

# Study on Impact of Perforation Size of Tympanic Membrane on Hearing Loss and Audiological Outcome after Closure in Patients with Chronic Otitis Media

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## ABSTRACT

**Background and Objectives:** Chronic otitis media (COM) is an important and a highly prevalent disease of the middle ear and poses serious health problem worldwide especially in developing countries. Chronic otitis media with perforation is often accompanied by varying degree of conductive hearing loss. Loss of hearing is a national health problem with significant physical and psychosocial problem. The objective of this study is to correlate size of perforation with hearing loss using pure tone audiogram and to evaluate the outcome of type I tympanoplasty in patients with chronic otitis media with tympanic membrane perforation.

**Methods:** The study comprises of 50 patients with chronic otitis media who visited ENT OPD, PBM Hospital, AGH with SPMC during Oct 2015 to Oct 2016, who have undergone type I tympanoplasty with cortical mastoidectomy. Inclusion criteria: All patients between 15-60 years of age with chronic otitis media with tympanic membrane perforation. Exclusion criteria: Age below 15 years and above 60 years of age, patients with SNHL, ossicular chain pathology and squamosal disease were excluded from the study. A correlation of size of perforation with hearing loss and postoperative hearing improvement after 3 months of surgery was done.

**Results:** In our study mean pure tone average for small, medium and subtotal perforation was 23.73dB, 30.11dB, 43.38dB respectively. Mean air bone gap for small, medium and subtotal perforation was 13.45dB, 20.07dB, and 31.38dB. Difference in mean pure tone average and mean ABG between different sizes of perforation is statistically significant. Hence we conclude that hearing loss increases with increase in size of perforation. Preoperatively, mean PTA threshold was 32.16dB and mean ABG was 23.26dB. Postoperatively, mean

PTA threshold was 23.26dB and mean ABG was 13.26dB. The hearing improvement from preoperative level to 3 months postoperative level was statistically significant.

Graft uptake in our study was seen in 88% of the cases. Out of 50 patients, 10 patients (20%) had excellent hearing improvement with 0-10dB postoperative ABG, 30 patients (60%) had good hearing results with 10-20dB postoperative ABG and 9 patients (18%) had fair hearing improvement with 20-30dB postoperative ABG. 1 patient (2%) had poor hearing outcome (More than 30dB postoperative ABG).

**Conclusion:** In our study we found a statistically significant correlation between the size of perforation and the hearing loss and a statistically significant improvement in hearing following type I tympanoplasty.

**Keywords:** Chronic Otitis Media, Type I Tympanoplasty, Size of Perforation, Pure Tone Audiogram, Hearing Loss.

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## INTRODUCTION

Chronic otitis media (COM) is an important and a highly prevalent disease of the middle ear and poses serious health problem worldwide especially in developing countries.<sup>1</sup> Chronic otitis media has been defined as a longstanding inflammatory condition of middle ear and mastoid associated with perforation of the tympanic membrane. Chronic otitis media is most likely a result of acute otitis media, Negative middle ear pressure or otitis media with effusion. Chronic otitis media with perforation is often

accompanied by varying degree of conductive hearing loss. Loss of hearing is a national health problem with significant physical and psychosocial problem.<sup>2,3</sup>

The surface area of an intact and normally vibrating tympanic membrane plays an important role in transmitting sound energy to middle ear. Perforation of the tympanic membrane is a very common cause of conductive hearing loss as there is loss in the vibrating area of tympanic membrane.

It is a general view that hearing loss increases with increase in size of perforation. This is more marked at lower frequencies than higher frequencies. It is also opined that size of perforation does not influence the outcome of the tympanoplasty. This study is done to test the validity of above concepts.

**METHODS**

The study comprises of 50 patients who have undergone type I tympanoplasty with cortical mastoidectomy.

**Inclusion criteria:** All patients between 15-60 years of age with chronic otitis media with tympanic membrane perforation.

**Exclusion criteria:** Age below 15 years and above 60 years of

age, patients with SNHL, ossicular chain pathology and squamosal disease were excluded from the study.

A correlation of size of perforation with hearing loss and postoperative hearing improvement after 3months of surgery was done.

**Statistical Analysis:** Statistical tests used: ANOVA (fischer test), students paired t test and Tukey HSD test.

Level of significance = 0.05

Decision Criterion: We compare the P- value with the level of significance. If P< 0.05 then there is a significant association between two groups, if P>0.05 then there is no significant association.

**Table 1: Size of perforation**

Size of perforation of TM	Frequency	Percent
Medium perforation	26	52.0
Small perforation	11	22.0
Sub total perforation	13	26.0
Total	50	100.0

**Table 2: Correlation of size of perforation and hearing loss**

Descriptives		N	Mean	Std. Deviation	F	p
PRE OPERATIVE	Medium	26	30.1154	5.10942		
PTA AVERAGE	Small	11	23.7273	3.92660		
	Sub total	13	43.3846	4.33087	57.59	.00
PRE OPERATIVE	Medium	26	20.0769	4.18495		
AIR BONE GAP	Small	11	13.4545	3.20511		
	Sub total	13	31.3846	4.27275	62.94	.00

**Table 3: Multiple Comparisons**

Dependent Variable	(I) Size of perforation of TM	(J) Size of perforation of TM	Mean Difference (I-J)	P
PRE OPERATIVE PTA AVERAGE	Medium perforation	Small perforation	6.38811	.001
		Subtotal perforation	-13.26923	.000
	Small perforation	Subtotal perforation	-19.65734	.000
PRE OPERATIVE AIR BONE GAP	Medium perforation	Small perforation	6.62238	.000
		Subtotal perforation	-11.30769	.000
	Small perforation	Subtotal perforation	-17.93007	.000

**Table 4: Comparison between preoperative & postoperative audiological results**

	Paired Differences		t	P
	Mean	Std. Deviation		
PREOPERATIVE PURE TONE AVERAGE- POSTOPERATIVE PURE TONE AVERAGE	8.900	6.345	9.919	.000
PREOPEARTIVE ABG-POSTOPEATIVE ABG	8.300	6.211	9.449	.000

**OBSERVATIONS AND RESULTS**

In our study, we included a total of 50 patients with chronic otitis media with tympanic membrane perforation. All the patients underwent cortical mastoidectomy with type I tympanoplasty. The grafts take up rate and audiological outcome at 3<sup>rd</sup> month of follow-up was compared with the preoperative status.

Out of 50 cases, 26 cases had a medium sized perforation forming 52% of the total sample, 13 patients had subtotal perforation and 11 cases had small perforation.

All 50 patients included in the study underwent pre-operative audiometry and the pure tone average and the air bone gap as

calculated. The mean PTA average for small perforation was 23.72dB, for medium perforation was 30.11dB and for subtotal perforation was 43.38dB. There was a significant association between the size of perforation and hearing loss.

Pre-operative mean ABG for small, medium and subtotal perforation was 13.45dB, 20.07dB and 31.38dB respectively. Data again showed there was a significant association between the size of perforation and hearing loss.

Multiple comparison of hearing loss between different sizes of perforation using tukey HSD test shows a significant correlation between size of perforation and hearing loss with hearing loss increasing

In our study on 50 patients with chronic otitis media mean preoperative PTA average was 32.16dB and ABG was 21.56dB. Puretone audiometry 3 months post-surgery showed mean PTA average of 23.26dB and ABG of 13.26dB. There was a significant difference between preoperative PTA average and postoperative PTA average as well as preoperative ABG and postoperative

ABG. Mean PTA average gain was 8.9dB and ABG was 8.3dB

Out of 50 patients, 10 patients (20%) had excellent hearing improvement with 0-10dB postoperative ABG, 30 patients (60%) had good hearing results with 10-20dB postoperative ABG and 9 patients (18%) had fair hearing improvement with 20-30dB postoperative ABG. 1 patient (2%) had poor hearing outcome (More than 30dB postoperative ABG).

In our study 10 cases had excellent hearing outcome of which 63.6% were small perforations and 11.5% were medium perforations. 33.3% of subtotal perforations had a fair outcome in comparison to only 19.2% of medium perforations. Hence we conclude that hearing outcome following type I tympanoplasty is best with small perforation, followed by medium and then by subtotal perforation.

In our study on 50 patients who underwent type 1 tympanoplasty, 44 patients (88%) had intact graft when they came for follow up at the end of 3 months of the surgery. 6 patient (12%) had developed residual perforation.

**Table 5: Postoperative hearing improvement**

Descriptives					
ABGdBHL	N	Mean	Std. Deviation	Minimum	Maximum
EXCELLANT	10	6.400	1.265	5.00	8.00
GOOD	30	12.300	2.322	10.00	15.00
FAIR	9	22.222	3.383	20.00	28.00

**Table 6: Hearing outcome vs size of perforation**

OUTCOME * Size of perforation of TM Crosstabulation						
		Size of perforation of TM			Total	
		Medium perforation	Small perforation	Subtotal perforation		
OUTCOME	EXCELLANT	Count	3	7	0	10
		%	11.5%	63.6%	0.0%	20.4%
	GOOD	Count	18	4	8	30
		%	69.2%	36.4%	66.7%	61.2%
	FAIR	Count	5	0	4	9
		%	19.2%	0.0%	33.3%	18.4%
Total		Count	26	11	12	49
		%	100.0%	100.0%	100.0%	100.0%

**Table 7: Graft uptake rate**

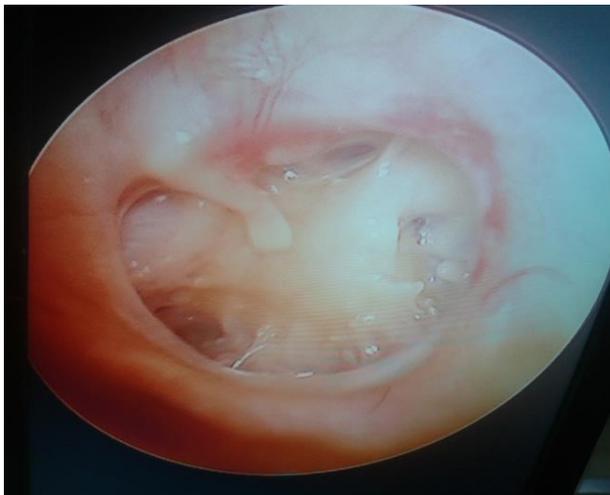
GRAFT UPTAKE	Frequency	Percent
INTACT GRAFT	44	88.0
RESIDUAL PERFORATION	6	12.0
Total	50	100.0

**DISCUSSION**

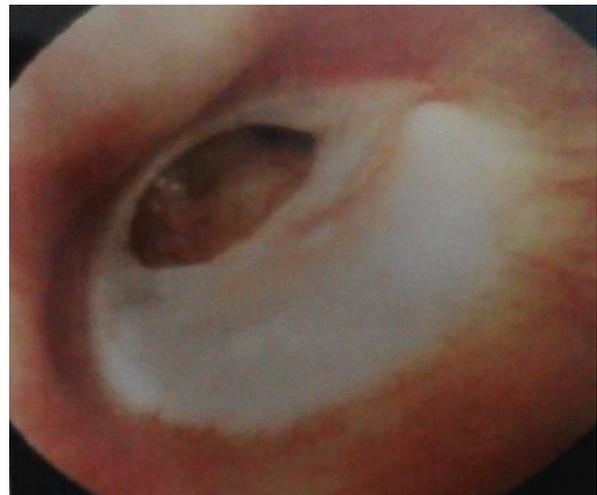
Type I tympanoplasty is one of the most commonly performed procedures in otorhinolaryngology. With advanced microsurgical techniques and equipment's, the state of art facility has now developed to the extent that graft success rates of 90% to 97% are to be expected<sup>4</sup>. Several studies done in the past have

reported good results with type I tympanoplasty with regard to hearing improvement, graft uptake and achieving dry ear.

A study on clinical profile of COM mucosal type with special reference to audiometric pattern in relation with site of tympanic membrane perforation and surgical management was carried out in 50 patients.



**Fig 1: Small perforation**



**Fig 2: Subtotal perforation**

In our study, we studied the association of size of perforation with hearing loss in 50 patients with chronic otitis media and audiological outcome following type I tympanoplasty.

On preoperative Pure Tone Audiometry the difference in PTA average and ABG between different groups of size of perforation was statistically significant. In our study complete graft uptake was seen in 44 cases (88%). Preoperatively, mean PTA threshold was 32.16dB and mean ABG was 23.26dB. Postoperatively, mean PTA threshold was 23.26dB and mean ABG was 13.26dB. The hearing improvement postoperatively was statistically significant. Out of 50 patients, 10 patients (20%) had excellent hearing improvement with 0-10dB postoperative ABG, 30 patients (60%) had good hearing results with 10-20dB postoperative ABG and 9 patients (18%) had fair hearing improvement with 20-30dB postoperative ABG. 1 patient (2%) had poor hearing outcome (More than 30dB postoperative ABG).

In a similar study like ours conducted by Kumar N et al on 50 patients to evaluate the correlation of hearing loss with size and site of tympanic membrane perforation it was found that on Pure tone audiometry (PTA) tympanic membrane perforation involving less than 25% of effective membrane surface area had hearing loss of 28.23dB, between 25-50% of effective membrane surface area had average hearing loss of 32.42dB, perforation involving 50-75% had loss of 36.26dB while larger perforation involving 75-100% of effective TM surface area suffered from an average loss of 44.62dB. So it was concluded that hearing loss increased with size of perforation.<sup>1</sup>

In another study conducted on 100 patients by Pannu K et al to evaluate hearing loss in tympanic membrane perforation, it was found that in small perforation (0-9mm<sup>2</sup>) the mean hearing loss at 250Hz was 31.43±1.59dB and at 4KHz was 19.91±11.54dB. In medium sized perforation (9-30mm<sup>2</sup>) the mean hearing loss at 250Hz was 39.88 ±11.43dB and at 4KHz it was 28.05±10.50dB. In large perforation (>30mm<sup>2</sup>) the mean hearing loss at 250Hz was 55.22±7.15dB and 32.61±6.01dB at 4KHz. So it was observed that average hearing loss increased with increase in size of perforation.<sup>2</sup>

In yet another study conducted by Lerut B to evaluate functional correlation of tympanic membrane perforation size 155 tympanic membrane perforations were examined and it was observed that hearing loss shows a linear relationship with increasing eardrum perforation size. The least impact of a perforation was seen at the

resonance frequency of 2 kHz. Above and below 2 kHz, an 'inverted V shape' of the air-bone gap was observed.<sup>3</sup>

In one of the studies conducted by Knapik M on 201 patients who underwent myringoplasty were examined and it was observed that audiological success rates were attained in 97.4%, 93.4% and 84.9% of patients at the end 6, 12 and 24 months respectively. A mean reduction of 9.1dB of the air bone gap was achieved postoperatively.<sup>5</sup>

In another study conducted by Thiel to evaluate factors affecting hearing improvement following successful repair of tympanic membrane, 169 tympanic membrane closure was done of which it was observed that 53% resulted in closure of air-bone gap to within 10dB, and 54% of cases had post-operative hearing thresholds of at least 30dB. The mean hearing change after surgery was +8.3dB. It was also observed that hearing improvement was more in large perforations than small perforations.<sup>6</sup>

In a study conducted to evaluate the impact of perforation size on closure and audiological improvement it was observed that the success was 80.8% and the mean air conduction gain was 6.8dB. Perforation size was not a statistically significant determinant factor for success of tympanoplasty.<sup>7</sup>

In studies conducted by Glasscock et al<sup>8</sup> the graft success rate in dry ear was 93.1%, in Ceylan et al<sup>9</sup> it was 88%, Nagle SK et al it was 88% and in our study the graft uptake rate was 88%.

Thus, the association of size of perforation with hearing loss and the success rate of tympanoplasty in terms of graft take and hearing improvement, as found in our study, was consistent with the results of most studies in the literature.

## CONCLUSION

In our study we found a statistically significant correlation between the size of perforation and the hearing loss and a statistically significant improvement in hearing following type I tympanoplasty.

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