Issue DOI- 10.21176/ojolhns.0974-5262.2017.11.1.

Orissa Journal of
Otolaryngology and HNS - ISSN - 0974 - 5262

COMPARISON OF HEARING RESULTS OF TYPE III TYMPANOPLASTY WITH MASTOIDECTOMY WITH OR WITHOUT AUGMENTATION OF STAPES HEAD

*Netra A Pathak, *Vidya V Rokade

HOW TO CITE THIS ARTICLE

Pathak Netra A, Rokade Vidya V. Comparison of Hearing results of type III tympanoplasty with mastoidectomy with or without augmentation of stapes head. Orissa J Otolaryngology Head Neck Surgery 2017 June; 11(1): 32-36. DOI: 10.21176/ojolhns.2017.11.1.5

Date of receipt of article - 08-02-2017

Date of acceptance – 21-02-2017

DOI- 10.21176/ojolhns.2017.11.1.5

DOI URL- https://doi.org/10.21176ojolhns.2017.11.1.5

ABSTRACT:

Background: To assess and compare the hearing results in patients undergoing tympano mastoidectomy with classical type III tympanoplasty using temporalis fascia alone and with cartilage augmented type III tympanoplasty.

Methods: Patients of 5 years of age or more with the diagnosis of chronic otitis media (squamous) with conductive or mixed hearing loss, who underwent classical type III tympanoplasty with or without cartilage augmentation, were included in the study. Pure tone audiometry (PTA) was performed and patients were clinically evaluated. Post- operative hearing was assessed in terms of average air bone gap (ABG) and size of ABG closure. Post-operative hearing results were compared in between classical type III and cartilage augmented type III tympanoplasty groups.

Results: When comparing average post-operative ABG and size of ABG closure between classical and cartilage augmented type III tympanoplasty, cartilage augmented group showed marginally better results but this difference was statistically not significant.

Conclusions: Hearing results after type III tympanoplasty varied widely. There was no statistically significant improvement in post-operative hearing results in cartilage augmented tympanoplasty when compared to classical type III tympanoplasty, suggesting possibility of the effects of multiple other factors.

INTRODUCTION:

Chronic otitis media (COM) is a common condition, affecting 0.5–30% of any community. Therefore, a conservative estimate of the number of people in the world suffering from COM is over 20 million[1]. The prevalence of squamous type of chronic suppurative otitis media (CSOM) is 3.5%[2]. The objective of tympanomastoid surgery for chronic otitis media, in decreasing order of priority are elimination of disease to produce safe and dry ear; alteration of anatomy to prevent recurrent disease, optimization of cleaning and otological monitoring; and reconstruction of the middle ear to achieve serviceable and stable postoperative hearing[4].

The goal of tympanoplasty is to restore sound pressure transformation at the oval window by coupling an intact tympanic membrane with a mobile stapes footplate via an intact or reconstructed ossicular chain and to provide sound protection for the round window

Affiliations:

*Professor,** Associate Professor
Smt. Kashibai Navale Medical College & General Hospital, Pune (Maharashtra)

Corresponding address:

Dr.Vidya V.Rokade
A-2,303 Sun Empire, Sun City Road
Vadgaon Bk., Pune-51
Phone no. 9922160881
E-mail- vidyarokade@hotmail.com

Issue DOI URL- https://doi.org/10.21176/ojolhns.0974-5262.2017.11.1

membrane by a closed, air containing, mucosa lined middle ear[3]. The modern era of tympanoplasty was ushered in by Wullstein and Zollner. Wullstein classified the operations as types I through V[4].

In classical type III tympanoplasty or myringostapediopexy, disease is removed from tympanomastoid compartment and advancement of the tympanic membrane (TM) or placement of tissue graft is done on top of the stapes capitulum. After this procedure, air-bone gap (ABG) range is around 10-60dB. Merchant et al. in laboratory model demonstrated that improved hearing results could be achieved in myringostapediopexy by interposing a thin cartilage disc between the graft and stapes head[4]. For augmented type III tympanoplasty, either cartilage or sculptured cortical bone can be kept between the intact stapes and the fascial graft[3].

Cartilage disc was hypothesized to improve the "effective" vibrating area of the graft that was coupled to the stapes head. Cartilage also offers the advantage of higher mechanical stability compared with membranous transplants thus preventing retraction of tympanic membrane in the long run but others argue that it may alter the acoustic transfer characteristics of the graft due to its increasing mass and stiffness of the reconstructed tympanic membrane.

MATERIALS AND METHODS:

A Prospective study was performed from October 2006 to April 2008. Patients who were 5 years and above of both sexes with intact and mobile stapes suprastructure at tympanomastoidectomy surgery for COM squamous type were included. Total number of patients enrolled during the study were 80. Out of which CWD(canal wall down) mastoidectomy.and classical type III tympanoplasty was done in 40 patients and CWD mastoidectomy and cartilage augmented type III tympanoplasty in another 40 patients.

Pure Tone Audiometry was performed within seven days prior to the operation. The test was performed through Air Conduction and Bone Conduction mode. Air and Bone Conduction threshold were calculated by taking the averages of 500, 1000, 2000 and 4000 Hz frequencies. The ABG was calculated by taking differences between Air conduction and Bone Conduction threshold. The Air and Bone conduction threshold were recorded both pre and post-operatively. Postoperative ABG closure was calculated by taking the difference between preoperative and postoperative ABG of the average frequencies of 500, 1000, 2000 and 4000 Hz. Audiometry results were reported. For classical type III tympanoplasty, a temporalis fascia graft was used to bridge the middle ear air space and placed in contact with the stapes head. For cartilage augmentation, thin disc of conchal cartilage of partial thickness and of 4-6 mm in diameter was interposed between the stapes head and temporalis fascia graft. Cartilage disc did not touch the external auditory canal or facial nerve canal.

The follow up was performed after 10th week postoperatively. During follow up, patients were subjected to pure tone audiometry (PTA) assessment. Results were analyzed in terms of average postoperative ABG and ABG closure. The results between both were compared. The data analysis was performed with the help of SPSS 11.5 software package. *P* value was calculated using the independent samples test and *P* value of < 0.05 was taken as significant.

RESULTS:

Total numbers of patients enrolled during the study were 80. Out of which CWD mastoidectomy and classical type III tympanoplasty was done in 40 patients and CWD mastoidectomy and cartilage augmented type III tympanoplasty in another 40 patients.

The difference in post-operative ABGs between classical type III tympanoplasty and cartilage augmented type III tympanoplasty at different frequencies (500Hz, 1000Hz, 2000Hz, and 4000Hz) were analyzed and found to be statistically not significant. The difference in four frequency average post-operative ABG between these two groups was also found to be statistically not significant with p value of >0.001.

However, the post-operative ABG was better by 2.5dB and 1.5dB at frequencies 500Hz and 2000Hz in cartilage augmented type III tympanoplasty as compared to classical type III tympanoplasty, but it was worse by 1.3dB and 2.2dB at frequencies 1000Hz and 4000Hz in cartilage augmented type III tympanoplasty as compared to classical type III tympanoplasty. On an average, there was 0.1dB improvement in cartilage augmented type III

Issue DOI- 10.21176/ojolhns.0974-5262.2017.11.1.
Orissa Journal of
Otolaryngology and HNS - ISSN - 0974 - 5262

tympanoplasty as compared to classical type III tympanoplasty, which was statistically not significant (Table 1).

Table 1 : Comparison of frequency wise post-operative PTA-ABG between patients with classical type III tympanoplasty and cartilage augmented type III tympanoplasty(n=40 each group)

Parameter	Group	Mean	SD	p value
Post op ABG 500HZ	cartilage augmented tympanoplasty	36.4	10.10	0.3586
	classical type III tympanoplasty	38.89	13.74	
Post op ABG 1000HZ	cartilage augmented tympanoplasty	32.47	10.25	0.6285
	classical type III tympanoplasty	31.13	14.12	
Post op ABG 2000HZ	cartilage augmented tympanoplasty	22.98	9.80	0.5341
	classical type III tympanoplasty	21.45	12.00	
Post op ABG 4000HZ	cartilage augmented tympanoplasty	30.47	7.80	0.1212
	classical type III tympanoplasty	28.21	4.73	
Post op ABG AVG	cartilage augmented tympanoplasty	30.7	7.70	0.8748
	classical type III tympanoplasty	30.80	10.72	

Table 2: ABG Closures in different categories (n=40 each group)

Groups	O-5 db	0-10 db	0-20 db	0-30 db	>30 db
classical type III tympan oplasty	10% (4)	17.5 %(7)	40% (16)	30% (12)	2.5 %(1)
cartilage augmen ted type III tympan oplasty	7.5 %(3)	27.5 % (11)	30% (12)	32.5 % (13)	2.5 % (1)

However, in CWD mastoidectomy and cartilage augmented type III tympanoplasty, ABG closure was good at frequencies of 1000Hz, 2000Hz, and 4000Hz and was average as compared to CWD mastoidectomy and classical type III tympanoplasty whereas it was worse in 500Hz . The ABG closure was again divided into different categories like 0-5dB, 0-10dB, 0-20dB, 0-30dB and 0-40dB. It was noted that 3(7.5%) cases fell within 0-5dB and 12(30%) cases within 0-20dB in CWD mastoidectomy and cartilage augmented type III tympanoplasty whereas 4(10%) cases within 0-5dB and 12(30%) within 0-20dB in CWD mastoidectomy and classical type III tympanoplasty. (Table 2).

DISCUSSION:

The objectives of this study were to access, analyze and compare post-operative hearing results in terms of average ABG and the size of ABG closure in patients of classical type III tympanoplasty using temporalis fascia alone and with cartilage augmented type III tympanoplasty with masoidectomy. During the length of follow up, there were no cases of cartilage extrusion. Different methods have been used by different authors to report the pure tone audiometric post-operative hearing results in middle ear surgery in the literature. Among these ABG closure, post operative ABG presented in 10 dB bins and air conduction threshold gain are commonly reported indicators of tympanoplasty outcome. We had applied average PTA-ABG and size of the ABG closure for audiological assessment. For calculation of the size of the post-operative PTA- ABG closure ABGs were divided into different bins of 0-5dB,0-10dB,0-20 dB,0-30 dB, and >30 dB.

In our study, while comparing the average post operative air bone gaps between classical type III tympanoplasty and cartilage augmented type III tympanoplasty at various frequencies the differences were found to be statistically not significant ($P>0.001$). The difference in four frequency average post-operative air bone gap between these two groups was also found to be statistically not significant with a p value of 0.965. However, the post-operative ABG was better by 2.5 dB and 1.6 dB at frequencies 500Hz and 2000Hz in cartilage augmented type III tympanoplasty as compared to classical type III tympanoplasty but it was worse by 1.4 dB and 2.3 dB at frequencies 1000Hz and

Issue DOI URL- https://doi.org/10.21176/ojolhns.0974-5262.2017.11.1

4000 Hz in cartilage augmented type III tympanoplasty as compared to classical type III tympanoplasty. Our findings are to some extent in agreement with those of Merchant et al who observed a 5 dB improvement at 250Hz, 500Hz and 2000Hz with interposition of thin disc of cartilage between the graft and the stapes head in both of their temporal bone model as well as in their clinical study[6]. Variation in functional hearing results between the two studies may also have occurred due to this difference in the technique used. While analyzing the frequency wise post-operative average PTA-ABG in both the groups it was seen that ABG was the smallest at 2000 Hz as compared to other frequencies. Similar findings were also noted by Merchant et al in 2003[7]. Similarly, there is no clear explanation for the cause of the air conduction thresholds showing to be the lowest at 2000Hz however; it could have resulted from resonances generated in the mastoid cavity and ear canal.

Twenty (52.6%) cases in classical type III tympanoplasty of our study fall within 30 dB ABG closure. Our result following classical type III tympanoplasty compare well with myringos-tapediopexy as a tympanoplasty procedure in canal wall down mastoid surgery as reported by Cheang et al (n =22) who observed PTA-ABG closure within 30 dB in 61.9 % of his patients[8].

Our results however are different from those of natural myringostapediopexy (n=15) and surgical canal down myringostapediopexy (n=35) as reported by Dawes who observed PTA ABG closure within 30 dB in 87.0 % and 90.0% of his cases in these two groups respectively [9,10].

Another study performed by Cook et al showed that the ABG closure in CWD mastoidectomy with cartilage from stapes to drum technique were 30% within 10 dB, 69% within 20 dB and 75% within 30 dB which are close to our results[11]. In our study, 20 (58.8%) cases in cartilage augmented type III tympanoplasty fell within 30 dB ABG closure. Cheang et al in his myringolenticulopexy group (n= 20) achieved an ABG of less than 30 db in 92 % and ABG of less than 20 dB in 64% of has cases[8]. Moustafa and Khalifa in their myringo-cartilago-stapediopexy group (n=95) achieved an ABG of less than 20 dB in 84%[10]. Kyrodimos et al in their cartilage shield type III tympanoplasty (n=52) using a 0.8 mm thick cartilage piece with no capitulum for stapes head report that post-operative PTA-ABG of 25dB or less was achieved in 41 (79%) of patients and of 20 dB or less in 54% of patients[12]. However their study included both canal wall up and canal wall down procedures[13]. One year after surgery, a post-operative ABG of 20 dB or less occurred in 84.3% (n=27) of patients and this after a mean follow-up of 7 years, post-operative ABG of 20 dB or less occurred in 81% (n = 26) of patients. Another factor leading to failure of tympanoplasty is total or partial non-functional results which are often influenced by wide variability in the surgical techniques employed, criteria used to evaluate hearing results and a number of other anatomical, physiological and pathological events that occur post-operatively in the middle ear as mentioned above. It must be remembered that fibrosis could be due to the underlying middle-ear or upper airway pathology that caused the disease– it may not be caused, in part or full, by surgery. Equally important may be the extent of destruction by the disease that may adversely affect the ultimate functional results. Such issues may be more relevant in an underdeveloped country like ours.

CONCLUSION:

The post-operative PTA–ABG ranged from 15–61.2 dB in classical type III tympanoplasty while the post-operative PTA –ABG ranged from 15– 47.5 dB in cartilage augmented type III tympanoplasty, suggesting the possibility of effect of multiple other factors .The post-operative PTA-ABG was 2.5dB and 1.6dB less at frequencies 500Hz and 2000Hz in cartilage augmented type III tympanoplasty as compared to classical type III tympanoplasty but this difference was not statistically significant. In comparison of size of ABG closure between classical and cartilage augmented type III tympanoplasty, cartilage augmented group showed marginally better results. In classical type III tympanoplasty 30% (12) cases and 32.5% (13) cases in cartilage augmented type III tympanoplasty fell within 30 dB ABG closure. But this difference was statistically not significant. However, cartilage augmentation type III tympanoplasty in canal wall down mastoid surgery is a worthwhile procedure.

DISCLOSURES:

(a) Competing interests/Interests of Conflict- None
(b) Sponsorships – None
(c) Funding - None

(d) Written consent of patient- taken

(e) Animal rights- Not applicable

REFERENCES:

1. Sadé J. Introduction. (eds) Cholesteatoma and mastoid surgery. illus, Kugler Publications BV, Amsterdam, The Netherlands, p-1-3. 1982.
2. Adhikari P, Sinha BK, Pokhrel NR, Kharel B, Aryal R, Ma J. Prevalence of chronic suppurative otitis media in school children of Kathmandu District. Journal of Institute of Medicine. 2007; 29**(3):**10-12.
3. Merchant SN, Rosowski JJ. Auditory physiology.Glassock-Shambough Surgery of the Ear, 5th edition. Elsevier India, New Delhi.2003, 64-78.
4. Merchant SN, McKenna MJ, Rosowski JJ. Current status and future challenges of tympanoplasty. Eur Arch Otorhinolaryngol. 1998; **255:**221–228.
5. American Academy of Otolaryngology-Head Neck Surgery Foundation, Inc. Committee on Hearing and Equilibrium guidelines for the evaluation of results of treatment of conductive hearing loss. Otolaryngol Head Neck Surg. 1995; **113:**186-7.
6. Merchant SN, McKenna MJ, Mehta RP, et al. Middle ear mechanics of type III tympanoplasty (stapes columella): II clinical studies. Otol Neurotol 2003; 24**(2):**186 –94.
7. Goode RL, Friedrichs R, Falk S. Effect on hearing threshold of surgical modification of the external ear. Ann Otol Rhinol Laryngol.1977; **86:**441–451.
8. Cheang PP, Kim D, Rockley TJ. Myringostapediopexy and myringolenticulopexy in mastoid surgery. J Laryngol Otol. 2008; 17**(3):**1-5.
9. Dawes PJ. Myringostapediopexy: surgical expectation The Journal of Laryngology & Otology. 2003 March; **117:**182–185.
10. Moustafa HM, Khalifa MA. Tympano-cartilago-stapediopexy: a method to improve hearing in open technique tympanoplasty. J Laryngol Otol. 1990; **104:**942-4.
11. Cook JA, Krishnan S, Fagan PA. Hearing results following modified radical versus canal-up mastoidectomy. Ann Otol Rhinol Laryngol .1996; 105**(5):**379-83.
12. Kyrodimos E, Sismanis A, Santos D. Type III cartilage “shield” tympanoplasty: an effective procedure for hearing improvement. Otolaryngol Head Neck Surg. 2007; 136**(6):**982-5.
13. Malafronte G, Filosa B,and Mercone F. A new double – cartilage block ossiculoplasty: long term results. Otol Neurotol 2008; **29:**531-33.