

Modified Radical Mastoidectomy: Open Mastoid Cavity versus Cavity Obliteration Using Periosteal Temporofascial Flap - A Comparative Study

<https://doi.org/10.47210/bjohns.2022.v30i1.589>

Vignesh Kumar R,¹ Rohit Bhardwaj,² Shams Uddin,³ Smrity Rupa Dutta Borah,³ Abhinandan Bhattacharjee,³ Kripamoy Nath,³ Manas Pratim Das³

ABSTRACT

Introduction

The surgical treatment of Chronic Otitis Media by modified radical mastoidectomy usually results in an open cavity, with chronic discharge, hearing loss of 30 to 40 dB, frequent visits to OPD for debris removal and none the less dizziness on cold air exposure. One way to deal with these issues effectively is to obliterate the mastoid cavity. In our study we used vascularised periosteal-temporofascial swing flap with medicated bone dust to obliterate the mastoid cavity.

Materials and Methods

In this prospective study, 50 patients who suffered from chronic otitis media, active squamous (cholesteatoma) disease, and underwent modified radical mastoidectomy with tympanoplasty procedure were and split between two equally sized groups. Group 1 had patients with open mastoid cavity and Group 2 had obliteration of mastoid cavity using vascularised periosteal-temporofascial swing flap with medicated bone dust. Patients were followed at 3rd week, 6th week, 3rd month and 6th month.

Results

Patients with cavity obliteration had better and statistically significant outcomes in term of discharge status of cavity and epithelization at 3 weeks. Patients with obliteration also had positive and statistically significant results in hearing levels and hearing gain at 6 months follow up.

Conclusion

Mastoid cavity obliteration with vascularised periosteal-temporofascial swing flap with medicated bone dust is a good and effective method for better post-operative outcomes and curtailing dependency on doctors for cavity care.

Keywords

Mastoidectomy; Tympanoplasty; Otitis Media, Suppurative; Hearing Loss.

Chronic suppurative Otitis Media has been defined traditionally as a long standing inflammation of the middle ear, and the mastoid and in most cases it is seen in association with perforation of tympanic membrane, as well as otorrhoea.¹ Usually this happens because of an earlier injury such as AOM or OME. Active squamous COM with extensive cholesteatoma mostly requires modified radical mastoidectomy (MRM) for complete disease removal. After MRM the result is an open cavity, with chronic discharge, hearing loss of 30 to 40 dB, frequent visits to OPD for debris removal and

none the less dizziness on cold air exposure.² A variety of methods that combine different materials and grafts

1 - Department of Otorhinolaryngology, VMMC & SJH, New Delhi

2 - Department of Otorhinolaryngology, Army College of Medical Sciences & Base Hospital, Delhi Cantt-10

3 - Department of Otorhinolaryngology, Silchar Medical College Assam

Corresponding author:

Dr Rohit Bhardwaj

email: drrohitbhardwaj90@gmail.com

have been employed to solve the mastoidectomy-related problems. As of now, it is difficult to establish an optimal procedure. The amount of evidence available regarding this subject is a bit weak and extremely limited.³ The obliteration of the mastoid cavity can avoid these complications in most of the patients.⁴ The chances of infection and granulation are also reduced and the hearing aids are also better tolerated due to the small cavity in these patients. In this study we compared patients who had obliteration of mastoid cavity using vascularized periosteal-temporofascial swing flap with medicated bone dust to those who had open (unobliterated) mastoid cavity in terms of various post-operative cavity related issues.

Material and Methods

This prospective study was conducted in the Otorhinolaryngology department of a tertiary care hospital over the course of one year (April 2018 to March 2019), with the prior approval of the institution's ethics committee. All patients who visited the OPD of the department of ENT who complain of discharge of the ears and hearing loss were examined. Patients with the active squamous (cholesteatoma) form of chronic otitis media identified, were enrolled in this study. The exclusion criteria for this study included radical mastoidectomy/ revision modified radical mastoidectomy / mastoidectomy without tympanoplasty and intracranial complications of chronic suppurative media otitis. Fifty patients from the age group 10 to 60 years and of any sex who suffered from chronic otitis media, active squamous (cholesteatoma) disease, and underwent modified radical mastoidectomy with tympanoplasty procedure to completely eliminate the cholesteatoma and granulations were included in the study and were followed for a duration of six months. Based on the criteria above, 50 patients were enrolled into the study and split between two equally sized groups (by alternate allocation) that had undergone Modified Radial Mastoidectomy with tympanoplasty. Group 1 included 25 patients with open mastoid cavity and Group 2 had 25 patients who had obliteration of mastoid cavity using vascularised periosteal-temporofascial swing flap with medicated bone dust. Patients were followed at – 3rd week,

6th week, 3rd month and 6th month. We assessed and compared the following results between the groups: (A) Discharge status of mastoid cavity, (B) Giddiness after surgery (C) Mastoid cavity epithelialisation status (D) Wax formation after surgery. Changes in the pre-op average PTA thresholds were also compared with post-op PTA (at 6 months) and hearing gain achieved.

The data were analyzed with IBM SPSS (version 20) Statistics. The numerical variables were presented as mean + standard deviation (SD). Intergroup differences were evaluated using a one way analysis of variance (ANOVA). The Scheffe test for post-hoc comparisons were utilised when ANOVA showed statistically significant difference. In order to compare non-parametric data Chi Square test was used. Values of $p < 0.05$ were considered to be statistically significant.

Results

(A) Discharge status of mastoid cavity: In this study, we found that the cavities began becoming dry by 56% in 3 weeks in group 2 (cases that had cavity obliteration using vascularised periosteal-temporofascial swing flap; Fig. 1) in comparison to 28% dry cavity in those with open cavity of group 1. In the final six months, 96% cavity cavities had dried in the group 2, while only 88% were dry in group 1 cases (Table I). The gap was statistically significant at 3 weeks, with $p=0.046$ but then later in the course of follow up it became non-significant.

(B) Giddiness after surgery: The study also showed that the giddiness did not appear in all patients in group 2 following surgery. However in group 1, it was present in 12% patients within 3 weeks. At the end of six months, it was still present in the 8% of patients (Table II). However, it was not statistically significant.

(C) Epithelialisation of mastoid cavity: The study demonstrated that many cavities had been completely epithelialized the patients in group 2 (40 percent) by the end third week, compared to group 1 (4 percent) patients. 92% of cavities were healed completely within 6 months in the case of group 2, compared with 72% of the healed cavities for the group 1 (Table III). This clearly demonstrated that obliteration promotes the early repair

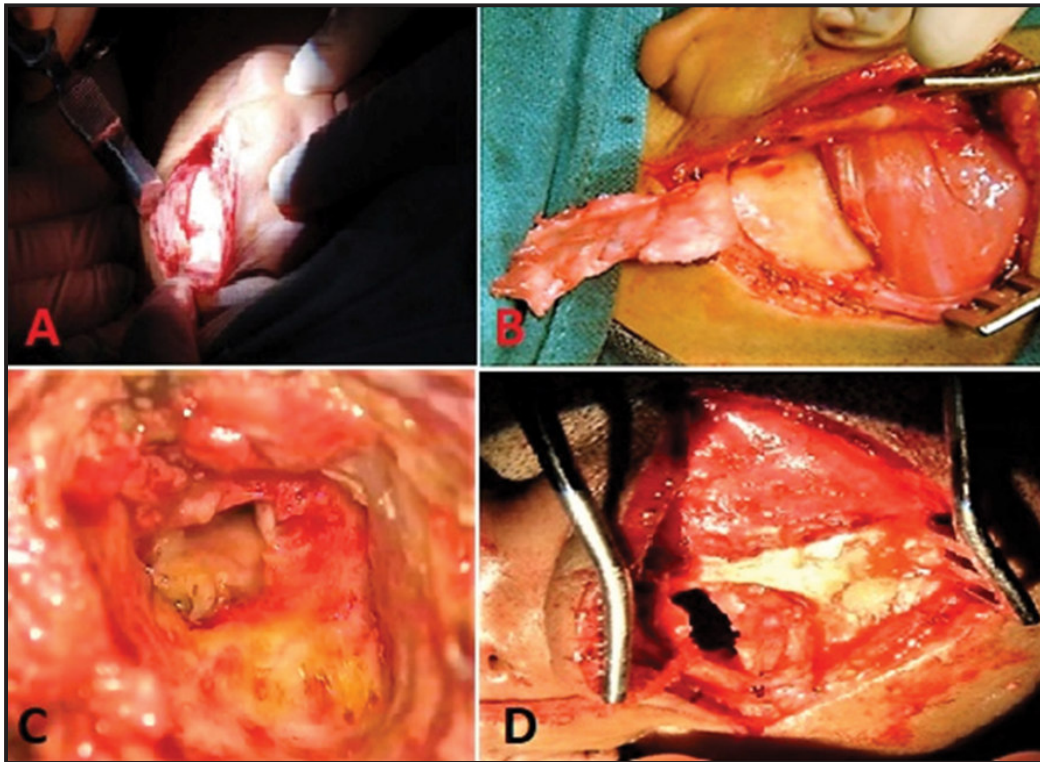


Fig. 1. Intra-operative images A and B) Showing securing periosteotemporo-fascial flap; C) showing a cavity after MRM, D) showing obliteration of MRM cavity with the flap.

Table I: Discharge status of mastoid cavity at various follow up visits

DISCHARGE IN WEEKS		GROUP 1		GROUP 2		p-VALUE
		NUM-BER	%	NUM-BER	%	
3 Weeks	Absent	7	28%	14	56%	0.046
	Present	18	72%	11	44%	
6 Weeks	Absent	15	60%	20	80%	0.128
	Present	10	40%	5	20%	
3 Months	Absent	17	68%	20	80%	0.344
	Present	8	32%	5	20%	
6 Months	Absent	22	88%	24	96%	0.307
	Present	3	12%	1	4%	

Table II: Giddiness after surgery at various follow up visits

GIDDINESS IN WEEKS		GROUP 1		GROUP 2		p-VALUE
		NUM-BER	%	NUM-BER	%	
3 Weeks	Absent	22	88.0%	25	100.0%	0.077
	Present	3	12.0%	0	0.0%	
6 Weeks	Absent	22	88.0%	25	100.0%	0.077
	Present	3	12.0%	0	0.0%	
3 Months	Absent	23	92.0%	25	100.0%	0.155
	Present	2	8.0%	0	0.0%	
6 Months	Absent	23	92.0%	25	100.0%	0.155
	Present	2	8.0%	0	0.0%	

Table III: Epithelialisation of mastoid cavity at various follow up visits

EPITHELIALISATION IN WEEKS		GROUP 1		GROUP 2		p-VALUE
		NUMBER	%	NUMBER	%	
3 Weeks	Complete	1	4%	10	40%	0.002
	Incomplete	24	96%	15	60%	
6 Weeks	Complete	12	48%	18	72%	0.086
	Incomplete	13	52%	7	28%	
3 Months	Complete	15	60%	21	84%	0.061
	Incomplete	10	40%	4	16%	
6 Months	Complete	18	72%	23	92%	0.068
	Incomplete	7	28%	2	8%	

of the mastoid cavity due to the fact that statistical significance was attained within 3 weeks at $p=0.002$ and at the end of six months, it was not significant with $p=0.068$.

(D) Wax formation after surgery: From this study we found that the formation of wax was observed in 12

percent of patients after 3 months, and 20 percent of patients at six months in group 1 (Table IV). However, patients in group 2 were seen having wax formation in just 4 percent of patients, that also at the end of the 6 the month, however the difference in the numbers was not statistically significant.

Table IV: Wax formation after surgery at various follow up visits.

WAX		GROUP 1		GROUP 2		p-VALUE
		NUMBER	%	NUMBER	%	
3 Weeks	Absent	25	100.0%	25	100.0%	-
	Present	0	0%	0	0%	
6 Weeks	Absent	25	100.0%	25	100.0%	-
	Present	0	0%	0	0.0%	
3 Months	Absent	22	88.0%	25	100.0%	0.074
	Present	3	12.0%	0	0%	
6 Months	Absent	20	80.0%	24	96.0%	0.082
	Present	5	20.0%	1	4.0%	

(E) Comparison of hearing levels in both the groups at 6 months follow up: This showed that the post-operative hearing levels (Mean \pm Standard deviation in dB) at 6 months in the patients of the two groups were 33.68 ± 2.59 (Group 1) and 25.16 ± 1.31 (Group 2) with a p value: $p < 0.001$ which is statistically significant.

(F) Hearing Gain: This study suggested that in group 1, the hearing gain (Mean \pm Standard deviation in dB) at 6 months after surgery was 6.96 ± 2.821 and in group 2 it was 13.24 ± 4.807 (Table V). The difference in hearing gain was statistically significant with $p=0.003$ (extremely

significant). This shows us that patients with obliteration of the cavity had better hearing gain than those with open cavity.

(G) Post-operative complications: From the Table VI showing post-operative complications, it is clearly evident that majority of the postoperative complications were far less in the group 2 cases when compared to the group 1 cases. However, the recurrence of cholesteatoma was there in one case each in both the groups which suggests that cholesteatoma recurs independent of the procedure done.

Table V: Comparison of preoperative and postoperative mean hearing levels and the hearing gain of the two groups in the study

AUDIOLOGICAL ASSESSMENT	GROUP 1		GROUP 2		P-VALUE
	MEAN	STD DEVIATION	MEAN	STD DEVIATION	
Pre-op hearing loss (dB)	40.64	3.893	38.40	4.726	0.250
Hearing threshold after 6 months (dB)	33.68	2.594	25.16	1.313	0.007
Hearing Gain (dB)	6.96	2.821	13.24	4.807	0.003

Table VI: Post-operative complications in both groups

SL. NO.	COMPLICATIONS	GROUP 1		GROUP 2	
		NO	%	NO	%
1.	Discharging cavity	3	12%	1	4%
2.	Giddiness	2	8%	0	0%
3.	Incomplete epithelialization	7	28%	2	8%
4.	Wax formation	5	20%	1	4%
5.	Ear canal stenosis	3	12%	1	4%
6.	Recurrence of cholesteatoma	1	4%	1	4%
7.	Residual cholesteatoma	0	0%	0	0%

Discussion

The obliteration of the mastoid cavities results in less surface for epithelialization to occur. Thus, these cavities epithelize quickly and easily, with the possibility of minor cavity granulations. The bone exposed after mastoidectomy can provide the perfect environment for the development of infection.⁵ If the bare bony wall is carpeted and covered with any obliteration agent than this process of getting infection is decreased. So, by performing mastoid-cavity obliteration, we could have positive outcomes for cavity-related issues and have shorter mean healing times in MRM with obliteration of the mastoid cavity compared to MRM without obliteration of the mastoid cavities.⁶

The bare bony walls of mastoid cavity secrete tissue fluids, which may prove a potential site for infection to set in. By meticulous and effective cavity obliteration we can minimise this possibility and can have dry cavities which remain uninfected. In our study we achieved the same results by obliteration with pedicled flap. We observed that the cavities started becoming dry faster by 56% at 3 weeks in the group 2 cases with obliteration of cavities compared to the 28% dry cavities in the open cavities of group 1. At the end of 6 months 96% of cavities were dry in group 2 whereas only 88% of cavities were dry in the group 1 cases. Other researcher also observed similar results by obliterating the cavities with different materials.^{7,8,9} We could attribute this as a key factor in having quality of life benefit to patients.¹⁰

One of the primary concerns of patients who develop an open cavity following surgery is that sometimes, they suffer episodes of vertigo due to the exposed lateral semicircular canal. For this reason, the majority of them are advised to refrain from swimming in order to avoid vertigo. However, for those who have an obliterated mastoid cavity, the lateral canal is protected because of the smaller exposed area of the cavity, which results in fewer instances of vertigo episodes. Our study results also suggested that the giddiness was absent in Group 2 cases throughout the follow-up who had obliterated cavities. Even though it was present in Group 1 patients (12% patients within three weeks) and that also improved

with time (in only 8% of patients at the end of six months) due to ongoing healing of the open cavity, we could not document a difference in two groups which would have been statistically significant. But there are other researchers who documented benefits of obliteration of cavity in terms of post-operative giddiness.¹¹

The most commonly used and most popular procedures for mastoid cavity obliteration consist of either locally-placed flaps (muscle, periosteum, or fascia) or free antillogous grafts (bone fascia, cartilage, fat) or alloplastic grafts (hydroxyapatite silicon, hydroxyapatite, synthetic bones, and many more).¹² When vascular flaps are used for obliterating the mastoid cavity, the lining gets the nutrients and vascularity, which is believed to fade away after surgery since the neo-cavity is smoothed by the burr used for polishing and the epithelial growth is reduced. In the aftermath of obliteration of the cavity, the size of the cavity gets decreased, and the lining process is enhanced if the pedicled graft has been utilized. This is the fact, which we attribute to the speedy epithelisation of mastoid cavity in our study.

The accumulation of wax is among the most frequently encountered and complex postoperative problems for patients who undergo a canal wall down mastoidectomy.¹³ A large, deep cavity with a small meatoplasty can cause problems for the debris to be cleaned out of the cavity. Patients have to have their mastoid cavities cleaned up routinely. When performing a Canal Wall Down procedure, attempts are made to ensure that the cavity is left to self-clean. One method to accomplish this is to shrink the size of the cavity, making it less susceptible to granulations and is more likely to retain its epithelial migratory capacity and be able to self-clean. In our study, wax formation was evident in 12 percent of patients after 3 months and in 20 percent of patients after 6 months of the group 1. Just 4% of patients in group 2 were seen with wax formation that too at the end of the 6 the month. Other studies where cavities that were obliterated were compared to open cavities with regard to the formation of wax, also showed significant reduction in the presence of wax in ear canals where obliteration was performed.^{7,14}

It is a truth that fitting aid to hear into a larger cavity

is a challenging and unsatisfactory job. Patients with open cavities face the fate of a poor rehabilitation experience with the help of hearing aids. However, patients with obliterated smaller cavities may benefit more significantly from hearing aid rehabilitation.¹⁵ In our study, we observed that those who were treated for mastoid obliteration showed superior outcomes in terms of hearing improvement. With all these advantages substantiated by evidence, it is safe to conclude that cavity obliteration can be beneficial in post-operative discharge, wax formation, giddiness, and improvement in hearing. There are several concerns about the obliteration of cavities, such as how it may entrap residual disease or cause a recurrence (that might not be noticed). Still, after careful disease clearance, we recommend that cavity obliteration has more advantages than risks of any kind. Research has limited evidence in determining the most appropriate obliteration material due to the absence of comprehensive studies. This opens the door for researchers to pursue future studies with a lengthy following and a more robust research setting to investigate the use of biological and synthetic materials in mastoid obliteration.¹⁶ Our study is an effort to contribute to this direction.

Although we have tried our best to compare the two modalities and draw conclusions through this study in a limited period at the same time, we acknowledge the certain limitations of this study like small sample size and short follow-up. In a large sample-sized study, we can make comparable groups (cavity obliteration and open cavity) after age and gender matching, which our study could not do.

Conclusion

Since the results are statistically significant (favouring mastoid cavity obliteration) in early post-operative period only and the long-term results between the two groups are comparable. Through this study, we want to conclude that mastoid cavity obliteration with vascularised periosteal-temporofascial swing flap with medicated bone dust is a good and effective method for better outcome in terms of postoperative discharge, giddiness, and wax

formation besides promoting early cavity epithelisation with improved hearing outcomes. With this method, it is possible to decrease the load on ENT OPD services (in terms of early frequent post-operative follow up visits) since the cavities will require less dependency on doctors, that too for a shorter period of time.

Acknowledgement

Authors acknowledge and thanks Dr. Nandita Nath, Dr. Tinku Moni Borah and Dr. Taba Nitin for their valuable help and support in conducting this study.

References

1. Sharma K, Manjari M, Salaria N. Middle Ear Cleft in Chronic Otitis Media: A Clinicohistopathological Study. *Indian Journal of Otolaryngology and Head and Neck Surgery* 2011; 65(S3):493-7
2. Saleem M, Wajid S. Post-operative Complications of Patients Underwent Mastoidectomy at Tertiary Care Hospital. *Pakistan Journal of Medical and Health Sciences* 2021; 15(6):1394-6
3. Mendlovic M, Monroy Llaguno D, Schobert Capetillo I, Cisneros Lesser J. Mastoid obliteration and reconstruction techniques: A review of the literature. *Journal of Otology* 2021; 16(3):178-84
4. Kim C, Oh J, Choi K, Park S, Park M. A technique for concurrent procedure of mastoid obliteration and meatoplasty after canal wall down mastoidectomy. *Auris Nasus Larynx* 2012; 39(6):557-61
5. Kennedy K, Lin J. Mastoidectomy [Internet]. *Ncbi.nlm.nih.gov*. 2021 [cited 5 December 2021]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK559153/>
6. Tulachan B, Swar R, Borgohain BN. Comparison of Healing Time Following Modified Radical Mastoidectomy with or without Mastoid Cavity Obliteration. *Glob J Oto*. 2018; 15(5): 555921. DOI: 10.19080/GJO.2018.15.555921
7. Chhapola S, Matta I. Mastoid Obliteration Versus Open Cavity: A Comparative Study. *Indian Journal of Otolaryngology and Head and Neck Surgery* 2012; 66(S1):207-13
8. Singh M, Jain S, Rajput R, Khatua R, Sharma D. Retrospective and Prospective Study of Singapore Swing Method on Healing of Mastoid Cavity. *Indian Journal of Otolaryngology and Head and Neck Surgery* 2010; 62(4):365-71
9. Sanjay Kumar K, Indra T, Vignesh S, Sheeba AB. Surgical Outcome of Mastoid Cavity Obliteration with Bone Dust versus Open Cavity in Canal Wall down Mastoidectomy - A

- Comparitive Study. IOSR Journal of Dental and Medical Sciences 2018; 17(5):5-10
10. Deshmukh S, Sharma A, Dabholkar J. Mastoid cavity obliteration: Our experience. *Otolaryngologia Polska* 2012; 66(6):379-81
 11. Kurien G, Greeff K, Gooma N, Ho A. Mastoidectomy and mastoid obliteration with autologous bone graft: a quality of life study. *Journal of Otolaryngology - Head and Neck Surgery* 2013; 42(1)49. doi: 10.1186/1916-0216-42-49
 12. Mehta R, Harris J. Mastoid Obliteration. *Otolaryngologic Clinics of North America* 2006; 39(6):1129-42
 13. Saraf A, Ahmad R, Jyoti D, Kalsotra P. Postoperative mastoid cavity problems: a tertiary care centre experience. *International Journal of Otorhinolaryngology and Head and Neck Surgery* 2020; 6(8):1500
 14. Sharma V, Koirala KP, Sathian B. Pediatric Modified Radical Mastoidectomy: Open Cavity versus Periosteal-Temporofascial Flap Obliteration: An Analysis. *American Journal of Public Health Research* 2015; 3(5A):174-7
 15. Geerse S, Bost T, Allagul S, de Wolf M, Ebbens F, van Spronsen E. Hearing and hearing rehabilitation after obliteration of troublesome mastoid cavities. *European Archives of Oto-Rhino-Laryngology* 2020; 277(12):3307-13
 16. Skoulakis C, Koltsidopoulos P, Iyer A, Kontorinis G. Mastoid Obliteration with Synthetic Materials: A Review of the Literature. *The Journal of International Advanced Otology* 2019; 15(3):400-4.