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# Dried amniotic membrane grafting as an adjuvant to canal wall-down procedure in pediatric cholesteatoma

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## Abstract

### Purpose

To evaluate the effect of dried amniotic membrane grafting on healing of radical cavity after canal wall-down procedure.

### Patients and methods

A total of 24 cases were included. All had canal wall-down surgery done with the use of dried amniotic membrane at the end of procedure to line the radical cavity. According to the course of healing, cases were divided into four groups regarding wideness and dryness of cavity. Results were statistically analyzed.

### Results

Among the 24 patients in the postoperative follow-up period of 6 months, only three (12.5%) patients needed revision meatoplasty for having narrow and wet cavities. Sixteen (66.7%) patients achieved the optimum goal of wide and dry cavity. Two (8.3%) patients had dry but narrow cavities. Three (12.5%) patients had wide but wet cavity, with recurrence of cholesteatoma.

### Conclusion

Dried amniotic membrane graft can be used safely to line the radical cavity. Further comparative studies are needed to evaluate efficacy among other materials used to achieve safe and dry cavities.

**Keywords:** Amniotic membrane, canal wall down, pediatric cholesteatoma

## INTRODUCTION

Canal wall-down (CWD) mastoidectomy is still opted by many otologists for pediatric cholesteatoma. Socioeconomic issues regarding the cost of multiple surgeries and lack of proper postoperative follow-up stand against the option of canal wall-up technique. The lower recurrence rates in CWD, together with lesser number of procedures, outweigh the advantages of canal wall-up in our society. It is important to achieve a safe, ventilated, quickly lined cavity before losing track of the patient.

Meatoplasty is a common step at the end of CWD to achieve the previous goals [1]. Complications of this step are added to those of the main procedure and may affect its outcome. These are mainly owing to infection accompanies exposed cartilage or mastoid bone (perichondritis, infected granulation tissue, and persistent discharge), which causes external canal

stenosis [2]. This canal stenosis may lead to premature closure of the mastoid cavity, especially in young population, owing to prompted healing process, entrapping any residual, or recurrent cholesteatoma.

The problem of exposed chondro/osseous tissue after CWD with meatoplasty was addressed over the years either by packing, flaps [2], and even molds [3] in trials to cover the exposed tissue and keep a patent meatoplasty with very scanty data about the outcome of each technique.

Amniotic membrane graft is an established method to

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cover exposed subcutaneous tissue in burns and donor site wound cases [4]. Being rich in growth factors, it promotes re-epithelization and inhibits fibrosis and scar formation, with antimicrobial and anti-inflammatory properties [5]. Both viable and dried types are used; dried being preferred by many authors because it is easier to store, transfer, and handle than the viable type [6]. Based on its properties and previous experience in similar wound problems, this study was conducted to evaluate its role in radical cavity healing.

## PATIENTS AND METHODS

The study was approved by local ethics committee. It consisted with all local laws and the principles of Declaration of Helsinki. A total of 28 pediatric patients with established cholesteatoma were recruited from outpatient clinic at the Hearing and Speech Institute from July 2017 till July 2019.

### Inclusion criteria

The following were the inclusion criteria:

Patients up to 8 years old (early childhood).

Patients with primary disease not operated upon before.

### Exclusion criteria

The following were the exclusion criteria:

Presence of cranial, intracranial, and extracranial complications.

Presence of gross anomalies in the external ear and computed tomography (CT)-proven anomalies of middle and inner ears.

Cases with suspected inaccessible residual pathology were excluded intraoperatively.

### Preoperative

All patients had full medical history recording and full general and ENT examination with detailed otological examination. CT imaging was requested to query cases to access the extension of the pathology and detect any anatomical variations. Full audiological assessment was done for all cases in the form of pure tone audiometry, speech audiometry and ABR in very young patients for whom the previous tests could not be done. Full preoperative laboratory and imaging investigations were requested, and anesthesia assessment was done to all cases.

At the day of surgery, the operated site is marked and hair is shaved in the inpatient ward.

### Operative

Using postauricular incision and operating microscope, a posteriorly based periosteal flap (Plava flap) [7] is elevated. CWD mastoidectomy is done via motorized drilling using bone cutting and diamond burrs of different sizes, removing the bridge and lowering the ridge following the cholesteatoma sac into all hidden areas, leaving no bone overhangs as much as possible. The ossicular chain was addressed according to each case individually regarding integrity and sac involvement. In all cases, Eustachian tube was not occluded aiming for

keeping a functioning middle ear cavity for further ossicular reconstruction or prosthesis when indicated.

Meatoplasty was done using open book technique, exposing the cavum concha cartilage posteriorly and removing the cavum concha, leaving the outer skin intact. Then, a longitudinal incision is done in the outer skin from the edge of incised cartilage down till the end of skin covering the cartilaginous external auditory canal. All the cartilage of the external canal was excised together with any residual skin tags. The resultant superior skin flap is sutured to the perichondrium of the auricle, and the inferior flap is sutured to the periosteum over the mastoid tip using 4/0 vicryl sutures.

The Plava flap was seated in the cavity in trial to reduce its size. Freeze dried HUMAN AMNION graft (prepared and gamma radiation sterilized at the Biological Dressing Laboratory of the National Center for Radiation Research and Technology, Atomic Energy Authority, Egypt) (Fig. 1) was used to cover all the exposed bone and soft tissue of the radical mastoid cavity while keeping the graft wet by saline to facilitate its separation from gauze (Fig. 2). Care was taken not to undermine the edges of the skin flaps of the meatoplasty with the graft. Gel foam was used to press the graft and fill the cavity till the bony edge.

The postauricular skin incision was closed in vertical mattress fashion using 2/0 vicryl sutures. Antibiotic-soaked gauze was rolled into the meatoplasty to secure the skin flaps in place. Standard dressing for major otologic surgery was used and kept in place for 1 week. Patient was transferred to inpatient room after full recovery to check on facial nerve integrity before leaving the operative theater.

### Postoperative

Patient was discharged on the day following the surgery after checking the dressing and facial nerve functions again with a prescription formed of intravenous antibiotics for 3 days then oral antibiotic compilation for 1 week, plus analgesics. A follow-up schedule was given to the patient's guardian. The schedule states on weekly visits the first month postoperatively,

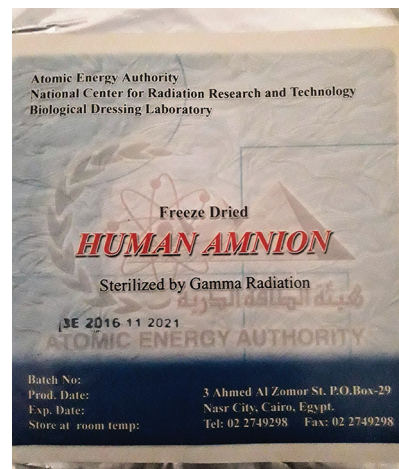


Figure 1: Dried amniotic membrane package.

then two visits the second month, and then a monthly visit for the next 4 months.

The first postoperative visit (1 week after surgery) was to remove the dressing and postauricular sutures and changing the meatoplasty gauze. In the following visits, debris inside the cavity were removed, and healing was observed. The need for postoperative local treatment was determined according to each case individually.

According to healing after the 6-month follow-up period, patients were grouped into the following:

Group 1: wide dry cavity (optimum result).

Group 2: wide wet cavity (manageable cavity).

Group 3: narrow dry cavity (query cavity).

Group 4: narrow wet cavity (least favorable).

Wideness was limited to meatoplasties that accommodate Hartmann ear speculum tip of 7.5 mm or larger.

**Statistical analysis**

Statistical data were described in mean ± SD for numerical data and frequency and percentages for categorical data using SPSS, version 24 (SPSS Inc., Chicago, Illinois, USA).

**RESULTS**

A total of 28 patients were included. Three cases were lost to follow-up, whereas one case had extension of cholesteatoma sac to the petrous apex, and complete elimination of the pathology could not be confirmed intraoperatively. The data of the remaining 24 patients were included in the statistical analysis. Age ranged from 2.5 to 8 years old, with an average of 5.2 ± 1.6. Females were 45.8% of cases.

The amniotic membrane preparation and grafting was user friendly. Average time added to the surgery was 10 ± 2 min.

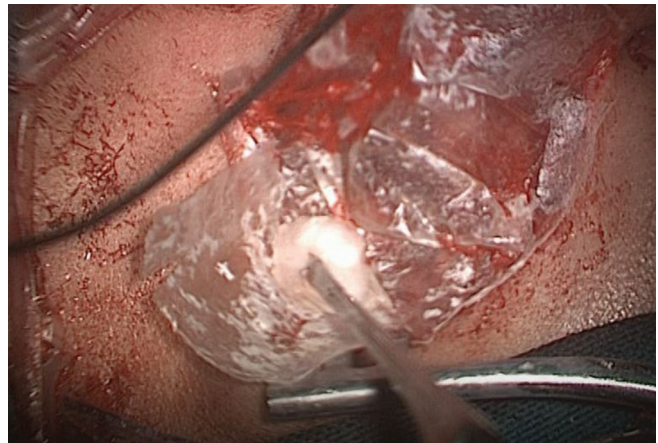
The postoperative follow-up results were as follows: 16 (66.7%) cases achieved wide and dry cavities (Fig. 3), three (8.3%) cases had wide but wet cavities, two (20.8%) cases had narrow but dry cavities, and three (12.5%) cases had narrow and wet cavities (Fig. 4).

Therefore, 18 (75%) cases achieved dry cavities; both patients and guardians were satisfied by cessation of troublesome discharge. In this subgroup, two (11.2%) cases had narrow cavities and guardians were advised to keep close follow-up to detect any recurrence, whereas six (25%) cases had persistent discharge.

Nineteen (79.2%) cases had wide cavities, and of them, three (15.8%) cases continue to discharge. No recurrence of pathology was detected in any of them. This subgroup was reassured, and the wide cavity allowed frequent toilet and still under continuous follow-up.

As for the least favorable group, all three (12.5%) cases were advised to go for revision surgery. All three cases had

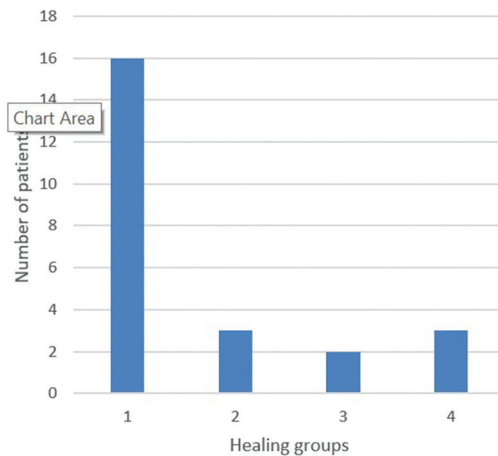
revision meatoplasty, and no amniotic grafting was done. Two cases revealed recurrence of cholesteatoma, which was removed thoroughly together with the remnants of the amniotic graft, whereas one case showed excessive granulation tissue



**Figure 2:** Covering the exposed mastoid cavity with dried amniotic graft.



**Figure 3:** Right ear after 6-month follow-up, group 1: wide and dry cavity.



**Figure 4:** Bar chart showing the postoperative distribution of the patients among healing groups.

formation, which was removed, and the cavity was chemically cauterized by hydrogen peroxide. All the three cases are still under follow-up to detect restenosis.

## DISCUSSION

Accelerated wound healing with fibrosis on expense of patent lumen in upper respiratory tract is a very well recognized problem in pediatric patients. Pediatric acquired subglottic and tracheal stenosis pathogenesis and management were studied in many papers [8–10]. Like laryngotracheal stenosis, meatal stenosis can be a troublesome problem after CWD procedure in pediatric patients [11]. Many techniques were adopted to solve this problem.

Amniotic membrane graft role to cover surface defects in plastic and ophthalmologic surgery is established years ago [12–15]. Its role in enhancing epithelization and reducing fibrosis is well known [5], so it was used in this research to cover the bare mastoid in trial to reach a wide and dry cavity.

In this study, the results of follow-up period of 6 months showed that only three (12.5%) patients needed revision meatoplasty for having narrow and wet cavities. Sixteen (66.7%) patients achieved the optimum goal of wide and dry cavity. Two (8.3%) patients had dry but narrow cavities. Three (12.5%) patients had wide but wet cavity, with recurrence of cholesteatoma.

These results are comparable with the study done by Tunkel [16] when he assessed 24 Z-meatoplasties in pediatric patients who had modified radical mastoidectomy with only three (12.5%) patients needing revision meatoplasty for restenosis. On the contrary, Z-meatoplasty is demanding with more time consumption and higher incidence of postoperative hyperemia [2] which may invite infection. However, amniotic graft coverage added only  $10 \pm 2$  min to the operative time.

In a comparative study with promising results, Sharma *et al.* [17] compared autologous medicated bone dust with periosteal-temporofacial swing flap coverage to conventional modified radical mastoidectomy without obliteration. Results of obliteration overweighed conventional surgery in epithelization and dryness of cavity. However, both techniques had only one case complicated with meatal stenosis. The study was not included in a systemic review on ‘mastoid obliteration with autologous bone in mastoidectomy CWD surgery’ published a year after [18].

Several studies have presented different techniques in meatoplasty [19–21] to prevent restenosis, whereas others proposed different materials to obliterate the mastoid cavity, with bioactive glass being the most reliable considering available evidence[22] but did not address pediatric population.

This study focused on the applicability and safety of dried amniotic grafts in lining mastoid cavity in pediatric population. Hearing outcome and vertigo were beyond its scope as the

air-bone gap was as expected in this type of surgery with no other groups to compare to and none of the patients in this series experienced postoperative vertigo.

## CONCLUSION

In conclusion, dried amniotic grafts are applicable and safe to use as lining to the mastoid cavity with fair results regarding wideness and dryness. Further studies are required to compare its results with other grafting materials.

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## Conflicts of interest

There are no conflicts of interest.

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