

## ORIGINAL ARTICLE

### Second Stage Reconstruction After Canal Wall Down Mastoidectomy

Yousef K. Shabana

Otorhinolaryngology Department Mansoura University, Egypt

**Objective:** To study results of revision surgery with reconstruction of the posterior canal wall and middle ear after canal wall down mastoidectomy using autograft cortical bone.

**Materials and Methods:** This study was conducted on 22 patients with previous canal wall down mastoidectomy. Reconstruction of the posterior canal wall together with reconstruction of the tympanic membrane and ossicular chain were done as a second stage operation. All operations were done at ORL department, Mansoura University hospital, between 2003-2007.

**Results:** Successful reconstruction of the posterior canal wall was achieved in 20 patients. Intact tympanic membrane was obtained in 18 patients. There was significant improvement of hearing after revision surgery. Postoperative complications included, persistent otorrhea in 6 cases, necrosis of the reconstructed canal wall in 2 cases and residual tympanic membrane perforation in 4 cases.

**Conclusion:** Revision surgery with second stage reconstruction of the posterior canal wall and middle ear provides good and stable results as well as improvement of hearing.

Submitted : 23 April 2009

Revised : 25 September 2009

Accepted : 12 December 2009

#### Introduction

Primary goal in surgical management of chronic otitis media with cholesteatoma is the creation of a dry, safe ear through removal of disease and prevention of recurrence. Canal wall up (CWU) techniques preserve the anatomy of the posterior canal wall, eliminating the need for periodic bowl cleaning and avoiding the risk of recurrent bowl infections. However, the recurrence rate may be as high as 36% in adults and 67% in children after CWU procedures<sup>[1]</sup>.

Canal wall down (CWD) mastoidectomy is also used for management of cholesteatoma<sup>[2,3]</sup>. Complete posterior canal wall removal provides exposure of the entire attic, especially the region of the anterior zygomatic cell tract. Removal of the posterior canal wall enhances exposure of the entire epitympanum and middle ear, helping to ensure complete disease eradication. This approach may reduce the recurrence rate to as low as 2%<sup>[2]</sup>.

Patients who have undergone canal wall down

mastoidectomy may have symptoms related to the cavity itself (chronic otorrhea resistant to medical treatment, granulations, dizziness in cold or hot water, and accumulation of debris in the exteriorized mastoid cavity, requiring periodic cleaning), social handicaps (non-esthetic meatoplasty, water restrictions to prevent bowl infections) or hearing problems (major conductive or mixed hearing loss when there was no attempt to ossicular chain reconstruction, difficult or impossible hearing aid application)<sup>[4,5]</sup>. In these cases, reconstruction of the posterior canal wall and the middle ear may help to overcome some of these problems.

Several materials have been used for reconstruction of the bony meatal wall. The patient's own tissues are the material of choice in reconstruction<sup>[6]</sup>. Recently bone substitutes were reported with varying incidence of failure rates. Weit et al.<sup>[7]</sup> reported 36% failure rate, Grote,<sup>[8]</sup> reported 25% failure rates both using hydroxylapatite. Geyer et al.,<sup>[9]</sup> reported 31% failure

#### Corresponding address:

Yousef K. Shabana

Otolaryngology Department, Faculty of Medicine Mansoura University Mansoura, Egypt

Email: yousefshabana@yahoo.com

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rate with using ionomeric cement which necessitate revision surgery and removal of the canal wall. The mean reason for failure reported by these authors was postoperative implant exposure<sup>[8-9]</sup>.

Our aim is to study results of reconstruction of the posterior canal wall and middle ear as a second stage operation after CWD mastoidectomy using autograft cortical bone.

### **Materials and Methods**

This study was conducted on 22 patients with previous canal wall down mastoidectomy (CWD). Reconstruction of the posterior canal wall together with reconstruction of the tympanic membrane and ossicular chain were done as a second stage operation. All patients were operated upon at the Department of Otorhinolaryngology, Mansoura University Hospital from 2003 to 2007. The time of surgery ranged from 1 year to 12 years after the CWD mastoidectomy depending on the time of presentation of the patients.

The mean causes for revision surgery were chronic otorrhea (12 patients), recurrent cholesteatoma (3 patients), debris accumulation (18 patients), deafness (19 patients) and dizziness (4 patients).

Patients were followed up postoperatively at intervals of 1 week, 2 weeks, 1 month, 3 months, 6 months, 1 year and at the last available follow-up.

Data were collected including the interval between the CWD mastoidectomy and the reconstruction, condition of the reconstructed canal wall, condition of the

tympanic membrane, pre- and postoperative audiogram, and complications.

Audiological evaluation was carried out using a clinical audiometer (Madsen. Model OB 822, Denmark) Pure tone audiometry (air conduction and bone conduction thresholds at frequencies: 500-4,000 Hz) was reviewed pre- and postoperatively at the follow up intervals. Results are reported in compliance with the American Academy of Otolaryngology-Head and Neck Surgery Committee on Hearing and Equilibrium guidelines for evaluation of the results of treatment of conductive hearing loss<sup>[10]</sup>.

Statistical analysis was carried out through SPSS program version 10, paired-samples T test. Results were considered significant when p value is < 0.05.

### **Surgical technique**

Most operations were performed under local anaesthesia while 4 operations were performed under general anaesthesia .

Through postauricular incision the mastoid bowl was exposed and temporalis fascia graft was harvested. The postauricular periosteal flap was freed anteriorly and the skin lining the mastoid cavity was carefully dissected. The canal skin and the remnants of the tympanic membrane were reflected anteriorly.

Any diseased tissues in the mastoid or the middle ear were cleaned. The posterior canal wall was reconstructed using autograft cortical bone (Figures 1,2) A small groove was made in the mastoid tegmen



**Figure 1.** Removal of the cortical bone.



**Figure 2.** Operative view of the reconstructed canal.

using cutting burr, this groove extended from medial to lateral up to the mastoid cortex, and a similar groove was made inferiorly.

A piece of the cortical bone was fashioned so as to fit into both grooves leaving a small hole in its medial part that was analog to the aditus ad antrum.

The canal side of the reconstructed wall was covered by the skin which was dissected from the cavity while the mastoid side was covered by the postauricular periosteal flap, so the reconstructed posterior wall was formed by 3 layers, skin, cortical bone and periostium. Sometimes the skin was deficient to cover the reconstructed wall completely, in these cases temporalis fascia was used to cover the pared area.

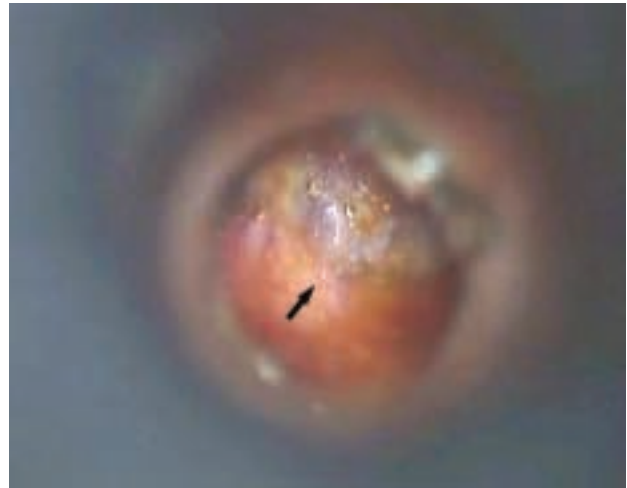
The tympanic membrane was reconstructed with temporalis fascia and the ossicular chain was reconstructed according to the operative findings using cortical bone to bridge the defect either from the oval window to the tympanic membrane or from the head of the stapes to the tympanic membrane. If the incus was absent only, an interposition technique was done.

The reconstructed external canal was packed with gel foam soaked with antibiotic ointment. The postauricular incision was closed.

## Results

There were 14 males and 8 females; the average age was 29 years  $\pm 12.3$  (12-55 years). The follow up period ranged from 6 months to 5.3 years with a mean of 2.4 years. The right side was involved in 10 patients (45.5%) and the left side in 12 patients (54.5%). The interval between the primary CWD mastoidectomy and the reconstruction was  $4.8 \pm 3.3$  years (1-12 years). The posterior canal wall remained intact (Figure 3) in 20 patients at the last follow up visit while it was necrosed in 2 cases, (9 months and 1.5 months after reconstruction respectively, due to recurrence of cholesteatoma).

Intact tympanic membrane was obtained in 18 patients. Mean preoperative AC was  $57.1 \pm 11.7$  dB (35- 77.5). Mean postoperative AC was 50 dB SD $\pm 11.7$  (27.5-70). Improvement in AC was statistically significant ( $p < 0.05$ ).



**Figure 3.** Two months post operative appearance.

The mean preoperative BC was  $22.7 \pm 6.3$  dB (15-38.7). Mean postoperative BC was  $23.2 \pm 6.9$  dB (11.2-38.7). This difference was statistically insignificant.

Mean preoperative ABG was  $34.3 \pm 8.4$  dB (16.2-48.7). Mean postoperative ABG was  $26.8 \pm 12$  dB (3.7-50). Improvement of ABG was statistically significant  $p < 0.05$ .

Closure of the ABG to within 20 dB was achieved in 6 patients (27.2%). Closure of the ABG to within 30 dB was achieved in 16 patients (73%). ABG closure was demonstrated in Table 1.

**Table 1.** Closure of the air-bone gap (ABG)

ABG closure	Number & percentage of patients
Within 10 dB	2/22 (9%)
Within 20 dB	6/22 (27%)
Within 30 dB	16/22 (73%)
Within 40 dB	19/22 (86%)

Persistent otorrhea was observed in 6 patients after revision surgery. Four of them were due to infection and formation of granulation tissue at the reconstructed canal wall (managed by frequent suction and systemic and local antibiotics and cauterization by silver nitrate). It was due to recurrent cholesteatoma in the other 2 patients who needed re-exploration later on.

## Discussion

Canal wall down mastoidectomy is considered to improve control of recurrent cholesteatoma compared with CWU techniques.

Removal of the canal wall improves exposure and facilitates the complete removal of all cholesteatoma. However, despite the fact that most well-constructed mastoid cavities remain problem-free, they do require periodic cleaning and are prone to bowl infections. Also, patients may have symptoms such as chronic otorrhea, granulation, dizziness in cold or hot air, accumulation of debris, water restrictions to prevent bowl infections and hearing problems especially when no ossicular chain reconstruction is attempted<sup>[4-5]</sup>.

To avoid the presence of an open mastoid cavity, canal wall reconstruction had been described, with preservation of near-normal anatomy.

Many materials have been used for reconstruction of the bony meatal wall, either autogenous or synthetic<sup>[6-8]</sup>.

In this study we used autologous cortical bone for reconstruction of the canal wall. It has the advantages of being self, readily available, economic with 91% success rate (20/22 patients). The high success rate is obtained because it is free of foreign body inflammatory reaction.

Autologous conchal cartilage was used in other studies with the result of intact rigid epithelialized canal wall in 100% of cases with 8 weeks after reconstruction<sup>[11]</sup>.

In some reports, cartilage reconstruction underwent resorption and loses its bulk<sup>[12]</sup>. We did not meet this complication as we covered the reconstructed wall from both sides with skin and periosteum.

In many reports, bone substitutes were used for reconstruction of the canal wall with different failure rates ranging from 25% to 36%<sup>[7-9,13]</sup>.

Hearing improved significantly after revision surgery and there was no significant change in bone conduction thresholds.

Tympanic membrane remained intact in 18 cases (82%). Perforation was observed in 4 cases, 2 of whom were due to recurrent cholesteatoma.

Postoperative complications included persistent otorrhea in 6 cases, 4 of whom were treated conservatively. It was due to recurrent cholesteatoma in 2 who needed further surgical intervention.

In conclusion, revision surgery with second stage reconstruction of the posterior canal wall and middle ear may provide good and stable results as well as improvement of hearing.

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