

Comparative Evaluation of Mastoid Cavity Obliteration by Vascularised Temporalis Myofascial Flap and Deep Temporal Fascial-Periosteal Flap in Canal Wall Down Mastoidectomy

NAVJOT KAUR¹, DINESH KUMAR SHARMA², JAGDEEPAK SINGH³

ABSTRACT

Introduction: A consensus is emerging amongst otologists that obliteration of the mastoid cavity that results after modified radical mastoidectomy is a sound option to prevent cavity related problems such as otorrhoea, infection, granulation tissue and hearing loss. A variety of techniques have been proposed to perform the obliteration.

Aim: The present study aimed to compare the conventional method of mastoid cavity obliteration by vascularised temporalis myofascial flap with deep temporal fascial-periosteal flap in canal wall down mastoidectomy.

Materials and Methods: The prospective study (conducted between July 2012 and August 2013) randomly assigned patients with evidence of attico-antral disease to two groups (20 in each group). After canal wall down mastoidectomy, a superior based

vascularised temporalis myofascial flap was used to obliterate the resultant mastoid cavity in group 1 patients and an inferior based deep temporal fascial-periosteal flap was used in group 2 patients for the cavity obliteration. They were then followed up till day 90.

Results: Cavity obliteration was better in group 2 (90%) as compared to group 1 (80%). Similarly, the final status of epithelisation of cavity at 90th day was clinically superior in patients of group 2 (85%) as compared to group 1 (75%). However, these difference were not statistically significant.

Conclusion: The clinical superiority of the results with temporal fascial-periosteal flap can be attributed to less frequent complications (partial obliteration and epithelisation of resultant mastoid cavities, residual perforation and persistent ear discharge) as compared to myofascial flap.

Keywords: Antrostomy, Mastoid infection, Obliteration

INTRODUCTION

Though mastoid infection has for centuries been a dreaded affliction, but still only few surgical procedures can rival the efficiency of modern mastoidectomy as a life-saving procedure. It did not become part of otological practice until about 1870. A new era for mastoidectomy was inaugurated by Sir William Wilde with his introduction of the eponymous retro auricular incision that was the first step towards modern mastoidectomy. Initially, simple mastoidectomy or antrostomy was considered to be adequate for acute mastoiditis until radical mastoidectomy was developed as a major procedure for cases of chronic otitis or acute cases presenting with intracranial complications [1].

A consensus is emerging amongst otologists that obliteration of the mastoid cavity that results after modified radical mastoidectomy is a sound option to prevent cavity related problems such as otorrhoea, infection, granulation tissue and hearing loss. A number of materials have been used to fill the cavity. These include fat, cartilage, bone, dust, variety of flaps (myofascial and fascial-periosteal flap), hydroxyapatite and bio-active glass [2].

However, a variety of techniques have been proposed to perform the obliteration. Amongst these, use of myofascial flaps is the most commonly used method but shrinking of the flap during healing period tends to take away most benefits of obliteration. The other advantages are the pliability of the flap which enables the flap to adjust in all corners of the mastoid cavity, good vascular supply leading to better healing of the cavity, see-through character which would enable early detection of recurrence [3]. Also, the procedure is simple and only requires extension of post auricular incision, with

hardly ten minutes of extra-time required as compared to the routine non-obliteration surgery [4].

A new technique which uses a deep temporal fascial-periosteal flap has been tried and is credited with much less shrinking during the healing period. In addition to reducing the cavity volume, this flap is said to promote the epithelialization over the bone and shortening of the healing time.

The present study was aimed to compare the conventional method of mastoid cavity obliteration by vascularised temporalis myofascial flap with deep temporal fascial-periosteal flap in canal wall down mastoidectomy.

MATERIALS AND METHODS

The study was conducted between July 2012 and August 2013 and comprised of 40 patients of either sex in the age group of 0-60 years (20 in each group). These patients with evidence of attico-antral type of pathology in the middle ear cleft were randomly selected and admitted to the Ear, Nose and Throat Ward of Ram Lal Eye and ENT Hospital, Amritsar. The patients for the study were selected on the basis of the following criteria:

1. Patients of either sex less than 60 years of age.
2. Patients having good general physical condition.
3. All the patients with active chronic otitis media; squamous type who required canal wall down mastoidectomy were selected.
4. Patients not having any evidence of active infection in nose, throat or para-nasal sinuses.

5. Patients with otogenic intra-cranial complications in the past were excluded from the study [5].

Thorough clinical, audiological, radiological and laboratory examinations were performed for all the patients. Pre-anaesthetic check-up was performed to ascertain their fitness for surgery under general anaesthesia. All the patients were subjected to pure-tone audiometry in order to assess the degree of hearing loss in the ear to be operated, know the nature of the hearing loss, assess the cochlear reserve and to evaluate the hearing of the opposite ear.

To ensure random distribution of patients in the two groups we used the lottery method. We put 40 folded pieces of paper mentioning the names of the two techniques of surgery in equal number in a bowl and thoroughly mixed them up. Then each patient was subsequently allotted one slip from the jar after vigorously shaking the jar each time and then set that piece of paper aside rather than putting it back into the bowl, so that we get equal number of patients (i.e., 20) in the two groups.

Then, modified radical mastoidectomy was performed in all the patients via the post-aural approach. The disease from the middle ear cleft was removed, usually preserving the ossicles if they were not surrounded by cholesteatoma. All the diseased air-cells from the middle ear cleft were exenterated and it marked the completion of the first stage of the operation. Different type of tympanoplasties was done in the same stage depending on the status of ossicles. and osiculoplasty was reserved for the 2nd stage if required. Sade's classification was used to classify the resultant mastoid cavity after canal wall down mastoidectomy. In patients with extensive disease these cavities were large (> 2ml in size). Small (< 1ml) and Medium (1-2ml); cavities were almost evenly divided [6]. Till this step the procedure adopted was same in all the patients.

Technique of Surgery

In group 1 patients, a superior based vascularised temporalis myofascial flap was used to obliterate the resultant mastoid cavity. In group 2 patients, an inferior based deep temporal fascial-periosteal flap was used for the obliteration.

The post-aural incision was extended superiorly so as to expose the temporalis muscle covered with the temporalis fascia. The superficial temporal artery was identified by palpation. An approximately 5cm long myofascial flap was dissected out based anteriorly on the artery. The flap was rotated into the middle ear cavity so as to obliterate the mastoid cavity with the muscle inside and the fascia facing outside. An edge of the fascia was advanced over the middle ear space so as to form the tympanic membrane graft. A piece of gel foam was used to mark the position of the external auditory meatus, around which the myofascial flap was positioned. Adequate meatoplasty was done. Finally the external auditory canal was packed with ointment pack. The post-auricular incision was closed in layers after completion of homeostasis. A bulky pressure dressing was applied.

In patients allotted group 2, an inferiorly based 5cm long flap comprising of deep temporal fascia and underlying periosteum was carved out and elevated. The periosteum anterior to incision line was elevated and forwarded as far as the lateral end of the posterior bony meatal wall and upwards to the level of the upper attachment of the pinna. All bleeding points were secured and a self-retaining retractor inserted. It was followed by the bone work. After the extenteration of the entire disease, 5cm long temporal fascial-periosteal pedicled flap was used to obliterate the mastoid cavity up to the point of forming a tympanic membrane graft. A piece of gel foam was used to mark the position of the external auditory meatus, around which the flap was positioned. Adequate meatoplasty was done.

Post-operatively antibiotics, analgesic and anti-histaminics were given along with wound care. All patients were followed in the outpatient department on 7th, 15th, 30th and 90th post-operative day.

During the follow-up visits, the status of the obliteration of mastoid cavity, the progress of epithelisation, persistence or cessation of ear discharge and any cavity related problems were specifically looked for.

A repeat audiogram was also performed on 90th day for assessment of hearing. The observations were carefully entered in MS excel format and the data so obtained was collected and analysed using parametric tests like paired t-test, unpaired t-test and non-parametric tests like chi-square test (with the help of SPSS version 17.0). The level of significance was determined and p-value of <0.05 was taken as statistically significant.

RESULTS

In the present study, 57.5% patients were 20 years or less in age. The youngest patient was eight-year-old and oldest patient was 60-year-old of age with male predominance amongst the patients included in the present study (65% males and 35% females). In almost three-fourth patients, the symptoms of the disease were experienced for ten years or less.

Most of the patients had a unilateral disease. Only three patients (7.5%) had bilateral disease. Right ear was involved in 42.5% and left ear in 50% patients. Most of the patients had more than one finding on otoscopic examination. [Table/Fig-1] shows erosion of outer attic wall and retraction pockets being the most common followed by central perforation. The most common additional finding on otoscopic examination was visible cholesteatomatous flakes [Table/Fig-2]. Other findings seen were granulations in external auditory canal and aural polyp. In most of the patients the radiological examination showed sclerotic mastoids. Lytic areas were seen only in three patients.

Otosopic finding	Group 1 (n=20)	Group 2 (n=20)	Total
Central perforation	6 (30.0%)	3 (15.0%)	9 (22.5%)
Marginal perforation	1 (5.0%)	5 (25.0%)	6 (15.0%)
Outer attic wall erosion	9 (45.0%)	7 (35.0%)	16 (40.0%)
Retraction pocket	3 (15.0%)	14 (70.0%)	17 (42.5%)

[Table/Fig-1]: Otoscopic findings of the patients enrolled for the study. $\chi^2 = 9.36$; df= 3 & p- value<0.05(significant)

Findings	Group 1 (n=20)	Group 2 (n=20)	Total
Cholesteatoma	8 (40.0%)	9 (45.0%)	17 (42.50%)
Granulations	1 (5.0%)	3 (15.0%)	4 (10.0%)
Aural polyp	4 (20.0%)	0 (0.0%)	4 (10.0%)
Postero-superior meatal wall erosion	2 (10.0%)	0 (0.0%)	2 (5.0%)
Cavity and middle ear epidermisation	1 (5.0%)	0 (0.0%)	1 (2.5%)
Debris	2 (10.0%)	0 (0.0%)	2 (5.0%)

[Table/Fig-2]: Additional otoscopic findings seen in the patients enrolled for the study.

The first surgical step in all patients of this study was modified radical mastoidectomy to exenterate the disease in its entirety from middle ear cleft. There was a varied involvement [Table/Fig-3] of various regions of Middle Ear Cleft (MEC) such as mastoid antrum, aditus, epitympanum, mesotympanum or hypotympanum by the two entities (i.e., cholesteatoma and chronic granulation tissue) which were also the most common pathological entities encountered pre-operatively in patients with clinical evidence of attico-antral disease. These two entities may be present alone or in conjunction with the other. Mastoid cavities formed after canal wall down mastoidectomy surgeries were divided into 3 categories using sade's classification [6] as depicted in [Table/Fig-4].

At 30 day follow-up, most of the patients had a wide and patent external auditory canal. None of the patients in both the groups developed any signs indicating flap necrosis [Table/Fig-5]. A comparative chart of the findings amongst patients of group 1 and

Type of pathology	Mastoid antrum	Aditus	Epi	up	up	up	up
Cholesteatoma	55.0%	67.5%	55.0%	15.0%	---	25.0%	25.0%
Granulations	35.0%	27.5%	27.5%	35.0%	2.5%	37.5%	35.0%
Both	10.0%	05.0%	17.5%	12.5%	---	---	---
None	---	---	---	37.5%	97.5%	37.5%	40.0%

[Table/Fig-3]: Intra-operative evaluation of the type of pathology in the middle ear cleft.

Cavity size	Small (< 1 ml)	Medium (1-2ml)	Large (>2ml)	Total
Group 1 (n=20)	2 (10%)	7 (35%)	11(55%)	20 (100%)
Group 2 (n=20)	9 (45%)	2 (10%)	9 (45%)	20 (100%)
Total	11(27.5%)	9 (22.5%)	20 (50%)	40 (100%)

[Table/Fig-4]: Intra-operative findings-cavity size based on Sade's classification. $\chi^2 = 7.43$; df = 2 & p value> 0.05(non- significant)

	Group 1 (n=20)	Group 2 (n=20)
Discharge	2(10%)	2(10%)
Epithelization	20(100%)	20(100%)
EAC stenosis	1(5%)	1(5%)
Miscellaneous	7(35%)	1(5%)

[Table/Fig-5]: Post-operative findings on day 30.*
* multiple findings could be present in 1 patient

group 2 at completion of 90 day follow-up [Table/Fig-6] showed that, five patients (25%) of group 1 and two patients (10%) of group 2 continued to have ear discharge due to chronic granulation tissue in external auditory canal which was further treated by chemical cauterisation with 50% Trichloro-Acetic. Four patients belonging to group 1 and two from group 2 had residual perforations due to graft failure.

The resultant mastoid cavities after canal wall down mastoidectomy depicted that 55% patients in group 1 and 45% patients in group 2 had large cavities i.e., more than 2ml in volume (as per Sade's classification [6]). [Table/Fig-7] compares the size of resultant cavity at the end of canal wall down mastoidectomy with status of cavity obliteration and their epithelization at the completion of 90 day follow-up exhibited 16 patients (80%) in group 1 and 18 patients (90%) in group 2 with complete obliteration of the resultant mastoid cavities.

However, four patients (20%) in group 1 and two patients in group 2 did not have complete obliteration and had resultant residual cavities. When the size of resultant cavities was compared with results of their obliteration, it was found that all these patients had large cavities. The final result of complete cavity obliteration was better in group 2 (90%) as compared to group 1 (80%) although this difference was not statistically significant ($p > 0.05$). Similarly the final status of epithelisation of cavity at 90th day was clinically superior in patients of group 2 (85%) as compared to group 1 (75%). However, this difference was not statistically significant. Two patients from group 1 and one patient from group 2 (total 7.5%) developed stenosis of the external auditory canal due to insufficient meatoplasty.

Findings	Ear discharge		Residual perforation		Cavity epithelization		Status of obliteration		EAC	
	Present	Absent	Present	Absent	Partial	Complete	Partial	Complete	Stenosis	Wide
Group 1 (n=20)	25.0%	75.0%	20.0%	80.0%	25.0%	75.0%	20.0%	80.0%	10.0%	90.0%
Group 2 (n=20)	10.0%	90.0%	10.0%	90.0%	15.0%	85.0%	10.0%	90.0%	5.0%	95.0%
p-value	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05				

[Table/Fig-6]: Post-operative otoscopic findings on day 90.

Per operative Cavity Size	Group 1	Group 2	Status of Cavity Obliteration	Group 1	Group 2	Epithelization	Group 1	Group 2
Small	10%	45%	Partial	20%	10%	Partial	25%	15%
Medium	35%	10%	Complete	80%	90%	Complete	75%	85%
Large	55%	45%						

[Table/Fig-7]: Comparison of the per-operative cavity size, status of cavity obliteration and Epithelization at day 90 between the two groups.

DISCUSSION

The present study comprised of 40 patients of either sex in the age group of 0-60 years with evidence of attico-antral type of pathology in the middle ear cleft. The socio demographic features were similar to some other studies that examined the attico-antral disease in Indian population [7,8]. Intra-operative findings of cholesteatoma and granulations as the most common pathologies seen were similar to other studies [4,7].

When the size of resultant cavities was compared with results of their obliteration, it was found that all these patients had large cavities. The final result of complete cavity obliteration was better in group 2 (90%) as compared to group 1 (80%), although this difference was not statistically significant. Similarly, the final status of epithelization of cavity at 90th day was clinically superior though clinically non-significant ($p < 0.05$) in patients of group 2 (85%) as compared to group 1 (75%). The obliteration of the mastoid cavity works on the principle that the mastoid cavity lining after the surgery has to derive its nutrition from bare bone of the mastoid cavity, vascularity of which is especially reduced due to the practice of smoothing of the cavity with the polishing burr at the end and thereby compromising the epithelial regeneration [4]. By obliteration of the mastoid cavity, the size of the mastoid cavity is reduced and the lining process is hastened if the pedicled graft is used [3]. Another study used a similar post-auricular periosteal-pericranial flap for mastoid obliteration after canal wall down tympanomastoidectomy and the primary outcome measure was control of suppuration and creation of a dry, low-maintenance mastoid cavity (82%), assessed using a previously developed semi-quantitative scale [9].

The use of deep temporal fascial-periosteal flap for canal wall down mastoidectomy is a simple technique that uses a post-auricular, inferiorly based pedicled flap. Although the deep temporalis fascial-periosteal flap is not bulky, it is large enough to obliterate a sclerotic mastoid cavity without the need for additional flaps. It shrinks much less than a muscular flap during the healing period. In addition to reducing the cavity volume, this flap promotes the epithelialization over the bone and the shortening of the healing time. The initial study attempted this technique in five patients and followed them up for 1-6 months. The authors of the study concluded that coverage of a canal wall down mastoid cavity by a deep temporalis fascial-periosteal flap is expected to be a reliable and effective technique that results in a dry, trouble-free mastoid cavity [10].

The use of inferiorly based deep temporal fascial-periosteal flap in present study resulted in 90% completely obliterated, 85% completely epithelized and 90% dry cavities at the completion of 90 day follow-up. In 95% cases, the procedure resulted in a wide

external auditory canal and there was no residual perforation in 90% cases. These results are consistent with similar studies.

In the present study, at 90 day follow-up in group 1, 80% patients had completely obliterated mastoid cavity, in 75% patients these cavities were epithelized and dry. There was no residual perforation in 80% patients and 90% patients had a wide external auditory canal. Although the 90 day follow-up results are clinically better in patients of group 2 as compared to those of group 1 these are not statistically significant ($p > 0.05$). The relatively inferior results in group 1 patients of this study could be attributed to shrinkage of muscle size due to disuse atrophy, resulting in more patients with partial obliteration and epithelization of resultant mastoid cavities, residual perforation and persistent ear discharge.

LIMITATION

The study has certain limitations because of the fact that it was a time bound study. A bigger sample size could give more consistent results. Comparison of the outcome of the two procedures in different age groups by using stratified sampling strategy could not be done in the study due to the small sample size.

CONCLUSION

Thus, the results of this study indicate that use of both deep temporal fascial-periosteal flap and superior based vascularised temporalis myofascial flap results in an obliterated, well epithelized, non-discharging cavities, wide external auditory canals and healed drums in most of the cases. Temporalis muscle flap is a very reliable technique with low complication rates and few donor site problems like shrinkage in the size of the muscle due to disuse atrophy. On the other hand, fascial-periosteal flap has some advantages over

the muscle based flap, as it shrinks less, large enough to obliterate a mastoid cavity, less bulky, promotes the epithelialization over the bone and decrease the healing time.

The results point towards a clinical superiority of the fascial-periosteal flap over the muscle based flap, however no statistically significant difference occurred in the various parameters used to assess the results. The outcome as far as hearing impairment is concerned; the results of both the techniques are comparable. The incidence of complications such as meatal stenosis is also similar.

REFERENCES

- [1] Bento RF, Fonseca ACDO. A brief history of mastoidectomy. *Int Arch Otorhinolaryngol*. 2013;17(2):168-78.
- [2] Shokry S, Al'Sayed AH, Zidan MF, Hafez AA, Abdulsalam HM. Avoiding mastoid cavity problems: Mastoid obliteration using bio-active glass. *The Egyptian Journal of Hospital Medicine*. 2012;47:321-33.
- [3] Chhapola S, Matta I. Mastoid obliteration versus open cavity: A comparative study. *Indian J Otolaryngol Head Neck Surg*. 2014;66(Suppl 1):207-13.
- [4] Wadhwa V, Anand TS, Kumar S, Kathria G, Rana I. Periosteal-temporofascial flap for cavity obliteration-first indian study. *Indian J Otolaryngol Head Neck Surg*. 2003;55(3):170-74.
- [5] Shea MC, Gardner G. Mastoid obliteration using homograft bone. *Arch Otolaryngol*. 1970;92:358-65.
- [6] Sade J, Konak S, Hinchcliffe R. Cholesteatoma and mastoid surgery. Proceedings of 2nd International Conference. Tel-Aviv, Israel. *Kugler Publications*;1982:640.
- [7] Jothiramalingam SB, Kumar D, Kumar P, Sasindran V, Kumar N. Atticoantral disease- revisited. *Indian J Otolaryngol Head Neck Surg*. 2007;59(3):203-06.
- [8] Rout MR, Mohanty D, Vijaylaxmi Y, Kamalesh B, Chakradhar M. Prevalence of cholesteatoma in chronic suppurative otitis media with central perforation. *Indian J Otol*. 2012;18:7-10.
- [9] Ramsey MJ, Merchant SN, McKenna MJ. Postauricular periosteal-pericranial flap for mastoid obliteration and canal wall down tympanomastoidectomy. *Otol Neurotol*. 2004;25 (6):873-78.
- [10] Lee DH, Jun BC, Jung SH, Song CE. Deep temporal fascial-periosteal flap for canal wall down mastoidectomy. *Laryngoscope*. 2006;116:2229-31.

PARTICULARS OF CONTRIBUTORS:

1. Senior Resident, Department of ENT and HNS, Post Graduate Institute of Medical Education and Research, Chandigarh, India.
2. Associate Professor, Department of ENT, Government Medical College, Amritsar, Punjab, India.
3. Professor, Department of ENT, Government Medical College, Amritsar, Punjab, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Navjot Kaur,
H. No. 517, Sector 69, Mohali, Punjab-160062, India.
E-mail: navjot517@gmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **May 18, 2016**
Date of Peer Review: **Aug 05, 2016**
Date of Acceptance: **Sep 12, 2016**
Date of Publishing: **Dec 01, 2016**