

## **CHOLESTEATOMA BY INSIDE OUT CANA WALL DOWN TECHNIQUES IN GOVERNMENT TERIARY CARE HOSPITALS**

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### **ABSTRACT**

A prospective study comprising of 50 patients with cholesteatoma on whom the inside out canal wall down mastoidectomy was performed. This study aimed at the efficacy of the technique in complete eradication of the disease as well as its usefulness in decreasing cavity problems. Present study the age group ranged from 8 to 60 years. The mean age in this study was 22.34 years. The male to female ratio in this study was 2.125:1. Cholesteatoma was seen in the posterosuperior quadrant of the tympanic membrane in 54% cases, while attic cholesteatoma was seen in 42% cases. The remaining 4% had a central perforation. The median air conduction threshold was 42.5dB in the present series. The median air bone gap in this series was 30dB. Intraoperatively 76% of the cases had a necrosed incus. Malleus was necrosed in 30% and stapes superstructure was necrosed in 40% of our cases. 44 patients (90%) had regular follow up. Overall success rate was 93.18% in this series. The average postoperative air bone gap in the present series was 18.03 dB and the average hearing gain was found to be 10.66dB. 84% of patients had a problem free cavity while excessive wax and debris was seen in 9%. Discharge due to persistence of disease was seen in 7%.

**KEYWORDS:** Cholesteatoma, Postoperative, CSOM

### **INTRODUCTION**

Chronic Suppurative Otitis Media (CSOM), infection of the middle ear, has been recognized since prehistoric times. It is characterized by intermittent or persistent purulent discharge through a perforated tympanic membrane and the unsafe variety may be associated with cholesteatoma. Cholesteatoma often, runs a malignant course destroying the patient's hearing and involving the surrounding structures including brain, thereby increasing the morbidity and mortality of those affected. Although Hippocrates, "Father of Medicine" had noticed the development of intracranial complications following ear discharge, the treatment for such a disease was not well established due to lack of better understanding of the disease and the non-availability of better technology. Although, the introduction of sulphur drugs by Domegk in 1935 and penicillin by Sir Alexander Fleming in 1942 reduced the mortality in case of safe type of CSOM, they could not cure cholesteatoma.

Surgery was thought of as a treatment for cholesteatoma as early as in the eighteenth century. Initially, the main aim of the surgery was disease eradication and it was only after the introduction of the operating microscope in 1921 by Nylen and Holmgren that restoration of hearing mechanism also became an important consideration. With the passage of time, the older procedures have been refined, and newer techniques have been adopted to make the diseased ear completely free of diseases along with restoration of the hearing mechanism and also minimizing the post-operative problems. A canal wall down mastoidectomy will no doubt cure the disease in most of the cases. But in doing this, the patient is left with a large postoperative cavity which is associated with many problems like retention of wax, debris, discharge, etc. An 'inside out' mastoidectomy differs from the classical 'outside in' technique by following the disease in the direction of its spread.

This is thought to limit the size of the postoperative cavity which will decrease the cavity problems to some extent.

Since the prevalence of ear disease with cholesteatoma is very high, it is very essential for all the otologists and otology students to have a fair knowledge of the disease and be well trained in the surgical techniques. Here we study the 'inside out' technique of canal wall down mastoidectomy and its effectiveness in achieving better cure rates and decreasing the postoperative cavity problems. We hope that this study will prove useful to the students of otology in future.

- To study the efficacy of inside out canal wall down mastoidectomy in completely eradicating the disease from the middle ear and the mastoid.
- To study the advantages of inside out technique in minimizing the complications of canal wall down mastoidectomy (open cavity mastoidectomy)

## METHODS

A Prospective study conducted at Bowring and Lay Curzon hospitals, which is attached to BMCRI, Bangalore. A fifty patients recruited with written consent. Prestructured questionnaires were used to collect the demographic profile pre OP and post OP data collected systematically with lesser error and greater accuracy. Data was analysed by using SAS statistical software. Univariate analysis was employed to draw the significant inference.

## RESULTS

This study involved 50 patients with cholesteatoma who underwent inside out canal wall down mastoidectomy. The observations made during the course of the study are as follows.

### Age Distribution

In this study the age group ranged from 8 to 60 years. Our observation is as follows

**Table 1: Age Distribution**

Age in Years	No. of Patients	% Age of Patients
0 to 10	4	8
11 to 20	21	42
21 to 30	17	34
31 to 40	6	12
41 & above	2	4

In the present study the youngest patient was eight years old and the oldest was sixty years old. As shown in the table and chart Tab(1), the maximum incidence of cholesteatoma in our study was seen in the second decade i.e. 21 cases (42%) followed by the third decade i.e. 17 cases (34%). There were 6 cases (12%) in the age group 31 to 40 years, 4 cases (8%) in 0 to 10 years group and 2 (4%) of the patients were above 41 years. The mean age in this study was 22.34 years.

### Sex Distribution

In the present study the sex distribution was also observed and the observations are as follows:

**Table 2: Sex Distribution**

Sex	No. of Patients	% Age of Patients
Male	4	68
Female	21	32

In the present study there was a male predominance constituting almost 68% i.e. 34 of the total number of cases while females made up only 32% (16 cases) of the study (Figure 5.2, Table 5.2). The male to female ratio in this study was 2.125:1.

### Side of Discharge

The side of the discharge whether right, left or bilateral was also noted in this study

**Table 3: Side of Discharge**

Side	No. of Patients	% Age of Patients
Right	17	34
Left	18	36
Bilateral	15	30

Of the fifty cases studied, 15 (30%) of them had bilateral cholesteatoma while the remaining 35 (70%) had unilateral disease. Among these patients who had unilateral disease, 17 (34%) of them had it on the left side (Figure 5.3, Table 5.3). Of the 35 cases which had unilateral ear disease, 4 of them had coexistent tubotympanic disease on other side.

### Symptoms

The presenting symptoms of all the patients were analysed and the observation are shown in the table and chart below.

**Table 4: Symptom Distribution**

Symptom	No. of Patients	% Age of Patients
Otorrhoea	50	100
Hearing Loss	46	92
Otalgia	14	28
Fever	7	14
Giddiness	6	12
Tinnitus	4	8
Vomiting	4	8
Headache	3	6

All the cases in this study presented with Otorrhoea. 46 of them i.e. 92% had history of hearing loss. Otalgia was seen in 14(28%), fever in 7(14%), giddiness in 6(12%) and tinnitus was seen in 4(8%) cases in the present study. Also vomiting was seen in 4(8%) and headache in 3(6%) (Figure 5.4, Table 5.4). Thus Otorrhoea appears to be the commonest presentation followed by hearing loss.

### Clinical signs

The clinical signs regarding the site of cholesteatoma and the presence of polyp and postaural swelling are as follows:

**Table 5: Clinical Signs Distribution**

Sign		No. of Patients	% Age of Patients
Cholesteatoma	Posterosuperior	27	54
	Attic	21	42
	Central	2	4
Ployp		13	26
Postaural Swelling		7	14

On examination, cholesteatoma was seen in the posterosuperior quadrant of the tympanic membrane in 27(54%) cases, while attic cholesteatoma was seen in 21(42%) cases. The remaining 2 cases (4%) had a central perforation (Figure 5.5). In this study, polyps were seen in 13 cases i.e 26% of the cases. Also 7 cases i.e. 14% had a Postauricular swelling resulting from mastoiditis (Table 5).

### Type of Cholesteatoma

Cholesteatoma type in the present study is as follows:

**Table 6: Type of Cholesteatoma**

Type	No. of Patients	% Age of Patients
Primary Acquired	48	96
Secondary Acquired	2	4

In the present study 48 cases i.e. 96% of the total 50 cases had a primary acquired cholesteatoma while the remaining 2 cases (4%) had a secondary acquired cholesteatoma (Figure 5.6, Table 5.6). Congenital cholesteatoma and residual cholesteatoma were excluded from the study.

### X-Ray Mastoids

In all the cases X-ray of the mastoids, Schuller's view was taken and was analysed. They were classified as whether they are pneumatised or sclerosed. Some cases showed a well defined cavity within which the cholesteatoma sac was present.

**Table 7: X-Ray Mastoids**

Type	No. of Cases	% Age of Cases
Bilateral Sclerosed	31	62
Sclerosed on affected side and pneumatised on opposite side	15	30
Cavity	4	8

In our study all the cases with cholesteatoma, except 4 were found to have a sclerosed mastoid. Bilateral sclerosis was found in 31 cases (62%). Sclerosis on the affected side and pneumatised on the opposite side was noted in 15 of our cases (30%). Cavity in the mastoid bone formed by bone erosion of cholesteatoma was seen in 4 cases i.e. 8% (Figure 5.7, Table 5.7).



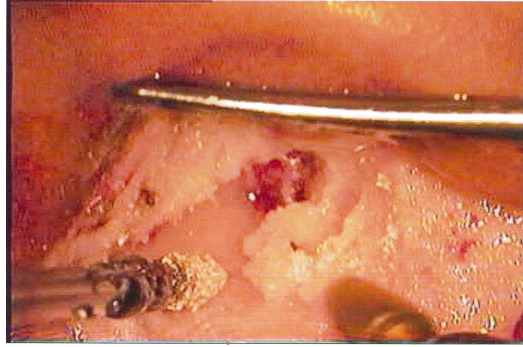
**Figure 5.1: Attle Cholesteatoma**



**Figure 4.2: Posterosuperior Cholesteatoma**



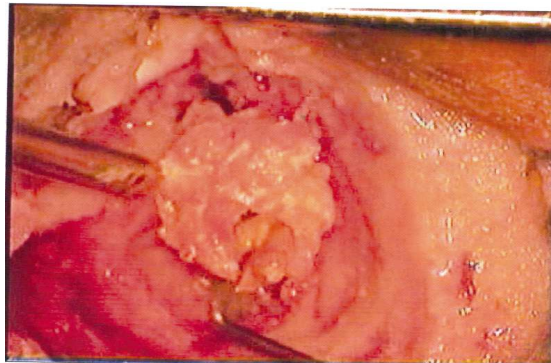
**Figure 4.5: Aural Polyp**



**Figure 4.6: Inside out Mastoidectomy-Enlarging the External Bony Canal**



**Figure 4.7: Inside out Mastoidectomy**



**Figure 4.8: Removal of Cholesteatoma sac**

### Microbiological Profile

The observations made on the bacterial culture report are as follows:

**Table 8: Microbiological Profile**

Organism	No. of Patients	% Age of Patients
Staphylococcus	13	26
Pseudomonas	11	22
Proteus	9	18
Klebsiella	3	6
E.coli	1	2
H.influenza	1	2
Mixed	6	12
No growth	6	12

Staphylococcus aureus was the commonest organism isolated in this series and was seen in 13 cases i.e. 26%. This was followed by pseudomonas 11 (22%), proteus 9 (18%), klebsiella 3 (6%), E.coli 1 (2%) and Haemophilus influenza 1 (2%) cases. Mixed growth was seen in 6 cases i.e. 12%. No organism was isolated in another 6 cases (12%) (Figure 5.8, Table 5.8).

### Audiological Profile

All the cases were subjected for pure tone audiometry and the hearing threshold for air conduction and bone conduction were noted.

**Table 9: Hearing Loss**

Type	No. of Cases	% Age of Cases
Conductive	27	54
Mixed	18	36
Sensorineural	4	8
Dead	1	2

In this series, there were 27 cases with pure conductive hearing loss i.e. 52%. Mixed loss (Bone conduction more than 20dB and A-B gap more than 15dB) was seen in 18 cases i.e 36% and sensorineural loss (Bone conduction more than 20dB and A-B gap less than 15dB) in 4 cases i.e. 8%. The remaining 1 case was a dead ear (Figure 5.9, Table 5.9).

## DISCUSSIONS

This study was conducted at BMCRI. Total 50 patients with cholesteatoma were selected and all of them were subjected to inside out canal wall down mastoidectomy.

### Age and Sex

The youngest patient in the present study was 8 years old and the eldest was 60 years old. The maximum number of patients was in the age group 11 to 20 years which is in accordance with the study conducted by Gupta et al (1998)<sup>43</sup>. The mean age in our series was 22.34 years. In a study conducted by Eero Vartiainen (1998)<sup>44</sup>, the mean age was found to be 38 years while Paparella and Kim (1977)<sup>45</sup> noted a mean age of 35.1 years.

Males predominated in the present study with the male to female ratio being 2.125:1.

### Clinical Picture

The incidence of discharge in the left ear was 36% and that in the right ear was 34%. 30% of our cases had bilateral ear discharge.

The commonest presenting symptom in our body was Otorrhoea which was found in all our cases. This was followed by hearing loss which was found in 92% of the cases in this study. Edelstein et al (1988)<sup>46</sup> noted hearing loss in 85% and Otorrhoea in 73% of cases. Other symptoms like Otagia, tinnitus and vertigo in our study were 28%, 8% and 12% respectively. This is similar to that noted by Edelstein et al in which Otagia; tinnitus and vertigo were found in 32%, 8% and 8% respectively (Table. 6.1). Apart from these symptoms related directly to ear disease, few patients had some systemic symptoms as well. Fever was noted in 7 patients, headache in 3 patients, vomiting in 4 patients and altered sensorium in one patient. These systemic symptoms herald the development of complications which are mostly intracranial. Also sudden increase in the discharge and development of pain is often seen in cases going for complications.

**Table 10: Clinical Profile-Comparison**

Symptom	Edelstein et al (1988) <sup>46</sup>	Present Series (2006)
Otorrhoea	73%	100%
Hearing Loss	85%	92%
Otalgia	32%	28%
Fever	8%	14%
Giddiness	8%	12%
Tinnitus	8%	8%

Examination of the ears revealed granulations and polyps in 26% of the cases in this study. This is similar to that of Edelstein et al, who noted this in 31% of their study.

Cholesteatoma was found in the posterosuperior quadrant in 54% of cases while it was found in attic in 42%. Edelstein et al noted 32% in posterosuperior quadrant and 20% in attic. Central perforation either subtotal or total was found in only 4% in this series while it was present in 9% in the study conducted by Edelstein et al.

In this study, primary acquired cholesteatoma was the commonest type seen and it was the diagnosis in 96% of the cases. The remaining 4% were secondary acquired. Congenital cholesteatoma and residual cholesteatoma were excluded from this study. Edelstein et al (1988) noted 48% primary acquired cholesteatoma, 10% of secondary acquired cholesteatoma, 18% recurrent cholesteatoma and 24% of congenital cholesteatoma. Sade and Skatz (1988)<sup>47</sup> noted 57.8% primary acquired and 7.3% secondary acquired cholesteatoma.

### **Radiological Profile**

In our study all the cases with cholesteatoma were found to have a sclerosed mastoid. Bilateral sclerosis was found in 31 cases (62%). Of the 31 cases that showed bilateral sclerosis, 15 of them had bilateral disease and the rest 16 had bilateral sclerosis but unilateral disease. So it is difficult to infer whether sclerosis predisposes the mastoids to cholesteatoma formation or if sclerosis is the result of cholesteatoma.

Sclerosis on the affected side and pneumatized on the opposite side was noted in 15 of our cases (30%).

The remaining 4 cases i.e. 8% of the patients showed a cavity on their X- Rays. This is because of the bone eroding property of the cholesteatoma. However such cases should be differentiated from postoperative cavities.

One case in this series with an intracranial complication (meningitis) presented with a cavity on X-Ray. However no bony erosion could be made in any of the complicated cases.

All cases with complications also underwent C.T scanning, especially the cases where an intracranial extension was anticipated. One case showed an extradural abscess around the lateral sinus. The sinus plate was eroded in this case. C.T scan in one patient showed a cerebellar abscess. This patient was initially treated by neurosurgeon for the cerebellar abscess and later underwent mastoidectomy. Two cases with meningitis showed erosion of the dural plate.

C.T scanning was also done in cases of extracranial complication to rule out any possible intracranial spread. Sinus plate was found to be eroded in one case, but there was no evidence of spread of infection intracranially. Other cases did not show any significant feature.



### Microbiological Profile

The discharge from the ear was sent for bacterial culture and antibiotic sensitivity. The predominant bacterium isolated in this study was staphylococcus aureus which was found in 26% of the cases. This was followed by pseudomonas (22%), proteus (18%), klebsiella (6%), E.coli (2%) and haemophilus influenza (2%). Mixed infection was seen in 12% and another (12%) did not produce any growth. This was similar to that found by B.N. Rao and M.S. Reddy (1994)<sup>48</sup> which shows staphylococcus in 41%, pseudomonas in 21%, proteus in 18% klebsiella in 10% and no growth in 10% (Table 6.2).

**Table 11: Microbiological Profile-Comparison**

Organism	B N Rao and M S Reddy (1994) <sup>48</sup>	Present Series (2006)
Staphylococcus	41%	26%
Pseudomonas	21%	22%
Proteus	18%	18%
Klebsiella	10%	6%
E.coli	0	2%
H.influenza	0	2%
Mixed	0	12%
No growth	10%	12%

Thus, we see that both gram positive and gram negative organism are involved in cases of cholesteatoma. So while starting antibiotic therapy it is necessary to include drugs that are active against these organisms.

### Pure Tone Audiometry

All the patients selected for the study were taken up for pure tone audiometry. 10% of them had a hearing threshold less than 30dB while a majority of them i.e. 62% had a hearing threshold between 31 to 59dB. 26% had a greater hearing loss and presented with a threshold of more than 60dB. 36% of the patients in this study showed mixed loss while 8% patients had a sensorineural hearing loss. One case was a dead ear.13 patients had an air bone gap of less than 20dB, while another 20 and 16 cases had an air bone gap of 21 to 31dB and more that 31dB respectively.

Audiological evaluation of patients with intracranial complications showed a mixed loss in 3 cases and a sensorineural loss in 1 case. In all these cases the average air conduction threshold was more than 55dB. Also of the 8 cases with extracranial complications, 4 had mixed loss and 1 had a sensorineural loss. This may be attributed to the delay on the part of the patients in seeking medical intervention. The present series as compared to Eero Vartiainen (1998)<sup>44</sup> is shown in the tables below. The air conduction threshold is more or less similar to that found by Vartiainen in his 1976 to 1985 subgroup (Tables 7).

**Table 12: Pure Tone Audiometry – Comparison**

A.C.Threshold	Present Series (2006)	Eero Vartiainen (1998) <sup>44</sup>	
		1976 - 1985	1986 - 1995
<30dB	10%	18.4%	29.4%
31 to 59dB	62%	56.4%	55.1%
>60dB	26%	25.2%	15.4%

**Table 13: Air – Bone Gap – Comparison**

A.C.Threshold	Present Series (2006)	Eero Vartiainen (1998) <sup>44</sup>	
		1976 - 1985	1986 - 1995
<20dB	26.53%	25.2%	37.5%
21 to 30dB	40.81%	28.2%	30.9%
>31dB	32.65%	46.6%	31.6%

In the present series, we see that 26.53% (13 cases) had an air bone gap of less than 20dB. This is because in this category, there are 4 sensorineural loss, 8 mixed loss. Only one case had a mild conductive loss and this was because of a limited disease in the attic with no significant destruction of the ossicular chain. One case had a dead ear and is excluded in this analysis.

The median air conduction threshold was 50dB in the present series. This is comparable to 47.0dB found by Vartiainen in his first group (1976-1985) and high as compared to 39.0dB found by him in his second subgroup (1986-1995). The median air bone gap in this series was 30dB which is equal to 1976 to 1985 subgroup of Vartiainen. The second subgroup of Vartiainen i.e. 1985 to 1995 had a median air bone gap of 25dB. The greater amount of hearing loss noted in our study may be due to the increased incidence of ossicular chain necrosis that we came across during surgery.

### Complications

There were also complications in the cases selected for the present study. Four cases had intracranial complications, two had meningitis, one had extradural abscess and one had cerebellar abscess. The rate of intracranial complication in our study which was 8% was much higher compared to that of Gupta et al (1996)<sup>49</sup> who noted it in only 0.82% of their cases.

In this study there were 16% of extracranial complications. Among them 7 had acute mastoiditis or abscess, 2 of them had labyrinthitis and one of them had facial nerve palsy. The two patients having labyrinthitis were also having acute mastoiditis was extradural abscess. Both the cases of labyrinthitis were serous labyrinthitis and they recovered and they recovered after surgery and postoperative antibiotic therapy with cefotaxim 1 gm intravenous twice daily for 3 days followed by oral cefixime 200 mg twice daily for another 5-8 days. Both intracranial and extracranial complications were very high in this series because of large number of patients coming from poor socioeconomic strata with poor hygiene. Also, as many patients come from a rural background with lesser accessibility to medical facilities, the diseases tends to be neglected for a long time. Moreover this institute being a tertiary referral centre for the surroundings region, the complicated cases are referred more often than the cases with limited disease of complications noted in our study.

### Operative Findings

All the cases in this study underwent inside out canal wall down mastoidectomy. Sixteen of them were operated under general anaesthesia and rest under local anaesthesia. Intraoperatively 76% of the cases had a necrosed incus which was higher compared to Edelstein et al (1988)<sup>46</sup> where it was 46% and was in accordance with Sade (1981)<sup>33</sup> who noticed it in 80% of cases. Malleus was necrosed in 30% of our cases similar to that of Edelstein et al (25%). Stapes superstructure was necrosed 40% of our cases similar to that of Edelstein (40%) and also Sade (40%). Facial nerve canal was eroded in 18% of our cases which was not noted in Edelstein et al in their study. Dural plate was eroded in 6% of our study, but was not seen in Edelstein et al series. Erosion of the sinus plate was seen in 8% of our cases which was similar to Edelstein et al.

Erosion of the lateral semicircular canal bulge was seen in 3 cases i.e. 6%, but the membranous labyrinth was open in only 1 case. This patient had a dead ear. The fistula was covered by a fascia graft. Postoperatively these patients did not have any complaints.

Higher incidences of bone erosion seen in our cases compared to Edelstein et al may be because of delay in our patients seeking medical intervention.

### **Healing Time**

The patients in our series were regularly followed to assess the healing time of the postoperative cavity. But however it was possible in only 44 cases as the rest of the patients turned out to be defaulters. None of the cavities had healed by one month in our series while Paparella and Kim (1977)<sup>45</sup> noted 30%. By the end of three months 36 (81.82%) of our cavities were healed which was lesser than that of Paparella and Kim (87%). By the end of six months all cases except those in whom the surgery failed i.e. 41 (93.18%) had shown complete epithelialization, which was similar to that of Paparella and Kim (1977) who noted 95% success.

The longer duration of healing seen in our series may be attributed to higher rate of infection (Table 5.15). Those patients with smaller cavities and no infection showed better healing and the cavity was completely epithelialized in 3 months in most of cases. 2 of the cases took almost 5 months for complete epithelialization. One of them had a meatal stenosis for which revision meatoplasty was done after 2 months. The other had extensive granulations near the meatoplasty site and initially topical antibiotic steroid ear drops were given. Later it also required cautery with 10% trichloroacetic acid and finally the cavity healed by 5 months without any further problems. Also, in this particular patient the postoperative cavity was relatively larger because of extensive disease and this may also contributed for delayed healing.

### **Postoperative Complications**

Superficial infection of the cavity and a treatment discharge was seen in about 9 (20.45%) of patients in this series. They all responded to topical and systemic antibiotics. Granulations were noticed in 6 (13.63%) of our cases. They were most commonly seen at the meatoplasty site or in the cavity healing site. They were noticed during the healing period around 2 to 6 weeks. They all responded to topical antibiotics and steroid ear drops. Only one case required cauterization with 10% trichloroacetic acid. Thus the infection rate was 34.18% in our study which was similar to that of Brown et al (1982)<sup>11</sup> who noticed this in 31% cases.

Perichondritis was seen in 2 (4.55%) of patients in this series. They were admitted and systemic antibiotics were given. Ceftriaxone with sulbactam 1.5gms was given intravenously twice daily for one week and later continued with oral cefixime 200mg twice daily for another 7 to 10 days in both cases. Both of them responded well to conservative treatment. Meatal stenosis was noted in one patient i.e. 2.27% of the study. A new meatoplasty was done after 2 months and the patient did not have any further problems till the end of the study. Facial nerve involvement after surgery was seen in one case. The nerve was exposed at the mastoid segment and the cholesteatoma sac adherent to the nerve. Facial nerve palsy was noted postoperatively and was treated with steroids (injection Dexamethasone 4mg i.v thrice daily for 5 days and tapered). There was no recovery at the end of the medical treatment and the patient was advised facial nerve grafting, but the nerve came for follow up. Recidivism in cholesteatoma was seen in 6.82% of the cases i.e. 3 of our patients had residual disease. Recurrence of the disease is unlikely as all these cases presented within 6 months of undergoing surgery. This was comparatively better than that found by Sade et al (1981)<sup>33</sup> who had failure rate of 20% in 65 cases operated by

him. Brown (1982)<sup>11</sup> found a failure rate of 13%, which was comparable to the present series. The results of the present series was also better than that of Gristwood (1976) who had 17% failure in his series of 141 canal wall down mastoidectomies. The success rate in our study was similar to that of Abramson et al (1977)<sup>50</sup> who had 9% failure rates in 155 cases. Similar results were obtained by Cody and Mc Donald (1984) where the failure rate was 7%.

Failure rate in our study was comparatively higher than that found Austin (1989) who noted 4%.

**Table 14: Mastoidectomies Results**

Series	No. of Cases	%Age of Failure
Gristwood(1976)	141	17
Abramson et al(1977)	155	9
Sade et al (1981)	65	20
Brown (1982)		13
Cody and Mc Donald (1984)		7
Austin (1989)		4
Present Series (2006)	44	6.82

Thus, the results of the present study are comparable to any other study where outside in technique was followed. Drilling the bone from within the ear canal and limiting the dissection as far the outer limit of cholesteatoma will not however increase the failure rates. Thus, with respect to disease eradication, the inside out technique is as good as the outside in technique.

### Postoperative Audiometry

Although it was not the primary aim of the study to evaluate the hearing outcome after surgery, a postoperative PTA was however obtained in all cases after healing of the cavities or 3 months, whichever was later. For the reasons mentioned earlier these were analyzed only on 38 patients.

25 of the cases i.e. 65.78% of them had less than 20dB air bone gap. Of these 25 cases, 8 patients had a mixed hearing loss and the remaining 17 cases had a pure conductive loss. 12 patients i.e. 31.52% had an air bone gap between 21 to 30 dB of which 6 were having mixed loss. The remaining 1 patient i.e. 2.63% had an air bone gap of more than 31 dB after surgery. This patient had a mixed loss preoperatively. Here incus and stapes superstructure was necrosed and the fascia graft was placed over the cartilage graft placed on the stapes footplate.

Postoperatively, the average air bone gap was found to be 18.03 dB which was similar to that of MW Yung (1996)<sup>36</sup> who noted 19dB in his study. The average hearing gain was 10.66dB as compared to 11.8 in MW Yung series.

### Cavity Condition on Follow - Up

All possible cases were followed up till the end of the study. However 6 cases did not comply with this and the results were thus limited to the remaining 44 cases. The longest follow up period was 1 year 9 months and the shortest was 3 months. During this period, we inspected the cavities for any excessive accumulation of wax, fungal debris, and persistence of discharge.

37 patients i.e. 84.09% had dry self cleansing cavities and rarely needed regular cleaning on their follow up visits.

4 cases had excessive accumulation of debris and wax. One of them had a very large cavity, which may be contributory to his problems. 2 patients had a high facial ridge leading to accumulation of wax in the cavity.

Shah N (1983)<sup>34</sup> in his 75 inside out mastoidectomies found 89% of his cavities to be dry which is similar to the present series. In his series, 6% of the cavities were problem cavities and there was persistent discharge in 4% of the cases.

Yung M W (1996)<sup>36</sup> performed inside out mastoidectomy in 39 cases and found 74% of their cavities to be dry.

The present series similar to the above two series where inside out mastoidectomies was performed.

## CONCLUSIONS

In this study we studied 50 cases of cholesteatoma and a canal wall down mastoidectomy was performed in all the cases by an 'inside out' technique as it was thought that a conventional 'outside in' technique will result in a large postoperative cavity. This large postoperative cavity is usually associated with accumulation of wax, debris, discharge, etc. A smaller cavity is thought to decrease these problems. In this study the results regarding complete removal of the disease was comparable to any other series where canal wall down procedure was employed. Also, by removing the mastoid bone in the direction of spread of cholesteatoma, a smaller postoperative cavity is achieved which in the long run will help in minimizing problems of a large cavity.

The postoperative hearing was also comparable to other series. The present series also analyzed the cavity problems which were comparable to other series of inside out mastoidectomies. Most of the patients had a dry, self-cleansing cavity at the end of the study.

Thus, from the present study it appears that inside out technique is a good option when a canal wall down procedure is contemplated, since apart from disease eradication it also leaves a small cavity, thereby not compromising the quality of life of such patients. However, considering the fact that the follow up period was small, we recommended a study with a longer follow up to evaluate the benefits of this technique, Also a comparative study with an outside in technique should be conducted and the two techniques carefully scrutinized before a final word is spoken in favour of inside out mastoidectomy.

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