant moderate agreement between the HRCT and intra-operative findings of stapes with κ=0.470 and p-value<0.05.

In our study, maximum agreement between HRCT and intraoperative findings among ossicles was noted with incus, followed by malleus and stapes. **Jose et al** (10) reported similar findings in their study, where they reported that there was maximum sensitivity of 92.86% in detecting incus erosions, followed by malleus erosions with sensitivity of 87.10%. The poorest agreement among ossicles was with stapes (κ=0.569). Sensitivity was also the lowest in stapes of approximately 70.9%.

The ***round window niche*** was normal in all 30 cases on HRCT in our study, but intraoperatively, it was found that RWN was normal only in 23 cases(76.67%) and was found to have cholesteatoma in 3 cases and granulation tissue in 4 cases, which had to be removed. There was no statistically significant agreement between the HRCT and intra-operative findings of Round Window Niche and κ=0.000 with p-value>0.05.

In our study, we found that the HRCT findings and intra-operative findings of ***Oval Window Niche*** were in statistically significant perfect agreement with each other with κ=1.000 and p-value<0.05.

We found that ***Sinus plate*** was normal in 25 cases and eroded in 5 cases on HRCT. Intraoperatively, sinus plate was normal in all 25 cases reported to be normal on HRCT and erosion was seen in 2 of the cases reported to have erosion on HRCT and the remaining 3 cases were found to have intact sinus plate. The HRCT and intra-operative findings of sinus plate were in moderate agreement with each other, this agreement was statistically significant with κ=0.526 and p-value<0.05. **Kanotra et al** (12) reported similar findings in their study that sigmoid sinus plate erosion was seen in 5 patients on HRCT temporal bone, and the same results were found intra‑operatively. Therefore, the sensitivity, specificity, positive and negative predictive value of HRCT in relation to Sinus plate erosion was 100%.

In our study, we found that ***facial recess*** was normal on HRCT in 20 cases, out of which all were found to be normal intraoperatively. 10 cases were reported to have some soft tissue density in the facial recess on HRCT, but out of them, only 1 case was found to have cholesteatoma in the facial recess intraoperatively and the remaining 9 cases were found to be normal. There existed statistically significant none to slight agreement between the HRCT and intra-operative findings of facial recess with a κ=of 0.129 and p-value<0.05

On HRCT, in 26 cases, ***sinus tympani*** were reported to be normal, out of which 22 cases were found to be normal and 4 cases were found to have cholesteatoma in the sinus tympani intraoperatively. 4 cases were reported to have soft tissue density in the sinus tympani on HRCT, out of which only 1 case was found to have cholesteatoma in the sinus tympani intraoperatively and the remaining 3 cases were found to have no involvement. There existed no statistically significant agreement between the HRCT and intra-operative findings of sinus tympani with κ=0.087 and p-value>0.05.

In our study, 25 cases were reported to have intact ***facial canal*** on HRCT, out of which, facial canal was intact in all 25 cases intraoperatively. 5 cases were reported to have erosion in facial canal on HRCT, out of which facial canal was eroded in all 5 cases intraoperatively. The HRCT and intra-operative findings of Facial Canal were in statistically significant perfect agreement with each other with κ=1.000 and p-value<0.05. Similar

findings were reported by **S. Ranjith Kumar et al** (9)**,** where they found that HRCT detected facial canal involvement in 5 cases, all 5 of which were found to have erosion intraoperatively; 25cases were found to be normal on HRCT and intraoperatively showing 100% sensitivity and 100% positive predictive value.

LSCC was intact in 29 cases on HRCT, out of which all 29 cases were found to have intact LSCC intraoperatively. LSCC was eroded on HRCT in 1 case, and intraoperatively also, erosion of LSCC was found in that case. There was statistically significant perfect agreement between the HRCT and intra-operative findings of SCC with κ=1.000 and p-value<0.05. **Jose et al** (10) reported similar findings and found that the highest level of agreement between the CT and surgical findings was in the area of the labyrinth with 100% sensitivity and specificity. All 8 cases of labyrinthine erosion on CT were found to be eroded intraoperatively with no false positives/false negatives.

In our study, 5 cases were reported to have ***Koerner's septum*** on HRCT, and all the 5 cases were found to have Koerner's septum intraoperatively. HRCT reported no Koerner's septum in 25 cases and no Koerner's septum was found intraoperatively, showing that there was statistically significant perfect agreement between the HRCT and intra-operative findings of Koerner's septum with κ=1.000 and p-value<0.05.

On HRCT, soft tissue density was reported in ***Prussak's space*** in 8 cases, out of which 4 cases were found to have cholesteatoma/granulation tissue in the Prussak's space and 4 cases were found to be normal intraoperatively. All the cases reported to have normal finding in Prussak's space on HRCT were also found to be normal intraoperatively. There was statistically significant moderate agreement between the HRCT and intra-operative findings of Prussak's space with κ=0.595 and p-value<0.05. Similar findings were reported by **Pramod V et al** (13) that Prussak's space involvement was seen in 13 cases, of which 12 cases were detected by HRCT. HRCT has a high sensitivity 92.8% and specificity 100% in detection of Prussak space involvement.

Eustachian tube opening was reported to have soft tissue density in 3 cases, out of which all 3 cases were found to have Cholesteatoma/granulation near the Eustachian tube opening. 27 cases were reported to be normal on HRCT w.r.t Eustachian tube opening, and all 27 of them were found to be normal intraoperatively too. The HRCT findings and Intra-operative findings of Eustachian tube opening were in statistically significant perfect agreement with each other with κ=1.000 and p-value<0.05.

HRCT can assess the integrity of the entire cochlea whereas intraoperatively we were able to assess only the ***promontory***. We found that bony cochlea was intact on HRCT in 28 cases, all of which were found to be have intact promontory intraoperatively. Bony wall of basal turn of cochlea was eroded in 2 cases, and in both the cases promontory was dehiscent intraoperatively. The HRCT findings and intra-operative findings of promontory were in statistically significant perfect agreement with each other with κ=1.000 and p-value<0.05.

The hallmarks of cholesteatoma are the presence of non-dependent soft tissue density in middle ear cavity, ossicular erosion, erosions of the middle ear borders and adjacent structures. These changes when associated with expansion of the middle ear cavity and aditus with loss of its "figure of 8" appearance are highly suggestive of cholesteatoma. HRCT delineates the extent and location of the disease with around 80% specificity(14,15) However HRCT may overestimate the extent of disease as it often cannot differentiate definitively between cholesteatoma, granulation tissue and fluid**.**(16) HRCT gives a good to excellent radiosurgical correlation for the middle ear ossicles in our cases, and this is also the experience that others have reported. Prior knowledge of the status of ossicles decides the likelihood of hearing preservation achieved after surgery. Patients with intact stapes tend to show better hearing preservation as compared to those where the superstructure is absent.(17)

HRCT temporal bones can identify soft tissue densities, but fails to characterize them as cholesteatoma, granulations or fluid. Other disadvantages like high cost especially in a setting like ours where the majority of patients are from the lower socioeconomic strata and the inevitable radiation exposure also sets it back a bit.

HRCT has a very high reliability for diagnosis of erosion of bony structures like scutum, ossicles, sinus plate, dural plate, tegment typami, semicircular canals, cochlea, facial canal and for pneumatization of mastoid. It can also determine extent of cholesteatoma in the middle ear and Mastoid. It helps in detecting complications like mastoiditis, abscess, dehiscence of mastoid cortex, erosion of sigmoid plate, facial canal dehiscence, labyrinthine fistula and intracranial complications. But HRCT is unable to characterize precisely some of the various pathological findings in the middle ear like cholesteatoma, granulation tissue, mucosal edema or fluid in the middle ear.

V. CONCLUSION:

We conclude that HRCT should be recommended in all suspected cases of atticoantral disease to know the extent of the disease, to look for bony erosions in adjacent structures so that adequate preoperative planning can be done, adequate clearance of disease may be achieved and intraoperative complications may be minimized.

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Table 1. Distribution of study subjects based on clinical features present.

Symptoms			**No. of patients**	**Percentage**
Otorrhoea	Amount	Absent	2	6.7
		Scanty	3	10.0
		Moderate	13	43.3
		Profuse	12	40.0
	Foul odour		28	93.3
	Blood tinged		11	36.7
Hearing loss			24	80.0
Headache			14	46.7
Tinnitus			8	26.7
Vertigo			7	23.3
Vomiting			1	3.3%
Facial palsy			2	6.7%
Altered sensoriun			1	3.3%
Diplopia			0	0.0

Table 2. Distribution of study subjects based on endoscopic findings.

Endoscopic Findings		**No. of patients**	**Percentage**
EAC erosion		3	10.0
Polyp		9	30.0
Granulation		2	6.7
Cholesteatoma		5	16.7
Pars tensa	SCP	3	10.0
	MCP	2	6.7
	LCP	4	13.3
	Subtotal perforation	3	10.0

	Retracted	11	36.7
	Not seen	7	23.3
Pars flaccida	Retraction pocket with cholesteatoma	18	60
	Perforation	6	20.0
	Not seen	6	20.0

Table 3. Distribution of study subjects based on surgery performed.

Types of Surgeries	**No. of patients**	**Percentage**
Canal wall down mastoidectomy	27	90%
Intact Canal wall mastoidectomy	3	10%
Total	30	100%

Table 4. Correlation between HRCT findings and intra-operative findings.

STRUCTURES	**HRCT FINDINGS**	**INTRAOPERATIVE FINDINGS**					**TOTAL**	**KAPPA VALUE**	**P-VALUE**
1. EXTERNAL AUDITORY CANAL		**Normal**	**Polyp**	**Erosion**				0.548	<0.05
	Normal	13(81.2%)	0 (0.0%)	3 (18.8%)			16 (100%)		
	STD	0 (0.0%)	9 (100%)	0 (0%)			9 (100%)		
	Wall thickening	5 (100%)	0 (0%)	0 (0%)			5 (100%)		
	Total	18 (60%)	9 (30%)	3 (10%)			30 (100%)		
2. MASTOID AIR CELLS		**Sclerosed**	**Cholesteatoma/Granulation**					0.009	>0.05
	Sclerosed	4 (100%)	0 (0%)				4 (100%)		
	STD	4 (36.36%)	7 (63.63)				11 (100%)		
	Erosion with STD	9 (60%)	6 (40%)				15(100%)		
	Total	17 (56.67%)	13 (43.33%)				30 (100%)		
3. ADITUS		**Normal**	**Cholesteatoma/Granulation**					0.139	>0.05
	Normal	5 (45.5%)	6 (54.5%)				11 (100%)		
	STD	6 (31.6%)	13 (68.4%)				19 (100%)		
	Total	11 (36.7%)	19 (63.3%)				30 (100%)		
4. SCUTUM		**Intact**	**Eroded**					1.000	<0.05
	Intact	4 (100%)	0 (0%)				4 (100%)		
	Eroded	0 (0%)	26 (100%)				26 (100%)		
	Total	4 (13.3%)	26 (86.7%)				30 (100%)		
5. EPITYMPANUM		**Normal**	**Cholesteatoma/Granulation**					-	>0.05
	STD	4 (13.3%)	26 (86.7%)				30 (100%)		
	Total	4 (13.3%)	26 (86.7%)				30 (100%)		
6. MESOTYMPANUM		**Normal**	**Cholesteatoma/Granulation**					0.036	>0.05
	Normal	8 (72.7%)	3 (27.3%)				11 (100%)		
	STD	13 (68.4%)	6 (31.6%)				19 (100%)		
	Total	21 (70%)	9 (30%)				30 (100%)		
7. HYPOTYMPANUM		**Normal**	**Cholesteatoma/Granulation**					0.379	<0.05
	Normal	21 (91.3%)	2 (8.7%)				23 (100%)		
	STD	4 (57.1%)	3 (42.9%)				7 (100%)		
	Total	25 (83.3%)	5 (16.7%)				30 (100%)		
8. TEGMEN TYMPANI		**Intact**	**Eroded**					0.294	<0.05
	Intact	25 (100%)	0 (0%)				25 (100%)		
	Eroded	4 (80%)	1 (20%)				5 (100%)		
	Total	29 (96.7%)	1 (3.3%)				30 (100%)		
9. MALLEUS		**Intact**	**Eroded**	**Absent**				0.625	<0.05
	Intact	10 (100%)	0 (0%)	0 (0%)			10 (100%)		
	Eroded	3 (16.7%)	11 (61.1%)	4 (22.2%)			18 (100%)		
	Absent	0 (0%)	0 (0%)	2 (100%)			2 (100%)		
	Total	13 (43.3%)	11 (36.7%)	6 (20%)			30 (100%)		
10. INCUS		**Intact**	**Eroded**	**Absent**				0.688	<0.05
	Intact	2 (50%)	2 (50%)	0 (0%)			4 (100%)		
	Eroded	1 (4.5%)	20 (90.9%)	1 (4.5%)			22 (100%)		
	Absent	0 (0%)	0 (0%)	4 (100%)			4 (100%)		
	Total	3 (10%)	22 (73.3%)	5 (16.7%)			30 (100%)		
11. STAPES		**Intact**	**Eroded**	**Absent**	**Intact+ Granulation**	**Eroded+ Granulation**		0.470	<0.05
	Intact	10 (76.9%)	0 (0%)	2 (15.4%)	0 (0%)	1 (7.7%)	13 (100%)		
	Eroded	2 (13.3%)	7 (46.7%)	4 (26.7%)	2 (13.3%)	0 (0%)	15 (100%)		

	Absent	0 (0%)	0 (0%)	2 (100%)	0 (0%)	0 (0%)	2 (100%)		
	Total	12 (40%)	7 (23.3%)	8 (26.7%)	2 (6.7%)	1 (3.3%)	30 (100%)		
12. RWN		**Normal**		**Cholesteatoma/Granualation**				-	>0.05
	Normal	23 (76.7%)		7 (23.3%)			30 (100%)		
	Total	23 (76.7%)		7 (23.3%)			30 (100%)		
13. OWN		**Normal**		**Cholesteatoma/Granualation**				1.000	<0.05
	Normal	26 (100%)		0 (0%)			26 (100%)		
	STD	0 (0%)		4 (100%)			4 (100%)		
	Total	26 (86.7%)		4 (13.3%)			30 (100%)		
14. SINUS PLATE		**Intact**		**Eroded**				0.526	<0.05
	Intact	25 (100%)		0 (0%)			25 (100%)		
	Eroded	3 (60%)		2 (40%)			5 (100%)		
	Total	28 (93.3%)		2 (6.7%)			30 (100%)		
15. FACIAL RECESS		**Normal**		**Cholesteatoma/Granualation**				0.129	<0.05
	Normal	20 (100%)		0 (0%)			20 (100%)		
	STD	9 (90%)		1 (10%)			10 (100%)		
	Total	29 (96.7%)		1 (3.3%)			30 (100%)		
16. SINUS TYMPANI		**Normal**		**Cholesteatoma/Granualation**				0.528	<0.05
	Normal	22 (84.6%)		4 (15.4%)			26 (100%)		
	STD	3 (75%)		1 (25%)			4 (100%)		
	Total	25 (83.3%)		5 (16.7%)			30 (100%)		
17. FACIAL CANAL		**Intact**		**Eroded**				1.000	<0.05
	Intact	25 (100%)		0 (0%)			25 (100%)		
	Eroded	0 (0%)		5 (100%)			5 (100%)		
	Total	25 (83.3%)		5 (16.7%)			30 (100%)		
18. LATERAL SCC		**Intact**		**Eroded**				1.000	<0.05
	Intact	29 (100%)		0 (0%)			29 (100%)		
	Eroded	0 (0%)		1 (100%)			1 (100%)		
	Total	29 (96.7%)		1 (3.3%)			30 (100%)		
19. KOERNER'S SEPTUM		**Present**		**Absent**				1.000	<0.05
	Present	5 (100%)		0 (0%)			5 (100%)		
	Absent	0 (0%)		25 (100%)			25 (100%)		
	Total	5 (16.7%)		25 (83.3%)			30 (100%)		
20. PRUSSAK'S SPACE		**Normal**		**Cholesteatoma/Granualation**				0.595	<0.05
	Normal	22 (100%)		0 (0%)			22 (100%)		
	STD	4 (50%)		4 (50%)			8 (100%)		
	Total	26 (86.7%)		4 (13.3%)			30 (100%)		
21. EUSTACHIAN TUBE OPENING		**Normal**		**Cholesteatoma/Granualation**				1.000	<0.05
	Normal	27 (100%)		0 (0%)			27 (100%)		
	STD	0 (0%)		3 (100%)			3 (100%)		
	Total	27 (90%)		3 (10%)			30 (100%)		
22. PROMONTORY/COCHLEA		**Intact**		**Dehiscent**				1.000	<0.05
	Intact	28 (100%)		0 (0%)			28 (100%)		
	Dehiscent	0 (0%)		2 (100%)			2 (100%)		
	Total	28 (93.3%)		2 (6.7%)			30 (100%)		

FIGURES:

Fig. 1. Distribution of study subjects according to age.

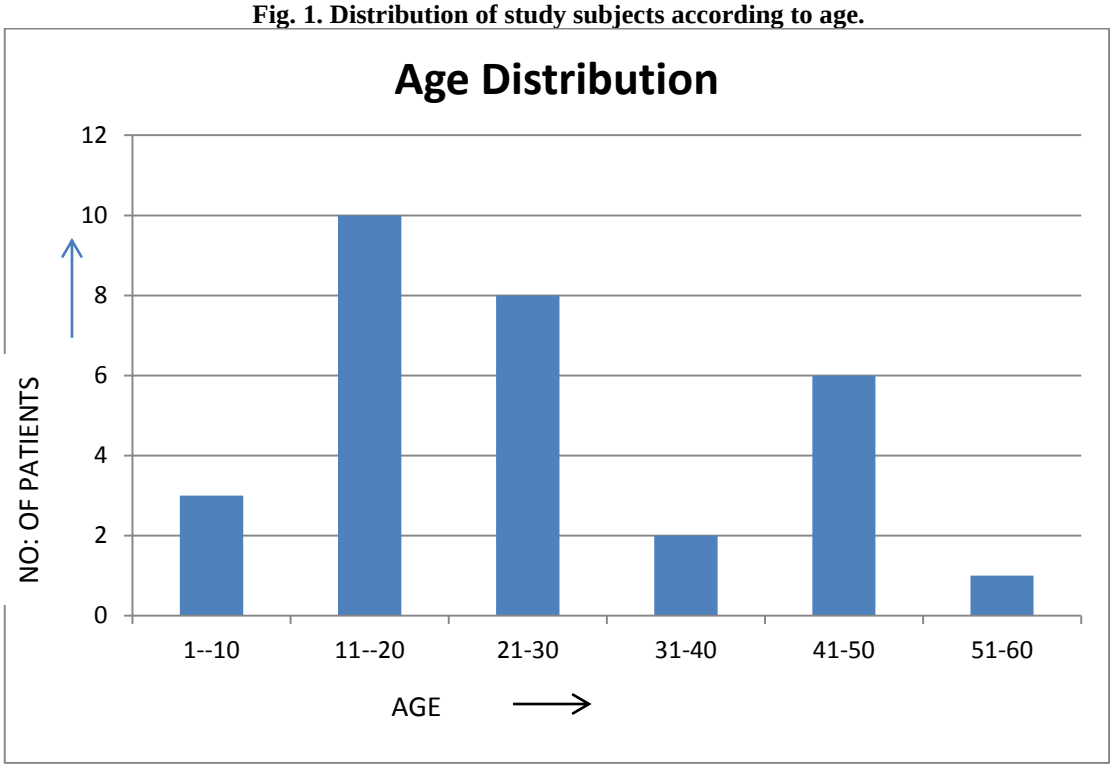

Fig. 2. Distribution of study subjects according to gender.