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Original Research Article

A Comparative Study on the Hearing Outcome in Canal Wall down And Intact Canal Wall Mastoidectomy in Chronic Suppurative Otitis Media with Special Reference to Atticoantral Disease

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ABSTRACT

Introduction: Though the major goal of surgery of the middle ear cleft is to render the ear safe and dry by removal of disease; the increasing concern of the hearing outcome of patients have lead to surgeons resorting to techniques with maximum conservation of hearing and at the same time ensuring effective disease clearance. There has been a never-ending debate on the comparison of the two types of mastoidectomy, CWD and ICW, for management of the unsafe variety of CSOM. An attempt has been made by the current study, to contribute to the available literature for the same.
Aims and Objectives: To compare the audiological outcome of patients with Chronic Suppurative Otitis Media (Atticoantral variety) undergoing Canal Wall Down Mastoidectomy and Intact Canal Wall Mastoidectomy.
Materials and Methods: A one-year single institute prospective comparative clinical study was conducted. 60 cases of CSOM (Atticoantral variety), were selected, and depending on the type of mastoidectomy, two equal groups were obtained, 30 patients planned for CWD mastoidectomy, 30 patients planned for ICW mastoidectomy. Pre- and postoperative air and bone conduction threshold were assessed from averaged pure-tone audiometry (PTA) at 500 Hz, 1 KHz, 2 KHz, and 4 KHz. Post operative audiometry was done at 3 weeks, 3 months and 6 months after operation. Audiometric analysis was performed according to the guidelines of American Academy of Otolaryngology-Head and Neck Surgery. [1]

Results: In the preoperative period, patients with ABG ≤30dB was 3.33% in CWD group and 6.67% in the ICW group; in 3 months postoperative period, it was 3.33%(CWD) and 20% (ICW); for 6 months postoperative period, it was 14.81%(CWD) and 34.48%(ICW). From these observations, it was evident that there was a shift of the ABG of patients towards the better hearing range, ICW>CWD. Comparison of patients with ABG ≤30dB between the two surgical groups, showed that the difference was statistically significant at 3 months postoperative period (p=0.0461).

Key words: Mastoidectomy, CWD, ICW, Chronic Suppurative Otitis Media (CSOM), Atticoantral disease.

INTRODUCTON

Existence of chronic suppurative otitis media (CSOM) dates back to the time of Hippocrates, who had appreciated the potential seriousness of suppurative middle ear disease. [2]

Prevalence surveys show that the global disease burden involves 65-330 million individuals with draining ears, 60% of whom suffer from significant hearing impairment. [3] This disease is particularly common in developing countries. According to the WHO survey, India is considered to be in the high prevalence zone (>4%). Middle ear cleft disease commonly affects the younger age groups and is usually a predominant disease among the rural lower socioeconomic strata. [4-6]

Chronic Suppurative Otitis Media can be simply defined as inflammation of the middle ear cleft. Though several new terminologies are available, the former classification will be maintained in this study; which divides CSOM into Tubotympanic or Safe type and Atticoantral or Unsafe type. Both the types bear a significant hearing burden. [7]

The main pathological entity in Atticoantral CSOM is Cholesteatoma, which is defined as a sac in the middle ear, lined by keratinizing stratified squamous epithelium containing desquamated epithelium as keratin debris. It has the potential to grow progressively at the expense of underlying bone, and has the tendency to recur, unless removed completely. The cholesteatoma may vary in size from a small sac confined to the attic or to the posterosuperior quadrant of mesotympanum to widespread disease involving the entire mastoid bowl and posterior half of the mesotympanum. Attic or a posterior-superior marginal perforation, or attic retraction pocket should create a high index of suspicion. [8]

In addition to specific pathology mentioned above, various non-specific pathology may be present in chronic suppurative otitis media such as tympanosclerosis, ossicular erosion, fibrous sclerosis, mastoid sclerosis, cholesterol granuloma, labyrinthitis and hearing loss. [9]

In atticoantral disease, the discharge is generally scanty, foul smelling and tends to be more chronic. When there is formation of granulation tissue or an aural polyp, blood-stained discharge may occur. [10]

As the name suggests, Atticoantral CSOM is notorious of intracranial and extracranial complications, unless treated adequately at the right time. The definitive treatment includes surgical procedures, undertaken to completely extirpate the pathology and at the same time focus on hearing outcome. [10]

Two main surgical techniques employed in the treatment of Atticoantral CSOM are- Canal Wall Down Mastoidectomy (CWD) and Intact Canal Wall Mastoidectomy (ICW). [10] The choice of technique is controversial and is dependent on several factors, including the extent of disease. In the current study, an attempt would be made to study the advantages and limitations of both the surgical techniques, and thus evaluate which technique would be better for achieving disease clearance with favourable hearing outcome.

AIMS AND OBJECTIVES

The aim of this study is:

To compare the audiological outcome of patients with Chronic Suppurative Otitis Media (Atticoantral variety) undergoing Canal Wall Down Mastoidectomy and Intact Canal Wall Mastoidectomy.

MATERIALS AND METHODS

This was a prospective study carried out in the Department of Otorhinolaryngology, Silchar Medical College and Hospital, Silchar, the study period being July 2015 to June 2016.

SOURCE OF DATA: After approval from the institutional ethical committee and after obtaining informed consent from the patients, a study entitled "A Comparative Study on the hearing outcome in Canal Wall Down and Intact Canal Wall Mastoidectomy in Chronic Suppurative Otitis Media with special reference to Atticoantral Disease" was conducted in Silchar Medical College and Hospital, Silchar, Assam from July 2015 to June

2016, on the patients satisfying the inclusion criteria.

STUDY DESIGN: A one-year prospective comparative clinical study.

SAMPLE SIZE: We had selected 60 cases of CSOM (Atticoantral variety), who were planned for surgery; and depending on the type of mastoidectomy they had undergone, two equal groups were obtained:

- 30 patients who had undergone CWD mastoidectomy, and
- 30 patients who had undergone ICW mastoidectomy

The choice of mastoidectomy, CWD or ICW, was the decision of the surgeon, after completely evaluating the patient, preoperatively and intraoperatively.

STUDY MATERIALS: Informed consent form, proforma

PATIENT SELECTION CRITERIA: The patients, who had attended the Outpatient Department of Otorhinolaryngology, Silchar Medical College and Hospital, were selected on the basis of the following criteria:

Inclusion Criteria

1. Patients with atticoantral (or squamous) variety of COM/CSOM, with either posterior-superior, marginal perforation, or attic perforation, or large central, subtotal or total perforation
2. Patients with atticoantral (or squamous) variety of COM, with pars flaccid or pars tensa retraction pocket
3. Conductive or mixed deafness
4. All status of ossicles except stapes footplate erosion
5. In bilateral disease satisfying the above mentioned criteria, the ear with more conductive hearing loss was chosen for surgery
6. No associated complications
7. Age between 10 and 60 yrs
8. No focus of infection in nose and throat

Exclusion criteria:

1. Active Upper Respiratory Tract Infection
2. Tubotympanic(or mucosal) variety of CSOM
3. Eustachian tube dysfunction
4. CSOM with intracranial or extracranial complications
5. Congenital ear disease
6. Pure sensory neural deafness
7. Age group below 10 years and above 60 years
8. History of trauma to the temporomastoid region
9. Revision surgery
10. Otosclerosis
11. Ear malignancy
12. Mental retardation
13. Poor general health

Hearing assessment by Pure Tone Audiometry

Pre- and postoperative air and bone conduction threshold were assessed from averaged pure-tone audiometry (PTA) at 500 Hz, 1 KHz, 2 KHz, and 4 KHz. Audiometric analysis was performed according to the guidelines of American Academy of Otolaryngology-Head and Neck Surgery. [1]

The test was begun with the better ear if the test subject was aware of a side difference. The ascending modified Hughson-Westlake method was employed.

Prior to audiometric assessment, it was ensured that the ears were suctioned clear of discharge or wax.

Air-Bone Gap (ABG) was calculated by subtracting average of the Bone Conduction threshold (BC) from Air Conduction threshold (AC); ABG = AC-BC

Hearing gain in each postoperative period was calculated by subtracting the ABG of postoperative period from the ABG of preoperative period.

ABG closure was determined, which is the shift of the patients towards the lower AB gap in the postoperative period in comparison to the preoperative period.

Statistical analysis: The results were compiled using Microsoft Excel 2007, and compared statistically using parametric (Chi square test, paired Student t test, unpaired Student t test) and non-parametric tests (Welch's test), wherever required. p value<0.05 was considered to be statistically significant.

PRE OPERATIVE PREPARATION

Informed consent was taken from each patient and guardian after explaining to them the procedure and probable outcome of the operation in detail. Each patient has been given a single dose of systemic antibiotic in the evening one day before operation and another dose on the day of operation 1 hr before surgery. Shaving of hair of post auricular region 3cm above and posterior to pinna was done.

Lignocaine sensitivity test was done in the evening and the patients were asked to take 0.5mg alprazolam tablets at bed time.

ANESTHESIA:

The patients were subjected to middle ear cleft surgery under General Anaesthesia. Local instillation of anaesthetic with 2% Xylocaine with 1:10,000 Adrenaline solutions was used.

SURGICAL APPROACH

All the patients were operated by post-auricular approach.

PROCUREMENT OF GRAFT MATERIAL

In all the patients, Temporalis fascia was used as graft material.

SURGICAL TECHNIQUES

- CWD Mastoidectomy accompanied by wide Meatoplasty
- ICW Mastoidectomy +/- Posterior Tympanotomy
- RECONSTRUCTION: To maintain uniformity in our study, Temporalis fascia graft and sculpted autologous ossicles were used for reconstruction. In accordance to Wullstein's classification, Type I, Type II or Type III Tympanoplasty was done for ICW mastoidectomy group and Type III or Type IV for the CWD group.

RESULTS AND OBSERVATIONS

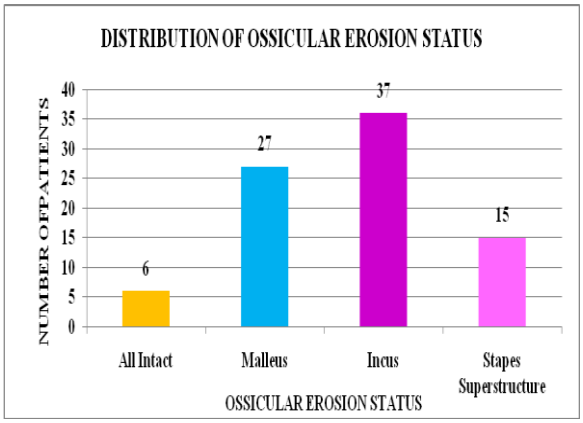

FIGURE 1: BAR DIAGRAM SHOWING THE DISTRIBUTION OF THE STATUS OF EROSION OF OSSICLE

Figure 1 shows that most common ossicle to be eroded was incus (61.67%), followed by malleus in 45%, stapes superstructure in 25%, all ossicles were intact in 10%.

TABLE I(a): CHANGES IN THE MEAN ABG IN THE DIFFERENT POSTOPERATIVE PERIODS WITHIN THE CWD GROUP

Time interval	Pre-op. $n_1 = 30$	3 weeks follow up $n_1 = 30$	3 months follow up $n_1 = 30$	6 months follow up $n_1 = 27$
Mean±SD	56.29 ± 9.12	53.75 ± 8.60	44.54 ± 7.92	39.35 ± 8.99
Percentage change		- 4.51%	- 20.87%	- 30.09%
P value		0.272 (NS)*	<0.0001 (S)*	<0.0001 (S)*

TABLE I(b): CHANGES IN THE MEAN ABG IN THE DIFFERENT POSTOPERATIVE PERIODS WITHIN THE ICW GROUP

Time interval	Pre-op. $n_2 = 30$	3 weeks follow up $n_2 = 30$	3months follow up $n_2 = 30$	6months follow up $n_2 = 29$
Mean±SD	53.67±7.02	50.96±6.67	37.70±7.70	32.07±7.51
Percentage change		- 5.05%	- 29.76%	- 40.25%
P value		P = 0.13 (NS)*	P<0.001 (S)*	P<0.0001 (S)*

* Paired t-test

TABLE II: DISTRIBUTION OF HEARING GAIN IN THE DIFFERENT POSTOPERATIVE PERIODS WITHIN THE TWO SURGICAL GROUPS

Time interval	Hearing gain in 3 weeks follow up $n_1=30, n_2=30$	Hearing gain in 3 months follow up $n_1=30, n_2=30$	Hearing gain in 6 months follow up $n_1=27, n_2=29$
CWD (n_1)	2.54 ± 1.69	11.75 ± 4.34	16.30 ± 6.15
ICW (n_2)	2.71 ± 1.40	15.87 ± 4.04	21.64 ± 8.57
P value	0.67 (NS)#	0.0003 (S)#	0.009 (S)@

Unpaired t-test @ Welch's t-test

TABLE III: AC THRESHOLD AT DIFFERENT FREQUENCIES IN TWO SURGICAL GROUPS AT DIFFERENT TIME INTERVALS

TABLE III(a): PREOPERATIVE PERIOD

Frequencies	500 Hz	1000 Hz	2000 Hz	4000 Hz
CWU (n_1=30)	76.67± 7.89	72.83± 7.60	69±7.57	67.5±7.5
ICW (n_2=30)	75.5± 5.68	72.67± 6.02	69.17± 5.49	68.33± 5.68
P value	0.51 (NS)*	0.93 (NS)*	0.92 (NS)*	0.63 (NS)*
* = unpaired t test				

TABLE III(b): POSTOPERATIVE 3 WEEKS

Frequencies	500 Hz	1000 Hz	2000 Hz	4000 Hz
CWU (n_1=30)	71.83± 6.52	69±8.30	67.83± 7.60	66.67± 7.45
ICW (n_2=30)	70.17± 5.70	69.50± 5.82	67.5± 5.44	67.67± 5.44
P value	0.30 (NS)*	0.788 (NS)*	0.85 (NS)*	0.55 (NS)*
* = unpaired t test				

TABLE III(c): POSTOPERATIVE 3 MONTHS

Frequencies	500 Hz	1000 Hz	2000 Hz	4000 Hz
CWU (n_1=30)	56.83± 8.01	55.83± 8.57	62± 7.26	63.33± 7.56
ICW (n_2=30)	49±6.24	49.67±6.94	60±7.96	63.5±7.32
P value	<0.0001 (S)*	0.0034 (S)*	0.31 (NS)*	0.92 (NS)*
* = unpaired t test				

TABLE III(d): POSTOPERATIVE 6 MONTHS

Frequencies	500 Hz	1000 Hz	2000 Hz	4000 Hz
CWU (n_1=27)	49.07± 8.05	49.44± 8.96	57.78± 8.64	61.48± 8.14
ICW (n_2=29)	41.72± 5.05	42.76± 5.60	52.93± 7.85	59.83± 7.38
P value*	0.0002 (S)@	0.001 (S)@	0.032 (S)@	0.43 (NS)@
@ = Welch's unpaired t test				

TABLE IV: DISTRIBUTION OF PATIENTS ACCORDING TO THE RANGES OF ABG

TABLE IV(a): AB GAP IN PREOPERATIVE PERIOD

AB Gap(dB)	CWD (n_1=30)	ICW (n_2=30)	P value
21-30	1(3.33%)	2(6.67%)	0.5562(NS)^
31-40	0	14(46.67%)	0.0001(S)^
41-50	7(23.33%)	14(46.67%)	0.0602(NS)^
51-60	14(46.67%)	0	0.0001(S)^
61-70	7(23.33%)	0	0.0053(S)^
71-80	1(3.33%)	0	0.3176(NS)^

^ Chi Square test

TABLE IV(b): ABG AT 3rd MONTH POSTOPERATIVE FOLLOW UP

AB gap (dB)	CWD(n_1=30)	ICW(n_2=30)	P value
21-30	1(3.33%)	6(20%)	0.0461(S)^
31-40	6(20%)	14(46.67%)	0.0298(S)^
41-50	18(60%)	10(33.33%)	0.0401(S)^
51-60	4(13.33%)	0	0.0401(S)^
61-70	1(3.33%)	0	0.3176(NS)^

TABLE IV(c): ABG AT 6th MONTH POSTOPERATIVE FOLLOW UP

AB Gap (dB)	CWD(n_1=27)	ICW(n_2=29)	P value
15-20	1(3.70%)	3(10.34%)	0.3392(NS)^
21-30	3(11.11%)	7(24.14%)	0.2074(NS)^
31-40	11(40.74%)	16(55.17%)	0.2845(NS)^
41-50	11(40.74%)	3(10.34%)	0.0093(S)^
51-60	1(3.70%)	0	0.3003(NS)^

TABLE V: COMPARISON OF THE PERCENTAGE OF PATIENTS WITH ABG CLOSURE TO ≤30dB POST-OPERATIVELY

Patient distribution	CWD	ICW	p value
Pre op period	3.33%	6.67%	>0.05(NS)^
3 months postoperative period	3.33%	20%	<0.05(S)^
6 months postoperative period	14.81%	34.48%	>0.05(NS)^

^ Chi Square test

TABLE VI: HEARING GAIN IN DIFFERENT TYPES OF TYMPANOPLASTY AT POSTOPERATIVE 6th MONTH FOLLOW UP

Tympanoplasty	CWD (n_1 = 27)		ICW (n_2 = 29)		P value
Type I	n=0	-	n=5	24±12.85	-
Type II	n=0	-	n=15	22.20±8.55	-
Type III	n=18	18.89±5.88	n = 5	17.05±4.42	0.5806(NS)@
Type IV	n= 9	11.67±2.72	n=4	21.25±5.30	0.0418 (S)@

@ = Welch's unpaired t test

TABLE VII: HEARING GAIN IN THE SURGICAL GROUPS WITH RESPECT TO THE OSSICULAR STATUS AT 6th MONTH

Ossicular erosion	CWD (n = 27)		ICW (n = 29)		P value
All intact	n=0	-	n=5	24±12.85	-
Malleus	n=0	-	n=9	25.97±9.38	-
Malleus, Incus	n=11	18.18±3.64	n=9	18.05±5.56	0.95(NS)@
Incus	n=7	20±8.90	n=2	19.7±0.88	0.933(NS)@
Incus, Superstructure	n=4	12.5±2.28	n=2	21.25±5.30	0.268(NS)@
Malleus, Incus, SuperStructure	n=5	11±3.11	n=2	15±3.53	0.394(NS)@

@ = Welch's unpaired t test

DISCUSSION

In this one year of prospective single centre comparative study, 60 patients with CSOM (Atticoantral variety) were divided into two groups according to the type of mastoidectomy they had undergone; CWD and ICW. A comparison of the hearing outcome of the two surgical groups has been carried out. An attempt has also been made to compare the results obtained in the

present study to that of the results obtained in the previous studies.

EVALUATION OF THE HEARING OUTCOME

Comparison of the Hearing Gain between the CWD and ICW groups

In the CWD group, mean hearing gain in 3 weeks postoperative period is 2.54±1.69 dB, in 3 months 11.75±4.34dB and in 6 months, it is 16.30±6.15dB. In the ICW group, hearing gain in 3 weeks postoperative period is 2.71±1.4 dB, in 3 months 15.87±4.04 dB and in 6 months, it is 21.64±8.57 dB. From these observations, it is evident that the hearing gain was almost negligible in 3 weeks, appreciable in 3 months and maximum in 6 months post-operative. This is quite reasonable because significant hearing gain is not expected at 3 weeks postoperative period.

Also the hearing gain between the two groups was compared separately for the three post-operative periods; it was found to be statistically significant for the 3 months (p=0.0003) and 6 months (p=0.009) post-operatively; signifying that that was a comparable difference for ICW mastoidectomy over CWD mastoidectomy in the matter of Hearing Gain.

The better hearing gain in the ICW group is easily attributable to the maximum preservation of the middle ear cleft anatomy, also leading to better reconstructive outcome.

Postoperative Hearing Gain Comparison from Other Studies

In the study by **Osborn et al**, ICW patients had better postoperative hearing (median AB gap, 38 dB vs 51 dB, P = .004) and greater hearing improvement (median hearing gain,

7 dB vs 0 dB, P = .004) than the CWD group. [11]

De Azevado AF (2013), in their study, found no statistically significant difference in pure tone average thresholds before and after surgery with either of the surgical techniques. [12]

In the study by **Kim et al (2010),** mean ABG closure was 10.9±19.5 dB in the ICW group and 10.9±19.5 dB in the CWU group. There was no statistical difference between the two groups. [13]

Varshney et al (2009) compared the hearing results by ICWM versus CWDM and found postoperative hearing gain in both groups similar with the hearing results of both these groups in our study. Hearing gain in ICWM and CWDM at 3 months was 19.37 dB and 11 dB, at 6 months was 21.91 dB and 13.61 dB, thus concluding that the hearing results in ICWM is better than in CWDM. [14]

Toner and Smyth (1990) published their comparison of patients who had CWU, CWD with reconstruction and CWD surgery with follow up of between 8 and 12 years. They found that the hearing benefit at one year (pure tone average (PTA) air conduction (AC) threshold) was greater in the CWU group, but that this benefit was lost over a longer period of follow up of between 7 and 11 years such that the average long-term AC gain was the same in all 3 groups. [15]

FREQUENCY SPECIFIC HEARING OUTCOME

In the present study, after evaluating the Air Conduction (AC) threshold in the preoperative and different postoperative period, the following can be summarised:

- **Preoperative-**Statistically insignificant results were obtained when the AC threshold between two surgical groups were compared for 500Hz (p=0.51), 1000 Hz (p=0.93), 2000 Hz (p=0.92), 4000 Hz (p=0.63); indicating that there was an equitable distribution in the preoperative period.
- **3 weeks postoperative-** Comparison of AC threshold between CWD versus ICW groups in 500 Hz (p=0.3), 1000 Hz (p=0.79), 2000 Hz (p=0.85), 4000 Hz (p=0.55) were also statistically insignificant.
- **3 months postoperative-** Statistically significant results were obtained in 500 Hz (p<0.0001), 1000 Hz (p=0.0034); however for 2000 Hz (p=0.31), 4000 Hz

(p=0.92), it was statistically insignificant.

- **6 months postoperative-** The results were statistically significant for 500 Hz (p=0.0002), 1000 Hz (p=0.001) and 2000 Hz (p=0.032); and insignificant for 4000 Hz (p=0.43).

From the above results, an inference can be drawn that 500 Hz and 1000 Hz (and sometimes 2000 Hz) are the frequencies which are important to be taken into consideration when evaluating hearing outcome. This is quite explanatory as the 500 Hz, 1000 Hz and 1500 Hz are considered to be the Speech Frequencies.

In the study by, **Choi et al,** in the ICW group, AC at all frequencies except 4,000 and 6,000 Hz significantly improved. AC and ABG results in CWD group showed improvement only at the frequencies of 250, 500, 2,000 Hz. [16]

According to the study by **de Azevedo AF**, there were no statistically significant pre- or postoperative differences in the pure tone average thresholds at 500 Hz, 1000 Hz, and 2000 Hz between the two surgical techniques. [17]

COMPARISON OF THE ABG CLOSURE IN THE POSTOPERATIVE PERIODS

In the preoperative period, patients with ABG≤30dB was 3.33% in CWD group and 6.67% in the ICW group; in 3 months postoperative period, it was 3.33% (CWD) and 20% (ICW); for 6 months postoperative period, it was 14.81%(CWD) and 34.48%(ICW). From these observations, it was evident that there was a shift of the ABG of patients towards the better hearing range, ICW>CWD. Comparison of patients with ABG ≤30dB between the two surgical groups, showed that the difference was statistically significant at 3 months postoperative period (p=0.0461). Statistical insignificance in 6 months postoperative period may be attributable to the non-completion of follow up(follow up till 3months only was accomplished) of 4 patients.

Mean hearing gain were 21±8.57dB (ICW) > 16.30±6.15dB (CWD), this difference was statistically significant (p=0.0102)

In the study by **Kim MB et al,** the proportion of ABG closure within 20 dB was 58.6% in the CWDM group and 68.4% in the CWUM group (P=0.25). The patients with ABG closure within 10 and 30 dB also did not show any differences according to the type of mastoidectomy. They found that the proportion of ABG less than 20 dB in the CWDM group was 58.6% and this was 68.4% in the CWUM group. There was no statistical difference between the two groups.

In the study by **Godinho et al (2005)**, a postoperative ABG result of 0 to 20 dB was with CWD, in 14.29%; and with CWU, in 40.90%.

Hirch BE et al. (1992), demonstrated superior hearing outcome in ICW (76%) versus CWD (69%) in terms of ABG closure less than 30 dB.

In the study by **Sagesh M**, the hearing improvement obtained in terms of air-bone gap closure ≥10 dB, was 81% in the tympano-mastoidectomy group, with the mean closure being 15.1 dB and 15.3 dB, respectively.

In their study, **McGrew et al. (2004)** got an average air-bone gap closure of 11.4 dB in the tympanomastoidectomy group.

In the study by **Cheng-Chuan C et al. (2000)**, 35.6% achieved the closure of air-bone gap within 20 dB. The availability of stapes superstructure influenced the postoperative hearing level significantly (p <0.001).

Comparison of Hearing Gain According To the Type of Tympanoplasty Accompanying Mastoidectomy

For adequate reconstruction, CWD and ICW mastoidectomies were accompanied by Tympanoplasty to yield maximum possible hearing gain. With CWD mastoidectomy, only Type III or IV Tympanoplasty could be undertaken; unlike in ICW mastoidectomy, where any of the

four types could be done depending on the status of ossicles.

A comparison of the hearing gain in the two groups, according to the type of Tympanoplasty done, was carried out, which showed that hearing gain was maximum for Type I Tympanoplasty (24±12.85dB), followed by Type II (22±8.55dB).

For Type III Tympanoplasty, hearing gain was 18.89±5.88 dB in CWD group and 17.05±4.42dB for ICW group; the minimal difference between the two was statistically insignificant. For Type IV Tympanoplasty, however, there was a statistically significant difference (p=0.0418) between CWD (11.67±2.72 dB) and ICW (21.25±5.30 dB).

In the study by **Shetty S (2012),** he shows the types of tympanoplasty with pre-operative and follow up post-op hearing threshold with statistical significance. There is a gain of 18.8 dB in type I, 26.46 dB in type II and 20.27 dB gain type III tympanoplasty.

In the study by **Khadakkar et al (2012)**, mean pre and post-operative Air-Bone Gap (ABG) in the patients who had undergone Type III tympanoplasty with CWD mastoidectomy, were found to be 40.89 dB and 29.65 dB respectively. Hearing gain of 11.24 dB was statistically significant.

Binti et al. (2013), in their audiological audit, stated that result for tympanoplasty did not demonstrate any significant difference between type III and type IV tympanoplasty.

Comparison of Hearing Outcome According To Status of Ossicles

The status of ossicles and type of reconstruction can affect the hearing outcome. In unsafe CSOM, the most commonly eroded ossicle is the incus, as evident by several studies; and hearing outcome is usually better with intact stapes superstructure. The observations from our study were as follows:

- All ossicles were intact in 10%, malleus erosion in 45%, incus erosion in 61.67%, stapes superstructure erosion in 25%.
- For all ossicles intact status, hearing gain was 24±12.85 dB (ICW); for only Malleus erosion, 25.97±9.38 dB (ICW); for malleus and incus erosion, 18.18±3.64dB (ICW), 18.05±5.56dB (CWD); for only incus erosion, 19.7±0.88dB (ICW) and 20±8.9dB (CWD); erosion of incus and superstructure, 21.25±5.3dB (ICW) and 12.5±2.28 (CWD); erosion of Malleus, Incus, Superstructure, 15±3.53dB (ICW) and 11±3.11dB (CWD). The comparison of hearing gain between the two surgical groups for the aforementioned ossicular status showed no statistical significance. The result of this statistical relationship is however subject to certain confounding factors like uneven sample size during the 6 months postoperative follow-up period; the different types of tympanoplasty accompanying ossicular reconstruction, restricted use of autologous ossicles for ossicular reconstruction.

Kim et al, (2010) found no statistically significant difference in post-operative ABG between ICW and CWD (10.9 vs 13.5dB) or in the proportion of patients with an ABG<20dB (58.6% vs 68.4%) 3 months after ossiculoplasty. This study is notable for the fact that the authors have tried to exclude confounding factors by comparing ICW and CWD outcomes in patients with an intact tympanic cavity and stapes who had a staged ossiculoplasty at least 6 months after mastoidectomy. Nevertheless their follow up period was considered short. [13]

In the study by **Mutlu et al. (1995),** social hearing level (< 25 dB) was achieved in 85% of cases with superstructure, in comparison to 53% of patients without superstructure. [18]

In the study by **Varshney et al. (2009),** in unsafe CSOM, they found only 15% cases with intact ossicular chain. M+S+ was seen in 13.33%, M-S+ in

20.00%, M-S- in 26.67% and M-S- in 25.00% cases. [14]

CONCLUSION

The study entitled "A Comparative Study on the hearing outcome in Canal Wall Down and Intact Canal Wall Mastoidectomy in Chronic Suppurative Otitis Media with special reference to Atticoantral Disease" attempted to compare the hearing rehabilitation in the two study groups.

The Atticoantral variety of CSOM (also commonly known as unsafe CSOM or Squamous variety of COM) is a disease which still bears a burden in the global picture, especially in the developing countries; WHO statistics show India to be in the high prevalence region. There are two surgical treatment options available, Canal Wall Down Mastoidectomy (CWD) and Intact Canal Wall Mastoidectomy (ICW).

CWD mastoidectomy has been proved to be an effective procedure for eradicating disease from the middle ear cleft, though it compromised the hearing outcome. However, with the advent of reconstructive surgery and cavity obliteration techniques, which accompanied CWD mastoidectomy, significant hearing benefit was achieved, as evident by several studies.

ICW mastoidectomy was initially introduced as a conservative procedure for limited middle ear cleft disease, to avoid the complications of CWD procedure. It had gained wide popularity because of better hearing outcome. However, the main concern following ICW procedure was residual or recurrent disease; thus frequenting the need for second-look surgery. However, with advancing time, having gathered experience and skill, certain modifications of this technique were explored. The combined approach or posterior tympanotomy approach overcame the drawback of limited exposure of certain important sites. The accompanying reconstructive procedures further improved hearing outcome.

Sheehy had quoted 'The key to success in otologic surgery is not whose technique one uses, but how one uses it and one's own ability and judgement'. The two surgical techniques in the correct hands seem almost at par; thus it had invoked varying views and choices from different surgeons.

In the current study, a comparison of CWD and ICW mastoidectomy in Atticoantral variety of CSOM has been made. Our results and observations showed that there was a significant hearing gain in ICW group in comparison to CWD group.

A universal conclusion as to the superiority of one surgical procedure over the other is not achieved as this study is concentrated only the audiological outcome, not on the overall postoperative results. Future long duration randomised controlled study, with a large sample size, maintenance of uniformity of surgeon and procedure, can probably help to reach a unanimous conclusion.

ABBREVIATIONS

CSOM=Chronic Suppurative Otitis Media, COM=Chronic Otitis Media, WHO=World Health Organization, CWD=Canal Wall Down, ICW=Intact Wall Mastoidectomy, PTA=Pure Tone Audiometry, ABG=Air Bone Gap, AC=Air Conduction, BC=Bone Conduction, dB=Decibel

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