

## OUTCOME OF TYPE I TYMPANOPLASTY IN TUBOTYMPANIC CHRONIC SUPPURATIVE OTITIS MEDIA IN RELATION TO SITE AND SIZE OF TYMPANIC MEMBRANE PERFORATION

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**ABSTRACT: AIM:** To find out the relation between hearing loss with site and size of perforation and assessment of improvement in hearing and graft uptake following type I tympanoplasty in dry Tubotympanic Chronic Suppurative Otitis Media.

Study Design-Non-Randomized Experimental Study.

**MATERIAL AND METHOD:** This study was done in ENT OPD at Tertiary Health Care Institute of Central India. It was conducted from November 2012 to October 2014 on 46 patients having dry Tubotympanic Chronic Suppurative Otitis Media. Type 1 Tympanoplasty was done in all patients using temporalis fascia graft. All patients were followed up for 12 weeks postoperatively and evaluated for graft uptake and hearing improvement with respect to size and site of perforation. Results were analyzed statistically.

**RESULTS:** Complete graft uptake was seen in 86.46% patients. Graft uptake was more in small perforations than larger ones (p value=0.0008). Graft failure was more in subtotal perforation and perforations involving all four quadrants. Average Pure Tone hearing loss was more in Subtotal perforation (45.5dB) and perforations occupying all four quadrants (41.27%). Hearing loss was more in Posteroinferior quadrant perforations as compared to Anteroinferior quadrant perforations and so also the hearing improvement after type I tympanoplasty.

**CONCLUSION:** There was a relationship between size and site of perforation with hearing impairment in tubotympanic type of CSOM. Posterior quadrant perforations were having more hearing loss and greater hearing improvement after surgery as compared to those with anterior quadrant perforation. Rate of graft uptake was directly proportional to size of perforation.

**KEYWORDS:** Chronic Suppurative Otitis Media; Tympanic Membrane Perforation; Pure Tone Audiometry; Tympanoplasty.

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**INTRODUCTION:** Chronic Suppurative Otitis Media (CSOM) is a most common cause of hearing loss in developing countries because of lack of specialized medical care, malnutrition and poor hygienic condition. Tubotympanic type of CSOM is characterised by perforation of pars tensa. Tympanic membrane plays important role in middle ear transformer mechanism.

It has been a general view that hearing loss increases with the size of perforation. The site of perforation in the tympanic membrane also has significant impact on magnitude of hearing loss.<sup>1</sup>

Posterior perforations have poor hearing than anterior ones because of direct exposure of round window to sound waves.<sup>1</sup>

Perforation at or near the site of attachment of tympanic membrane has more severe effect than those of same size at different site. However some authors believe that there is no significant effect associated with location of perforation.<sup>2</sup>

This study was done with the aim to find out the relation between hearing loss with site and size of perforation and assessment of improvement in hearing and graft uptake following type I tympanoplasty in dry tubotympanic Chronic Suppurative Otitis Media.

**MATERIAL AND METHODS:** The study was conducted in the Department of ENT, at Tertiary Health Care Institute of Central India for the duration of 24 months from November 2012 to October 2014. Every consecutive patient of Chronic Suppurative Otitis Media (CSOM) fulfilling inclusion and exclusion criteria were included in the study. The Patients were selected based on the following criteria:

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1. Patients with age group of 16 to 60 years of either sex with Tubotympanic disease (Safe CSOM) having dry ear for minimum period of 6 weeks.
2. Patients with small, moderate, large or subtotal central perforation.
3. Patients with pure conductive hearing loss and good cochlear reserve.
4. Patients with normal or partially impaired Eustachian tube function.

Patients with active discharge, traumatic perforation, post-ventilation tube insertion perforation, and those with altered ossicular status detected on Pure Tone Audiometry and intraoperatively, who required Tympanoplasty other than Type I, were excluded from the study.

These selected patients were subjected to clinical, radiological and laboratory investigations required for Pre-anaesthetic fitness. Otomicroscopy was done in all cases.

#### **Tympanic membrane was divided into four quadrants:**

Anterosuperior (AS), Anteroinferior (AI), Posterosuperior (PS) and Posteroinferior (PI).

#### **Size of Tympanic membrane perforation is defined as follows:**

**Small Perforation:** Occupying less than the size of one quadrant of tympanic membrane. Medium perforation-Occupying more than the size of one quadrant but less than two quadrants. Large perforation-Occupying more than the size of two quadrants but less than three quadrants. Subtotal perforation-Occupying more than the size of three quadrants.

Before undergoing surgery, all patients underwent Eustachian tube function assessment by "Interacoustic AT 235 impedance audiometer" by Toynbee test.<sup>3</sup> Hearing assessment of all patients was carried out one day prior to the surgery with the help of Pure Tone Audiometry using "ELKON eda Giga 3 audiometer." The technique followed was Carhart and Jerger's 5 up and 10 down method.<sup>4</sup> The tests were performed in the acoustically treated room with no ambient noise. In the patients with bilateral ear disease, the ear with more hearing loss was operated.

The air and bone conduction threshold averages were calculated by taking the average of 500, 1000, 2000 and 4000 Hz frequencies. The Air Bone Gap (ABG) was calculated by taking difference between air conduction and bone conduction thresholds. The air and bone conduction thresholds were recorded both pre-and postoperatively. Type I Tympanoplasty was done in all patients by postaural approach under Local Anaesthesia with I.V. sedation or General Anaesthesia using temporalis fascia graft as a graft material.

Postoperatively, all the patients were put on injectable antibiotics for 1 day followed by oral antibiotics, analgesics and antihistaminics for 7 days. Sutures were removed on 7<sup>th</sup> day. All cases were followed up on OPD basis after 1<sup>st</sup> week, 2<sup>nd</sup> week, 4<sup>th</sup> week, 8<sup>th</sup> week and 12<sup>th</sup> week. Otoscopy was done to assess the graft status and presence of any discharge at every follow-up. Postoperative hearing assessment with Pure Tone Audiometry was done at the end of 12 weeks. The presence of any complication was noted and treated simultaneously. The post-operative ABG closure was

calculated by taking difference between pre-operative ABG and post-operative ABG of average frequencies of 500, 1000, 2000 and 4000 Hz.<sup>1,5</sup>

From the air conduction threshold level, the deafness can be graded into several categories like below.<sup>6</sup>

- <25 dB-Normal Hearing,
- 26 – 40 dB – Mild hearing impairment,
- 41 – 60 dB – Moderate hearing impairment,
- 61 – 70 dB –Severe hearing impairment,
- 71 – 90dB – Profound hearing impairment,
- 91dB and above – Total deafness.

For the purpose of study: Successful graft uptake is stable, healed, clinically intact tympanic membrane. Graft failure includes residual perforation, reperforation, medialization of graft, and complete graft failure. All the results were analyzed statistically.

**RESULTS:** The present study was carried out in 46 patients of dry tubotympanic type Chronic Suppurative Otitis Media in two years' period. Out of 46 patients, 22 were males and 24 females. The mean age was 27.87±9.79 years and maximum number of patients (45.65%) were in the age group of 21-30 years; 41 patients (89.14%) had unilateral disease while 5 (10.87%) had bilateral disease. Otorrhoea was the commonest complaint in all patients (100%) followed by hearing loss in 39 (84.78%) patients.

On ascertaining the size of tympanic membrane perforation, it was observed that 9 (19.57%) patients had small central perforation, 22 (47.83%) had moderate, 11 (23.91%) had large and 4 (8.69%) had subtotal perforation. Maximum number of patients (17 patients) had two quadrant perforation followed by four quadrant perforation (12 patients), single quadrant perforation (9 patients) and three quadrant perforation (8 patients) in decreasing order.

#### **Graft uptake according to Size and Site of perforation:**

After surgery, at the end of 12 weeks' follow-up, out of 46 patients, 40 patients (86.96%) had complete graft uptake and 6 patients (13.04%) had graft failure. Graft uptake results were excellent i.e. 100% in small sized perforation involving single quadrant as compared to subtotal perforation (25% graft uptake) as shown in Table I. Smaller the perforation, graft uptake rate was more. (chi-square Test=16.54, p value= 0.0008). Out of 6 graft failures, 4 had medialization of graft and 2 had residual perforation (Table II).

None of the patient had complete graft failure. Medialization of graft was seen in 1 patient of moderate sized perforation, 2 patients of large perforation and 1 patient of subtotal perforation. Two patients who had residual perforation were of subtotal size involving all four quadrants. According to the site of perforation, graft failure was more in perforations involving all four quadrants (AS+AI+PS+PI), i.e., in 3 patients of which 1 had medialization of graft and 2 had residual perforation (Table II).

#### **Hearing Improvement according to Size and Site of perforation:**

On assessing the hearing loss on Pure Tone Audiometry, average preoperative Pure Tone hearing loss (Air-Bone Gap) was 35.86dB (SD+/-5.81). At the end of 12 weeks after surgery, the average Pure tone hearing loss (Air-Bone Gap) was 22.73dB (SD+/-2.87). So the average hearing

improvement after surgery was of 13.05dB (SD+/-5.06).

As shown in Table III, Pure Tone average hearing loss (ABG) was found to be more in subtotal perforation, i.e., 45.5dB followed by hearing loss in large perforation (38.48dB), moderate perforation (35.95dB), and small perforation (28.13dB). After surgical treatment, average hearing improvement was 6.03dB in small perforation. In Subtotal perforation average hearing improvement was found to be maximum i.e., 19.25dB as preoperative hearing loss was also more in those cases (Table III).

On assessing the hearing level according to the site of perforation, we observed that single quadrant perforation in posterior quadrant had more hearing loss as compared to anterior perforation. Perforations in AS quadrant had average hearing loss of 25dB and AI quadrant perforations had average hearing loss of 24.7dB while in PI quadrant perforations it was 33.92dB as shown in Table IV. On comparing the hearing loss between AI quadrant and PI quadrant perforations by using unpaired t-test, the difference was statistically significant (p value=0.0004). Similarly, two quadrant posterior perforations in PS+PI had more Pure Tone average hearing loss (36.8dB) as compared to anterior quadrant AS+AI perforation (30.67dB) and difference between the two was statistically significant (Unpaired t-test, p value=0.016). Perforation occupying all four quadrants (AS+AI+PS+PI) had average hearing loss of 41.27dB. (Table IV).

Postoperatively, after 12 weeks follow-up, Hearing improvement was more in PI quadrant perforations (11.16dB) as compared to AS quadrant perforations (4dB) and AI quadrant perforations (3.5dB). All four quadrant perforation (AS+AI+PS+PI) had shown average hearing improvement of 17.10dB which was more as compared to three quadrants, two quadrants or single quadrant perforation as shown in Table IV.

**DISCUSSION:** Chronic Suppurative Otitis Media with perforation of pars tensa is very common worldwide and is one of the main causes of conductive hearing loss in developing countries like India. The aim of management of such cases is to provide safe and dry ear and to restore the hearing mechanism. Sakagami et al.<sup>7</sup> in his study of CSOM observed that 90.1% (82 out of 91) cases had tympanic membrane perforation and ossicular chain was absolutely intact in them. Therefore timely management provides better hearing results and protects middle ear cleft from further complications. In this study, an effort was made to study the effect of site and size of perforation on degree of hearing loss and to assess the graft uptake and improvement in hearing after type I tympanoplasty in relation to site and size of perforation.

**Hearing loss in relation to size of perforation:** In general, larger the size of perforation greater is the hearing impairment. In our study, hearing loss was found to be directly proportional to the size of perforation. This observation is consistent with the studies of Vos SE et al.<sup>8</sup> Walter PA.<sup>9</sup> et al., Kumar et al.<sup>10</sup> and Vaidya S et al.<sup>11</sup> The larger perforations result in loss of middle ear and mastoid volume, decrease in areal ratio; also there is more chance of

diminish in the phase effect due to exposure of the round and the oval window to the sound pressure.

**Hearing loss in relation to site of perforation:** Average hearing loss in single quadrant perforations in AI quadrant and PI quadrant were compared and it was seen that hearing loss was more in cases of PI quadrant perforations and the difference was statistically significant (p value 0.0004). In the study of Kumar et al.,<sup>10</sup> average hearing loss in AI quadrant perforation was 26.6dB and that in PI quadrant was 32.4dB. Vaidya S et al.<sup>11</sup> found average hearing loss of 30.36dB in AI quadrant perforations and 39.10dB in PI quadrant perforations.

In two quadrant perforations, Kumar et al.<sup>10</sup> found average hearing loss of 28.12dB in AS+AI quadrant perforations and that of 36.6dB in PS+PI quadrant perforation. According to the study of Vaidya S et al.<sup>11</sup> average hearing loss in AS+AI quadrant perforation was 37.12dB, while in PS+PI perforation, it was 46.83dB. Our findings are consistent with both these studies. Unlike this, Mehta et al.<sup>12</sup> and Oluwole M et al.<sup>13</sup> did not observe significant difference in average hearing loss in anterior versus posterior quadrant perforations.

In our study, all four quadrant perforations had shown average hearing loss of 41.27dB which is consistent with Kumar et al. study.<sup>10</sup> (44.6dB) and Vaidya S et al.<sup>11</sup> study (48.88dB).

**Postoperative hearing improvement in relation to size of perforation:** In our study average hearing improvement was more in subtotal perforation (19.25dB) as compared to small perforation (6.03dB). Vidya S et al.<sup>11</sup> observed average hearing improvement of 14.03dB in small sized perforation, 16.08dB hearing improvement in medium sized perforation, 15dB in large sized perforation and 16.25dB hearing improvement in subtotal perforation.

**Postoperative hearing improvement in relation to site of perforation:** In our study, average hearing improvement was more in PI quadrant perforation than AS and AI quadrant perforation. Average hearing improvement was greater in perforations involving all four quadrants (AS+AI+PS+PI). These results are consistent with Vaidya et al.<sup>11</sup> study, in which average hearing improvement in PI quadrant perforation was of 17.04dB. In AS quadrant perforation, hearing improvement was of 12.94 and in all four quadrant perforation, hearing improvement was of 16 dB.<sup>11</sup>

**Graft uptake in relation to size and site of perforation:** In our study, we have considered medialization of graft, residual perforation and complete graft failure and reperforation as graft failures. We have observed that complete graft uptake was in 86.96% patients and failure in 13.04% patients. Graft failure was more in larger perforations than small ones and those occupying all four quadrants.

In Vaidya S et al.<sup>11</sup> study, graft intact was in 86% cases and residual perforation in 14% cases. In his study residual perforation was more in subtotal perforation (37.5%) and those involving all four quadrants (33.33%). In Kumar et al.<sup>10</sup> study, graft was intact in 80% patient and rejected in 20%

patients. In Kumar et al.<sup>10</sup> study, graft uptake rate had not been not studied in relation to size and site of perforation.

**CONCLUSION:** We have observed that there is a relationship between size and site of perforation with hearing impairment in tubotympanic type of CSOM. The larger the perforation greater is the hearing loss. Average hearing improvement was also found to be greater in larger perforations.

Posterior quadrant perforations were having more hearing loss and greater hearing improvement after surgery as compared to those with anterior quadrant perforation. Rate of graft uptake is directly proportional to size of perforation.

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Size of Perforation	No. of Ears	Graft Uptake	
		Successful No. (%)	Failure No. (%)
Small central	9	9 (100%)	0
Medium central	22	21 (95.45%)	1 (4.54%)
Large central	11	9 (81.81%)	2 (18.18%)
Subtotal perforation	4	1 (25%)	3 (75%)
Total patients	46	40 (86.96%)	6 (13.04%)

**Table I: Distribution of Patients According to Size of Perforation and Status of Graft at the End of 12 weeks Postoperatively (n=46)**

Chi square Test = 16.54, P value= 0.0008 (Highly Significant)

\*p value < 0.05- significant

Graft Failure	Size of Perforation	Site of Perforation	No. of Patients of Graft Failures
Medialization	Moderate	AS+AI	1
	Large Perforation	AS+AI+PI	2
	Subtotal Perforation	AS+AI+PS+PI	1
Residual Perforation	Subtotal Perforation	AS+AI+PS+PI	2

**Table II: Status of Graft Amongst Graft Failure Patients According to Site and Site of Perforation at the End of 12 weeks Postoperatively**

Size of Perforation	No. of Ears	Average Preoperative ABG $\pm$ SD# (dB)	Average Postoperative ABG $\pm$ SD# (dB)	Average Hearing Improvement (ABG Closure) $\pm$ SD# (dB)	Paired T-test	P value*
Small	9	28.13 $\pm$ 5.14	21.78 $\pm$ 2	6.03 $\pm$ 4.05	4.65	0.0009
Moderate	22	35.95 $\pm$ 2.85	22.23 $\pm$ 2.88	13.72 $\pm$ 3.11	11.70	< 0.0001
Large	11	38.48 $\pm$ 3.26	23.27 $\pm$ 3	15.20 $\pm$ 3.47	12.07	< 0.0001
Subtotal	4	45.5 $\pm$ 2.46	26.25 $\pm$ 1.44	19.25 $\pm$ 3.56	25.77	< 0.0001
<b>Table III: Hearing Improvement According to the Size of Perforation 12 weeks after Type I Tympanoplasty.</b>						

\*p value <0.05-Statistically significant

#SD- Standard Deviation

Quadrant Involved	No. of Ears	Average Preoperative ABG $\pm$ SD# (dB)	Average Postoperative ABG $\pm$ SD# (dB)	Average Hearing Improvement (ABG Closure) $\pm$ SD# (dB)	Paired T-test	P value*
AS	1	25	21	4	-	-
AI	5	24.7 $\pm$ 0.33	21.35 $\pm$ 1.26	3.35 $\pm$ 0.99	5.75	0.004
PS	0	0	0	0	-	-
PI	3	33.92 $\pm$ 3.09	22.75 $\pm$ 3.26	11.16 $\pm$ 2.02	4.30	0.12
AS+AI	3	30.67 $\pm$ 2.02	20 $\pm$ 2.91	10.67 $\pm$ 1.53	5.21	0.006
PS+PI	5	36.8 $\pm$ 2.77	21.75 $\pm$ 1.45	15.05 $\pm$ 2.43	10.76	<0.0001
AI+ PI	9	36.94 $\pm$ 2.45	23.47 $\pm$ 4.89	13.47 $\pm$ 3.60	7.38	<0.0001
AS+AI+PI	3	34.33 $\pm$ 1.15	22.17 $\pm$ 1.59	12.17 $\pm$ 1.42	10.73	<0.004
PS+PI+AI	5	37.9 $\pm$ 1.92	22.7 $\pm$ 3.27	15.2 $\pm$ 2.25	8.96	<0.0001
AS+AI+PS+PI	12	41.27 $\pm$ 4.14	24.17 $\pm$ 2.87	17.10 $\pm$ 3.80	11.75	<0.0001
<b>Table IV: Hearing Improvement According to the Site of Perforation 12 weeks after Type I Tympanoplasty.</b>						

\*p value <0.05- Statistically significant

#SD- Standard Deviation