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ORIGINAL RESEARCH

To assess surgical outcome of mastoid cavity obliteration with postauricular soft tissue in canal wall down mastoidectomy

[1]Dr. Justin Sebastian, [2]Dr. R.N.Karadi, [3]Dr. H.T Lathadevi, [4]Dr. Shashikumar T

[1]Final Year Post Graduate, [2]Professor, [3]Professor, [4]Assistant Professor, Department of Otorhinolaryngology, BLDEDU, Shri B.M Patil Medical College Hospital and Research Centre, Vijayapura, Karnataka, India

Corresponding Author
Dr.Shashikumar T
Assistant professor, Department of Otorhinolaryngology, BLDEDU, Shri B.M Patil Medical College Hospital and Research Centre, Vijayapura, Karnataka, India
Email:dr.shashikumart@gmail.com.

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ABSTRACT

Introduction: Chronic Suppurative Otitis Media (CSOM) is a common ear condition in India and many other parts of the world. The incidence of CSOM is estimated at more than 20 million people worldwide. It is characterized by chronic middle ear and mastoid cavity inflammation, typically leading to persistent ear discharge and hearing loss. mastoid cavity obliteration with postauricular soft tissue in canal wall down (CWD) mastoidectomy is likely to see several advancements and refinements aimed at improving patient outcomes, surgical efficiency, and overall healthcare effectiveness, especially with Minimally Invasive Approaches.**Objectives:** The objectives of the study were to evaluate the surgical outcomes of mastoid cavity obliterationusingpostauricular soft tissue in patients undergoing CWD mastoidectomy for CSOM with cholesteatoma.**Methods:** The study was a hospital-based prospective study with a sample size of 48 subjects, divided into case and control groups. The primary outcome measure was the creation of a dry, infection-free, low-maintenance mastoid cavity as assessed by a grading system developed by Merchant et al.The study used a cohort of patients undergoing CWDM for CSOM with cholesteatoma, with postauricular soft tissue used to obliterate the mastoid cavity. Patients were evaluated for ear discharge and epithelialization at 15, 45, and 90 days post-surgery using the Merchant et al grading system for otorrhea.**Results:** The study found that 50% of the case group subjects had no or minimal ear discharge on day 15, compared to 20% in the control group. At day 45, 79% of case group subjects attained grade 0 ear discharge, while only 50% of control group subjects did.At day 90 the study revealed that 87% of subjects had no discharge, while only 66% of control had no discharge.The study found that 33% of subjects in the case group had epithelialisation by day 15, while only 24% attained epithelisation by day 15 in the control group. By day 45, 63% of subjects in the case group had fully formed epithelial tissue, compared to 38% in the control group.At day 90, 88% of subjects have fully formed epithelial tissue over the surgical site in the case group 54% in the control group**.** The study found that the use of postauricular soft tissue in CWD mastoidectomy leads to better surgical outcomes, including reduced ear discharge, faster healing, and improved epithelial tissue formation. **Conclusions**: The study concludes that the use of postauricular soft tissue for mastoid cavity obliteration in CWD mastoidectomy leads to better outcomes, including faster healing, less discharge, and improved epithelialization.

Keywords: Mastoidectomy, canal wall down mastoidectomy, CWD Mastoidectomy, Chronic Suppurative Otitis Media, CSOM, cholesteatoma, Mastoid Cavity obliteration, Post Auricular soft tissuegraft.

INTRODUCTION

Chronic Suppurative Otitis Media (CSOM) is a common ear condition in India and many other parts of the world. The incidence of CSOM is estimated at more than 20 million people worldwide. It is characterized by chronic middle ear and mastoid cavity inflammation, typically leading to persistent ear discharge and hearing loss. CSOM has two distinct types, benign or tubo-tympanic, which causes a persistent central perforation and mainly affects the anterior inferior portion of the middle ear cleft. People with this kind of CSOM do not typically have severe consequences despite this symptom. However, because it affects both the attic and posterosuperior areas of the middle ear, the second classification, known as the malignant or attico-antral type, is sometimes referred to as the “unsafe” type and poses a severe risk to the health of those who are affected [1].

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Surgery is the mainstay for the attico-antral type of CSOM. For the past 150 years, the open mastoidectomy approach has been the cornerstone of the care of cholesteatoma. It has a long and renowned history. Open cavity procedures can be broadly defined as those requiring the removal of the posterior wall of the external auditory canal. These operations go by several. Names, including Bondy mastoidectomy, radical mastoidectomy, modified radical mastoidectomy, and canal wall down mastoidectomy, depending on how the middle ear and the disease are managed [2]. The purpose of the open cavity procedure is to exteriorize the mastoid cavity for future monitoring of recurrent cholesteatoma, provide drainage for unresectable temporal bone infection, and occasionally offer exposure for difficult-to-access areas of the temporal bone [3].

The concept of mastoid obliteration was first introduced in 1911 by Mosher to promote the healing of a mastoidectomy cavity defect. Over the years, numerous reports have detailed various techniques for obliterating the mastoid cavity. Most obliteration techniques consist of local flaps (muscle, periosteum, or fascia) or free grafts (bone, cartilage, hydroxyapatite, and so on). Mosher's original description was that of a superiorly based postauricular soft tissue flap [4].

Mastoid reconstruction and obliteration procedures can be classified into two main categories: a) Free grafts, further subdivided into biologic and non-biologic. b) Local flaps. Free Grafts: After a Canal Wall Down mastoidectomy (CWDM) , the mastoid cavity can be filled with cartilage, fat, fascia, allogenous or autogenous bone chips, and cortical bone pate, among other biologic techniques. Free Grafts: Non-biologic techniques for reconstructing or filling the canal wall after CWDM include bioactive glass ceramics, hydroxyapatite crystals, and ceramic granules of calcium phosphate. Several different flap types were used, such as the inferiorly based fascial periosteal flap, postauricular myocutaneous flap, pedicled superficial temporalis fascial flap, middle temporal artery flap, Hong Kong flap, Temporoparietal Fascial Flap (TPFF), and temporalis muscle flap [5].

When treating persistent otitis media, canal wall down mastoidectomy is the most common reason to consider mastoid obliteration. A mastoid cavity can also cause frequent cleaning, trouble using a hearing aid, water intolerance because of an increased risk of infection, and a tendency to become dizzy when exposed to caloric stimuli like water or warm/cold air. It is recommended to obliterate the mastoid cavity to decrease the cavity's size and cavity problems; the best time to perform it is during a canal wall-down mastoidectomy as a primary surgery. Thus, to manage the attico-antral type of CSOM, we need to investigate the outcomes and advantages of this process [6].

MATERIALS AND METHODS

Study Population

A total of 48 subjects (24 Case Group + 24 Control Group) who met the inclusion criteria below were included in the study.

Inclusion Criteria: All Chronic Suppurative Otitis Media (CSOM) cases with cholesteatoma, Subjects of CSOM with extensive granulations.

Exclusion Criteria: Known Chronic Suppurative Otitis Media (CSOM) cases with intracranial complications and Tubercular otitis media

Study Tools and Data Collection

Subjects who met the inclusion criteria, were evaluated in the out Patient department, and a detailed history was taken before enrolling in the study. Later, the subjects were randomly grouped into case and control groups. Following randomization, the case group will undergo canal wall down mastoidectomy (CWDM) with mastoid cavity obliteration, and the control group will undergo canal wall down mastoidectomy (CWDM) without mastoid cavity obliteration. Later, both groups will be evaluated for ear discharge and epithelialization on days 15, 45 and 90 post-surgery. The ear discharge is evaluated using Merchant grading [7].

The sample size was calculated with the anticipated proportion of postoperative Epithelization between CSOM with cholesteatoma cases and control 40 % and 4% (ref) resp. The study would require a sample size of 24 per group. (a total sample size of 48 assuming equal group sizes), to achieve a power of 85% for detecting a difference in proportions between two groups at a two-sided p-value of 0.05. using G* power software 3.1.9.7.

Surgical Procedure

Following GA induction, the ear was cleaned by cleaning the auricle and post-auricular area and using a povidone-iodine solution of normal saline in the ear canal. Then Lignocaine with 1:100000 adrenaline infiltration was given in the postauricular region and the external auditory canal for hemostasis. A postauricular William Wildes incision was made in the postauricular skin crease, and the temporalis fascia graft was harvested. T-shaped incision given mucoperichondrial and mucoperiosteal flap elevated. Post auricular soft tissue graft harvested. A large cutting burr was used to perform a simple mastoidectomy. At this point, the granulations and cholesteatoma occupying the mastoid cavity, attic and middle ear were removed, and the cavity was cauterized. The posterior canal wall was securely removed, and the anterior and posterior buttresses were removed. The facial ridge is reduced, and a thin layer of bone is removed across the vertical segment of the facial nerve. The ossicular chain was examined, and those that were unhealthy were removed.

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Cholesteatoma and granulation tissue from the mastoid cavity, attic and middle ear were done along with saucerization of the mastoid cavity. Following ossicular reconstruction and tympanoplasty, free skin grafting over the fascia and bone and angel foam were kept in situ. The mastoid cavity was now obliterated by extending the post-auricular soft tissue. Following this, meatoplasty was done, haemostasis was achieved, and suturing was done with vicryl 3.0 and ethylene 3.0; later Post post-operatively, each patient was administered antibiotic, analgesic and antihistaminic medication for one week. The ear pack was removed one week after surgery. Patients were discharged on postoperative day seven and were followed up later on days 15, 45 and 90 [8].

Statistical Analysis

The data obtained will be entered in a Microsoft Excel sheet, and statistical analysis will be performed using statistical package for the social sciences (Verson 20). Results will be presented as Mean ±SD,Median and interquartile range, frequency, percentages and diagrams. For normally distributed continuous variables between two groups will be compared using independent t test for not normally distributed variables Mann Whitney U test will be used. Categorical variables between two groups will be compared using Chi square test/Fisher\s Exact test. p value<0.05 will be considered statistically significant. All statistical tests will perform two tailed.

Ethical approval and Informed consent

Complications of surgery in language understandable to the subjects, later a written consent regarding same was obtained. Participants identity and surgical details were kept All participants were informed about the surgical procedure, benefits, risk and confidential. The study was approved by the Ethical Committee of BLDE (Deemed to be University) and granted ethical approval (IEC/707/2022-23) on Friday, 26th August 2022.

RESULTS AND OBSERVATIONS

Out of 48 patients enrolled maximum patients were in between the age group 18-35 years In our study we found that the samples were distributed among 4 age groups, with mean age of 30.4 in case group and 34.7 in control group. Out of 48 patients enrolled in the study 23 (47.9%) were females, 25 (52.1%) were males. In our study, 25 (52%) of the population is comprised of males, with 16 subjects in the case group and 9 in the control group. At the same time, females comprised 23 (48%), with 8 in the case group and 15 in the control group [table 1].

Table 1: Frequency distribution of age in both groups

Gender	Cases	Controls	Total
Female	8 (33.3%)	15(62.5%)	23 (47.9%)
Male	16 (66.7%)	9 (37.5%)	25 (52.1%)
Total	24	24	100.0%

In this study, we examined the ear discharge post day fifteen of surgery under oto-endoscopy, which revealed that in the case group of 12 (50%) of the study population had grade 0 ear discharge, where only 6 (25%) subjects tend to have grade 1, 4(16%) subjects had grade 2 and 2 (8%) subjects had grade 3 ear discharge. Later on, examining the ear discharge on day forty-five, we observed that 19(79%) case subjects were having grade 0 discharge, and out of 6 subjects having previous grade 1 discharge, were reduced to 3, and we see a 75% decline in several subjects in grade 2 category over 30 days. Regarding grade 3, we see a 50% decline in several subjects. On observing the ear discharge status after 90 days, the study revealed that 87% of subjects had no discharge over 90 days, with a major decline in the number of subjects in grade 2 and grade 3 [table 2].

Table 2: Frequency distribution of ear discharge in case group subjects.

CASES	Day 15	Day 45	Day 90
Grade 0	12	19	21
Grade 1	6	3	2
Grade 2	4	1	0
Grade 3	2	1	1
Total	24	24	24

On observing the control group of our study, after 15 days of examination for ear discharge, it was revealed that 5 (20%) of the sample had grade 0 ear discharge, and around 5 (20%) of the sample were in grade 1 and grade 2 categories. When we see the study data, 10 (41%) of the study population has grade 3 ear discharge post 15 days of surgery in the control group. The study revealed that on 45 days and 90 days of ear discharge examination, we found 12 (50%) and 16 (66%) of the case group with grade 0 ear discharge. In this study, we observe that the day 15 ear examination revealed the majority of the sample had grade 3 ear discharge, with the majority of the sample on both day 45 and day 90 having grade 0 ear discharge [table 2].

Table 3: Frequency distribution of ear discharge in case group subjects.

Controls	Day 15	Day 45	Day 90
Grade 0	5	12	16
Grade 1	4	3	4
Grade 2	5	5	2
Grade 3	10	4	2
Total	24	24	24

In this study, we found that eight among 24 (33%) subjects in the case group attained epithelisation by day 15 post-surgery, while 15 (63%) of subjects achieved epithelialization by day 45 and 21 (88%) attained epithelialization by day 90 post-surgery [table 3].

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Table 4: Frequency distribution of epithelialization in case group subjects.

CASES	Day 15	Day 45	Day 90
YES	8	15	21
NO	16	9	3

Among the control group of study, we observe that only one among the 24 (4%) subjects attained epithelisation on day 15 post-surgery, 9 (38%) of control group subjects attained epithelialization by day 45, and only 13 (54%) of subjects attained epithelialization by day 90 [table 4].

Table 5: Frequency distribution of epithelialization in control group subjects.

CONTROLS	Day 15	Day 45	Day 90
YES	1	9	13
NO	23	15	11

In our study, we also evaluated any relationship between age and the outcome of both surgeries; the study revealed that the younger age group had better healing, where 100% of samples in the case group attained grade 0 ear discharge by day 45. Still, the control group took 90 days for the same. When observing the older age group, we see that healing was slow and took longer. When comparing both groups, we observe that the case group showed better and faster healing than the control group.

DISCUSSION

Our study was done on 48 subjects with CSOM, divided equally into case and control groups, with mean ages of 30.4 and 34.7, respectively. The study consisted of 23 females (48%) and 25 males (52%); the study was done over 90 days post-surgery, where the patient was evaluated for discharge and epithelisation post-surgery. Each patient was assessed on days 15, 45 and 90 post-surgery, where ear discharge was assessed using the Merchant et al. grading system for Otorrhea.

In our study, we assessed both the case and control groups for ear discharge, revealing that 50% of the case subjects had no or minimal ear discharge on day 15, compared to a control group, where only 20% had grade 0 ear discharge. Later on, after assessing the ear discharge on day 45, 50% of the control group subjects attained grade 0 ear discharge, while the others had minimal to continuous ear discharge. In contrast, the case group achieved 79% grade 0 ear discharge by day 45. At day 90 the study revealed that 87% of subjects had no discharge, while only 66% of control had no discharge. A study in 2021 evaluated the outcomes of using postauricular soft tissue for mastoid cavity obliteration in patients undergoing canal wall down mastoidectomy (CWDM), where he observed that this surgical method has better outcomes than the conventional method, where closure of canal with post auricle soft tissue helps in faster healing and less discharge compared with the non-obliterated cases [3].

The study highlights the outcome for the following reasons: firstly, the postauricular soft tissue provides an effective barrier, sealing the mastoid cavity and preventing the entry of infectious agents. Secondly, the obliteration technique enhances the drainage of residual secretions, reducing the likelihood of discharge accumulation. Thirdly, the well-vascularized postauricular soft tissue promotes quicker and more effective healing, reducing inflammation and discharge. Finally, filling the cavity reduces the soft tissue's size, making it easier to manage and less prone to chronic discharge issues.

In this study, we evaluated both groups for the formation of epithelial tissue on days 15, 45 and 90 post-surgery; the study found that 33% of subjects in the case group had epithelialization by day 15 while only 24% attained epithelialization by day 15. Comparing both groups on days 45 and 90, we see that 63% and 88% of subjects have fully formed epithelial tissue over the surgical site in the case group, compared to 38% and 54% in the control group. The study highlights the benefits of using a postauricular flap in faster and better healing compared to the normal formation of epithelial tissue in surgery where no flaps are used. A study in 2021 assessing the surgical outcome of using a postauricular flap has also found that using a postauricular flap leads to better outcomes in canal walls down mastoidectomy. He explains that post-auricular flaps significantly reduce the incidence of chronic infections [9].

The postauricular soft tissue helped seal the mastoid cavity, creating a more stable environment less prone to infections. Patients experienced fewer episodes of Otorrhea (ear discharge) and required less frequent medical intervention for infections. The study also explained that the postauricular flap, rich in blood vessels, promoted better healing by ensuring a robust blood supply to the obliterated area. This vascularization was crucial in reducing healing times and improving overall surgical outcomes. Using the patient's tissue minimized the risk of rejection and graft complications. The compatibility of the autologous tissue led to better integration and fewer adverse reactions or infections. The use of postauricular soft tissue provided durable and stable results over the long term. Patients experienced fewer recurrences of disease and less need for revision surgeries [10-11].

In our study, we also evaluated any relationship between age and the outcome of both surgeries; the study revealed that the younger age group had better healing, where 100% of samples in the case group attained grade 0 ear discharge by day 45. Still, the control group took 90 days for the same. When observing the older age group, we see that healing was slow and took longer. When comparing both groups, we observe that the case group showed better

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and faster healing than the control group. The study provides robust data on the effectiveness of using a post-auricular flap for canal walls down mastoidectomy (CWDM). Various studies, including a survey by Navneet Mathur in 2021, have reported the role of age in surgical healing; generally, younger patients tend to have better healing outcomes due to higher cellular regeneration capabilities, more robust immune responses, and better overall health status. Healing can be slower in older patients due to reduced cellular regeneration, weaker immune responses, and the presence of comorbidities that can complicate recovery [12].

The bone quality in younger individuals is typically better, facilitating easier surgical manipulation and better outcomes. Osteopenia or osteoporosis can be more common in older patients, potentially complicating the surgery and affecting the stability and integration of grafts used in mastoid cavity obliteration. Chronic conditions such as diabetes, cardiovascular diseases, and hypertension, which are more prevalent in older populations, can negatively impact surgical outcomes and prolong healing times [13].

The future of mastoid cavity obliteration, with postauricular soft tissue in canal wall down mastoidectomy (CWDM), will likely see several advancements and refinements to improve patient outcomes, surgical efficiency, and overall healthcare effectiveness. Advances in the field of endoscopic and minimally invasive surgical techniques could reduce surgical trauma, improve precision, and enhance recovery times [14]. These techniques may allow for better visualization and access during surgery, leading to more effective obliteration and fewer complications. Developing new biomaterials that mimic the properties of natural tissue more closely could enhance the success of mastoid cavity obliteration. These materials might include bioactive scaffolds that promote tissue integration and healing [15].

Limitation of study

Few cases that met the inclusion criteria were not able to be included in the study due to intracranial complications, especially in Gradenigo syndrome and CSOM with facial nerve palsy, as it may warrant multiple revision surgeries due to the high chance of recurrence.

CONCLUSION

The study on the surgical outcome of mastoid cavity obliteration using postauricular soft tissue in canal wall down mastoidectomy (CWDM) demonstrates significant benefits over conventional methods. Postauricular soft tissue provides an effective barrier, promotes quicker and more effective healing, reduces inflammation and discharge, and enhances surgical outcomes. The future of mastoid cavity obliteration with postauricular soft tissue in canal wall down mastoidectomy (CWDM) is likely to see several advancements and refinements aimed at improving patient outcomes, surgical efficiency, and overall healthcare effectiveness. An advance in endoscopic and minimally invasive surgical techniques could reduce surgical trauma, improve precision, and enhance recovery times. These techniques may allow for better visualization and access during surgery, leading to more effective obliteration and fewer complications. The use of post-auricular flaps helps achieve better outcomes. Still, developing new biomaterials that closely mimic natural tissue's properties could enhance mastoid cavity obliteration's success. This study helps in understanding the benefits of newer techniques compared to traditional canal wall down mastoidectomy (CWDM).

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