

A clinical study on revision tympanomastoid surgery in chronic otitis media to identify the causes of failure and its management with special reference to computed tomography in Bihar

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Abstract

Background: Tympanomastoid surgery is intended to eradicate the disease process and to help in regression of middle ear cleft histopathological changes. **Method:** Study was carried out in the department of Out-Patient Department and Indoor of Department of Otorhinolaryngology in Darbhanga Medical College and Hospital, on January 2018 to July 2019. In Patients of Chronic Otitis Media, who need revision tympanomastoid surgery by Canal Wall Down procedure for management of post-operative refractory discharge even after 6 months of previous surgery. **Result:** Here we include the present study of total 32 patients, who had come with persistent symptoms even after 6 months of previous tympanomastoid surgery, and undergone a revision canal wall down mastoidectomy for management. There were 15 male (46.87%) and 17 female (53.13%) amongst the 32 patients. **Conclusion:** A revision canal wall down surgery, if performed successfully following all the basic principles of tympanomastoid surgery, can help achieve a safe and dry ear and can significantly improve the subjective well-being of the patient

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INTRODUCTION

CHRONIC OTITIS MEDIA (COM) is a chronic infection of the middle ear cavity. The diagnosis of Chronic Otitis Media (COM) implies a permanent abnormality of the pars tensa or flaccida, most likely a result of earlier acute otitis media, negative middle ear pressure or otitis media with

effusion.¹ Chronic Otitis Media is a prevalent disease worldwide but mostly it is a disease of the developing countries. i.e. cholesteatoma, which, due to its invasive property leads to various intracranial and intratemporal complications. The goal of cholesteatoma surgery, whether primary or revision, is eradication of the disease completely, creation of a dry and safe ear and preservation or restoration of hearing.^{2,3} Most of the works on revision tympanomastoid surgery have been published from western world whereas the problem is more prevalent in the developing countries like India. So, the present study aims towards ascertaining the causes of failure of primary tympanomastoid surgery with the help of pre-operative clinical examination and investigations and per-operative identification of shortcomings of previous surgery; its operative management and finally assessment of the result of revision surgery in terms of subjective well-being and hearing outcome with regular follow up.

METHODOLOGY

• STUDY AREA:

Out-Patient Department and Indoor of Department of Otorhinolaryngology
DARBHANGA MEDICAL COLLEGE AND HOSPITAL.

• STUDY POPULATION:

Patients of all age, sex, demographic and socio-economic strata coming to the Otorhinolaryngology Out-Patients' Department (OPD) and/or getting admitted in the Otorhinolaryngology Ward with Chronic Otitis Media with a past history of undergoing tympanomastoid surgery in the same institution or outside presently complaining of persistent ear discharge and impairment of hearing even after 6 months of surgery.

❖ **STUDY PERIOD:** January 2018 to July 2019

❖ **SAMPLE SIZE:** 32 patients

❖ INCLUSION CRITERIA:

Patients of Chronic Otitis Media, who need revision tympanomastoid surgery by Canal Wall Down procedure for management of post-operative refractory discharge even after 6 months of previous surgery.

❖ EXCLUSION CRITERIA:

1. Patients who need revision tympanoplasty in case of Mucosal variety of Chronic Otitis Media
2. Neoplastic disease of temporal bone
3. Candidates for revision tympanomastoid surgery with sensorineural hearing loss
4. Candidates for revision tympanomastoid surgery with intracranial complication.

❖ **STUDY DESIGN** - Institution based Prospective Study .

❖ SCHEDULE OF DATA COLLECTION

The patients were included in the study for the period of January 2018 to July 2019. The data collection, analysis and tabulation were done throughout the study period i.e. 18 months. Data were collected pre-operatively, per-operatively and post-operatively after 1 month, 3 months and 6 months.

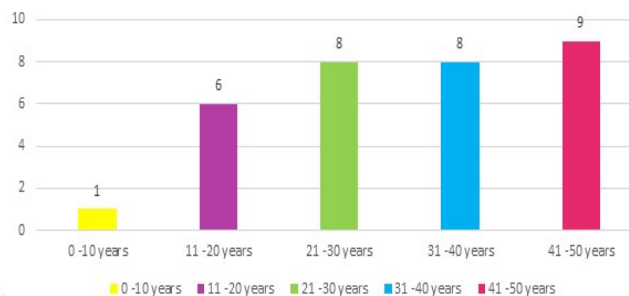
❖ PLAN FOR ANALYSIS OF DATA

❖ Data analysis was done manually and evaluated thereafter at the end of the study by SPSS (Statistical Package for Social Sciences) Software Version 22.0.0.0.

RESULTS

The present study included a total 32 patients, who had come with persistent symptoms even after 6 months of previous tympanomastoid surgery, and had undergone a

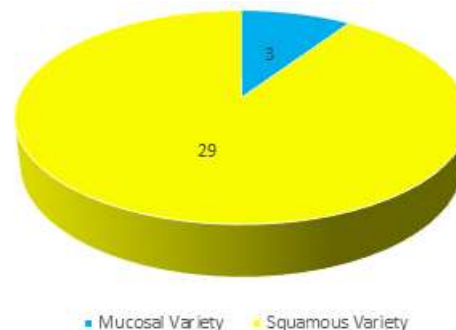
revision canal wall down mastoidectomy for management. The pre-operative, intra-operative and post-operative data were collected and recorded separately, and thereafter analysed and corroborated together by using standard statistical charts, tables and diagrams. There were 15 male (46.87%) and 17 female (53.13%) amongst the 32 patients . The patients mostly belonged to the 41 – 50 years (28.12%), 31 -40 years (25%) and 21 -30 years (25%) of age group (Figure 2). 5 patients (9.4%) were in the age group 0 -15 years. The mean age of the sample size is 31.59 years.



Graph 1: Age distribution

Type of Chronic Otitis Media

Most of the patients (29 patients, 90.6%) had Squamous variety of Chronic Otitis Media, whereas 3 of them suffered from Mucosal variety of Chronic Otitis Media (9.4%) (Figure 5) as diagnosed at the time of initial surgery.



Graph 2: Type of Chronic Otitis Media

❖ TYPE OF SURGERY:

Amongst all 32 patients, 23 patients (71.88%) had past history of undergoing canal wall down mastoidectomy, amongst them 17 (53.13%) Modified Radical Mastoidectomy and 6 (18.75%) Radical Mastoidectomy were there. Out of 17 patients of Modified Radical Mastoidectomy, 8, 6 and 3 patients were associated with Type III Minor Columella Tympanoplasty with PORP (Partial Ossicular Replacement Prosthesis), Type III Major Columella Tympanoplasty with TORP (Total Ossicular

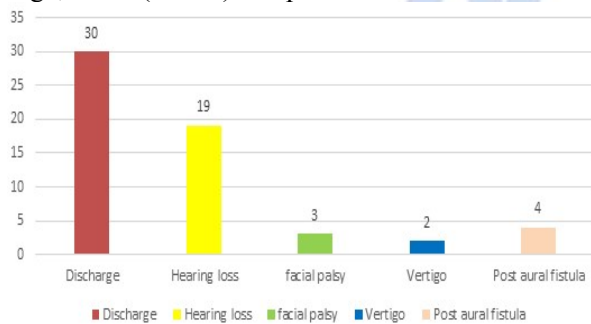
Replacement Prosthesis) and Type III Stapes Columella, respectively

Table 1:

TYPE OF SURGERY		NO OF PATIENTS (PERCENTAGE)	TOTAL NO OF PATIENTS (PERCENTAGE)
MODIFIED RADICAL MASTOIDECTOMY	Type III Minor Columella	8 (25%)	17 (53.13%)
	Tympanoplasty with PORP		
RADICAL MASTOIDECTOMY	Type III Major Columella	6 (18.75%)	6 (18.75%)
	Tympanoplasty with TORP		
	Type III Stapes Columella	3 (9.4%)	
ATTICOTOMY/ ATTICOANTROSTOMY WITH RECONSTRUCTION	Type III Minor Columella	4 (12.5%)	6 (18.75%)
	Tympanoplasty with PORP		
CORTICAL MASTOIDECTOMY	Type III Major Columella	2 (6.25%)	2 (6.25%)
	Tympanoplasty with TORP		
	Type III Tympanoplasty PORP	1 (3.13%)	
TYPE I TYMPANOPLASTY (without mastoid exploration)	Type I Tympanoplasty	1 (3.13%)	1 (3.13%)

A. PRESENTING COMPLAINTS:

Persistent ear discharge (93.75%) and hearing impairment (59.38%) were the major two complaints the patients presented with in the OPD. 3 patients (9.4%) had facial palsy at the time of presentation, one patient with Grade II and two others with Grade IV palsy. 2 patients (6.26%) had vertigo, and 4 (12.5%) had post aural fistula



Graph 3: Presenting complaints

PRE-OPERATIVE INVESTIGATIONS: AUDIOLOGICAL

The mean Pure Tone average of all the patients, irrespective of type of hearing loss, is 59 dB and mean Air-Bone Gap here is 38.7 dB, showing a moderately severe conductive hearing loss overall, with mean bone conduction at 20.3 dB. 18 out of 32 (56.25%) cases have pure conductive hearing loss, whereas 14 (43.75%) had mixed hearing loss (A-B gap 20 dB or more)

Table 2

TYPE OF HEARING LOSS	NO OF CASES	PERCENTAGE
CONDUCTIVE HEARING LOSS	18	56.25%

MIXED HEARING LOSS	14	43.75%
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INTRA-OPERATIVE DATA ANALYSIS

Intra-operative data can be divided into 4 parts-

- Pitfalls of previous surgery
- Intra-operative findings
- Corroboration of intra-operative findings with findings in HRCT Scan
- Final surgical management.

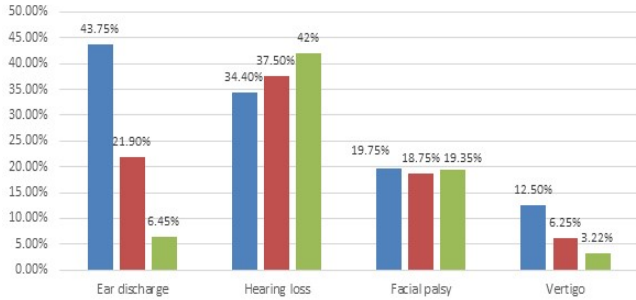
SURGICAL OUTCOMES OF SPECIFIC CASES:

- The patient who had undergone a staged hearing reconstruction had undergone a Type III major columella ossiculoplasty after 6 months of uneventful follow-up during the study period (Table 17).
- 2 patients, out of 32 patients had undergone facial decompression, one from Group A and one from Group B.
- Among the three second time revision surgeries, two had undergone Radical Mastoidectomy, and one had undergone a Modified Radical Mastoidectomy with Facial Decompression along with a Type III Tympanoplasty with TORP (major columella).
- Among the 5 paediatric cholesteatoma (0 - 15 years), 3 had undergone Modified Radical Mastoidectomy, with same stage Type III stapes columella Tympanoplasty in two patients, and second stage Type III major columella Tympanoplasty with TORP in one of them. 2 patients who had undergone Radical Mastoidectomy, who at the end of 6 months of

follow-up have been planned for second stage ossiculoplasty.

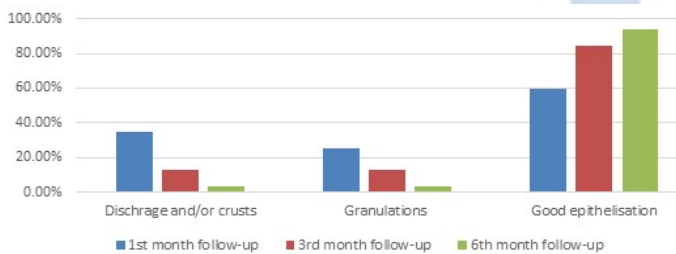
POST-OPERATIVE DATA ANALYSIS

The findings in 1st month, 3rd month, and 6th month follow-up is summarised in the following tables and charts



Graph 4: Presenting complaints during follow-up

Distribution of patients according to Findings in otoscopy + EUM + Otoendoscopy throughout the follow-up period



Graph 5: Progression of patients according to post-operative outcome

VISUAL ANALOGUE SCORE

Analysed the following four tables-

Table 3: Distribution of patients according to pre-operative Visual Analogue Score

PARAMETER	PRE-OPERATIVE VISUAL ANALOGUE SCORE		
SCORE	8 - 10	4 - 7	0 - 3
NO OF PATIENTS	0 (32)	12 (32)	20 (32)
PERCENTAGE	0%	37.5%	62.5%

Table 4: Distribution of patients according to Visual Analogue Score 8 – 10

PARAMETER	VISUAL ANALOGUE SCORE 8-10		
FOLLOW-UP	1 st MONTH	3 rd MONTH	6 th MONTH
NO OF PATIENTS	3 (32)	10 (32)	18 (32)
PERCENTAGE	9.4%	31.25%	58.1%

Table 5: Distribution of patients according to Visual Analogue Score 4 – 7

PARAMETER	VISUAL ANALOGUE SCORE 4-7		
FOLLOW-UP	1 st MONTH	3 rd MONTH	6 th MONTH

NO OF PATIENTS	25 (32)	21 (32)	13 (31)
PERCENTAGE	78.1%	65.62%	41.9%

Table 6: Distribution of patients according to Visual Analogue Score 0 - 3

PARAMETER	VISUAL ANALOGUE SCORE 0-3		
FOLLOW-UP	1 st MONTH	3 rd MONTH	6 th MONTH
NO OF PATIENTS	4 (32)	1 (32)	0 (31)
PERCENTAGE	12.5%	3.13%	0%

DISCUSSION

The pre-operative, intra-operative and post-operative data from the patients undergoing revision canal wall down tympanomastoid surgery have been collected according to the data collection proforma, summarised in forms of charts and tables and analysed accordingly in terms of percentages, ratio and proportions. In this section, the cause of failure of the previous surgeries, their appropriate management and the post-operative follow-up results will be discussed; along with supportive evidence from relevant textbook or literature reviews in appropriate points. Also, the probable methods to reduce the incidence of revision canal wall down tympanomastoid surgery will also be elaborated.

BASIC PRINCIPLES OF CANAL WALL DOWN TYMPANOMASTOID SURGERY

1. Radiographic evidence of an enlarged, smooth-walled antrum indicates a large cholesteatoma cavity.
2. Otorrhea persists after several cleanings.
3. A very small attic perforation makes cleaning painful, difficult, and unsatisfactory.
4. Cholesteatoma is observed behind the pars tensa.
5. There are symptoms or signs of erosion of vital structures, such as the fallopian canal, semi-circular canals, cochlea, or dura.
6. There is hearing loss, either conductive or sensorineural, indicating progression of cholesteatoma.
7. The patient is uncooperative or is geographically unable to return for necessary management.

Surgical removal is the only effective treatment for cholesteatoma.^[1] The aims of surgery for active squamous COM are: eradication of disease; an epithelialized, self-cleaning ear; hearing improvement.^[1]

A canal wall down procedure is always better in terms of recidivism because this process exteriorises the mastoid space so that residual cholesteatoma can be detected easily and recurrence, theoretically does not occur. But, but follow-up is problematic in canal wall down procedure for the patient because of long term cavity inflammation. But, in certain specific cases, a canal wall down

mastoidectomy, i.e. a modified radical mastoidectomy is always needed. The indications for a modified radical mastoidectomy can be absolute or relative. [4]

These are-

Absolute Indications of Modified Radical Mastoidectomy:

- Unresectable disease
- Unreconstructable posterior canal wall
- Failure of a first stage canal wall up procedure due to poor eustachian tube function
- Inadequate patient follow-up

Radical mastoidectomy is another canal wall down procedure which is done in specific situations like the following [4]

- Unresectable cholesteatoma extending down the Eustachian tube or into the petrous apex
- Prorontory cochlear fistula caused by cholesteatoma
- Chronic perilyabyrinthine osteitis or cholesteatoma that cannot be removed and must be cleaned or inspected periodically
- Resection of temporal bone neoplasms with periodic monitoring.

A successful open cavity mastoidectomy has two major components; clearance of all the disease process and all the accessible mastoid air cells to achieve a safe and dry ear and creating a manageable cavity to minimise the post-operative cavity problem. Primary goal of cholesteatoma surgery is complete removal of the disease

FAILURE OF TYMPANOMASTOID SURGERY PROBLEM DESCRIPTION

According to Khalil and Windle-Taylor (2003), the commonest reasons for repeated visits were the removal of wax, keratin accumulations, discharge, debris and granulation tissue, which occurs due to chronic cavity inflammation.⁵ According to Attallah et al. (2010), among a total 91 cases, 82 cases (90.11%) presented with a discharging ear not responding to medical treatment, two (2.2%) had facial palsy, and one (1.1%) had discharging post auricular fistula and five (5.5%) cases with profound sensorineural hearing loss in the operated ear.⁶ The major complaint of the patients, in the present study, even after a mean time gap of 3.34 years from the previous tympanomastoid surgery, were persistent ear discharge which does not subside even with regular aural toileting (93.75%). Some patients complained of vertigo secondary to a large cavity size. The pre-operative Visual Analogue Score shows that, 62.5% of the patients were not satisfied (0 – 3) with the outcome of previous surgery, whether done

in the same tertiary care institution or outside. The major problem affecting personal and socio-economic aspect of life of the patients, in the present study, was the need for frequent visits to the doctor. In the present study, the patients presented with persistent hearing impairment (59.38%), which also affects the quality of life. Above all, 40.62% of the patients had a mixed hearing loss, indicating chance of poor improvement even after a successful revision surgery and hearing reconstruction.

FAILURE OF TYMPANOMASTOID SURGERY- BURDEN OF PROBLEM

Among all 32 patients, 23 patients (71.88%) had past history of undergoing canal wall down mastoidectomy (modified radical mastoidectomy with hearing reconstruction or radical mastoidectomy), 6 patients (18.75%) had past history of functional canal wall up procedure (atticotomy/ atticoantrostomy with reconstruction), canal wall up procedure (cortical mastoidectomy with hearing reconstruction) in 2 patients (6.26%) and tympanoplasty in 1 patient (3.13%).

CHOLESTEATOMA RECIDIVISM- (RESIDUAL AND RECURRENT) AND ITS MANAGEMENT:

The two components of recidivism, residual and recurrent cholesteatoma, although can present with same symptoms, i.e. persistent ear discharge and hearing loss and can lead to a failure of tympanomastoid surgery; differ in their pathogenesis, as well as from the management point of view to some extent.

PREVIOUS CANAL WALL DOWN PROCEDURES IDENTIFICATION OF PITFALLS:

According to Wormald and Nilssen, they found the following significant findings in the chronically discharging cavities:^[7]

- high facial ridge;
- sump in cavity below floor of external auditory canal;
- perforation in tympanic membrane;

small external auditory meatus The major factors related to failure of surgery, as per the present study was recrudescence of cholesteatoma (91.3%). Most common site of hidden cholesteatoma in the present study was tip cells (85.2%). Protympanum (59.3%), anterior epitympanic recess (59.3%), supratubal recess (51.85%), facial recess (40.7%) and sinus tympani (34.8%) were also some of the major sites of recrudescence.

PREVIOUS FUNCTIONAL CANAL WALL UP PROCEDURE:

CAUSE OF FAILURE AND PLANNING OF MANAGEMENT:

In a previously done atticotomy or atticoantrostomy, removal of attic contents and loss of the underlying bony support give rise to an epitympanic retraction pocket, progressively forming a recurrent cholesteatoma, even

with a normally aerated middle ear. our study includes 6 patients with past history of atticotomy/ atticostomy with reconstruction by cartilage, who presented with recurrent attic cholesteatoma in 4 (66.67%), attic retraction in 5 (83.33%) and granulation in 3 (50%). Only one (16.67%) patient had mesotympanic retraction, indicating presence of eustachian tube dysfunction. Scutum erosion was present in all of them, in HRCT Scan.

FAILURE OF TYMPANOMASTOID SURGERY- INTRA-OPERATIVE MANAGEMENT:

The all the 32 patients had undergone a revision canal wall down mastoidectomy, either by a Modified Radical Mastoidectomy with hearing reconstruction or a Radical Mastoidectomy. All the residual and recurrent cholesteatoma had been removed, meticulously, from all the visible as well as hidden sites, as assessed by a pre-operative otoendoscopy, including facial recess, sinus tympani, oval window, round window, protympanum, supratubal recess, anterior epitympanic recess etc. For complete clearance of disease, the canal wall down procedure was carried out under microscope in the present study. There were 12 Radical Mastoidectomy and 20 Modified Radical Mastoidectomy in total in the present study. Out of the three second revision cases, two had undergone a Radical Mastoidectomy and one, a Modified Radical Mastoidectomy with Type III Tympanoplasty (PORP) for hearing reconstruction.

REVISION TYMPANOMASTOID SURGERY - DANGERS OF SURGERY:

A combination of long term extensive disease and previous surgery can eliminate many of the normal landmarks and make orientation difficult.⁸ There is every chance of incomplete surgery or damage to vital structures during the surgery. Only a thorough knowledge of the three-dimensional anatomy of the middle ear cleft will ensure total removal of the disease avoiding complications.⁹

In the present study, out of 32 canal wall down revision mastoid surgeries, intra-operatively 6 facial canal dehiscence, 6 LSCC dehiscence, 4 tegmen tympani and 5 sinus plate dehiscence had been seen. HRCT Scan helped in diagnosing these complications pre-operatively, which had helped while performing the surgery without any iatrogenic injury.

REVISION TYMPANOMASTOID SURGERY- POST-OPERATIVE FOLLOW-UP

post-operative results, in the present study, showed gradual decrease in all the complaints throughout the 6-month follow-up period. The complaints, like ear discharge due to chronic cavity problem were more in the patients undergoing Radical Mastoidectomy than Modified Radical Mastoidectomy. But at the end of 6-month follow-up, 29 out of 31 patients (93.6%) the patients had a well

epithelised cavity without any evidence of crusts, granulations or discharge. This proves that in all patients all the residual as well as recurrent cholesteatoma had been removed properly. At 3rd month follow-up, 31 out of 32 cases showed adequate lowering of facial ridge, suggesting bone work had been adequate. The conchomeatoplasty had been adequate in 83.87% at the end of 6-month follow-up. Hearing impairment was the only persistent problem in the present study. There was no gain in hearing in the patient having pre-operative mixed hearing loss and the patients undergoing a Radical mastoidectomy as a revision surgery.

CONCLUSION

- ❖ A revision canal wall down surgery, if performed successfully following all the basic principles of tympanomastoid surgery, can help achieve a safe and dry ear and can significantly improve the subjective well-being of the patient.
- ❖ Revision tympanomastoid surgery, due to the distorted anatomical landmarks and extensive disease process, is difficult to perform without proper knowledge of the three-dimensional anatomy of tympanomastoid cavity.
- ❖ Meticulous surgical technique is required for complete clearance of cholesteatoma from all visible as well as hidden sites. Adequate bone work is needed in the form of facial bridge removal, facial ridge lowering, saucerization for a smooth, shallow cavity. Cavity obliteration and appropriately wide conchomeatoplasty are required to combat long-term cavity problems.
- ❖ HRCT Scan of temporal bone is a useful tool for pre-operative evaluation of extent of disease process, ossicular status, anatomical landmarks in a revision surgery and signs of complications like facial canal dehiscence and LSCC dehiscence etc. Corroboration of intra-operative findings with pre-operative HRCT Scan will help in formulating the management plan and will ensure a safe surgery with minimal complications.

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