Evaluation of Requirements for Staging the Procedure of Reconstruction of Middle Ear After Canal Wall Down Mastoidectomy

C. Ravishankar¹ · R. K. Datta¹

Received: 19 January 2016 / Accepted: 2 May 2016 / Published online: 18 May 2016
© Association of Otolaryngologists of India 2016

Abstract Cholesteatoma is a progressive destructive ear disease which can affect any age group. It has been found to be more severe in children and young adults. It erodes the surrounding bone of middle ear, mastoid and ossicles. It causes partial to total deafness, unpleasant smelling discharge, pain, tinnitus, vertigo and facial paralysis. It can even cause meningitis, brain abscess and death. The post-operative outcome of hearing, and the state of the reconstructed middle-ear cavity after concurrent and staged reconstruction of middle ear after canal wall down mastoidectomy was studied in 30 ears with middle-ear cholesteatoma. The reconstructed middle ear was re-aerated in 60.5 % of the cases, which was significantly higher than for the epitympanum (39.5 %). Tympanoplasty was successful in terms of hearing results in 68.9 % of all subjects and in 75.4 % of the ears having a re-aerated tympanic cavity, which was significantly better than the 38.5 % for ears in which the tympanic cavity was not re-aerated. The findings of recurrent cholesteatoma, tympanic atelectasis, and tympanic effusion were observed with significantly ($p < 0.03$) high incidence in ears with no re-aerated space in their reconstructed mastoid cavities. It was revealed that the post-operative outcome of this surgical technique was significantly related to the state of re-aeration of the reconstructed middle-ear cavity but not with either concurrent or staged reconstruction. Audiological results are same for both concurrent and staged reconstruction following canal wall down tympanomastoidectomy, and hence we recommend that concurrent reconstruction is preferred in limited disease and staged reconstruction in severe disease.

Keywords Middle ear reconstruction · Canal wall down mastoidectomy · Staging

Introduction

Attico-antral disease, in particular, destroys the ossicles and has the potential to cause life threatening complications due to bone erosion nature of cholesteatoma. Surgical treatment of middle ear cholesteatoma remains one of the most challenging surgeries in otology [1].

The primary objective of surgery for cholesteatoma is to eradicate the disease and rendering the ear safe and dry and second objective is to restore hearing to serviceable level by tympanoplasty [1].

Tympanomastoidectomy can be combined with ossicular reconstruction as a single stage when suspicion of residual cholesteatoma is minimal. Factors like extensive mucosal disease of middle ear, lack of certainty of removing cholesteatoma dictates staged procedure [5].

Staged procedure is done 6–9 months following primary clearance. It enables removal of residual and recurrence of cholesteatoma and reconstruction of hearing system. Staging is indicated in 70–75 % of ears with cholesteatoma [5]. Hearing improvement varies depending upon several factors like the stage of the disease, degree of destruction of ossicles, state of middle ear mucosa, Eustachian tube function, the degree of pre-operative hearing loss and the material used for reconstruction [6]. Autologous ossicles and septal, conchal and tragal cartilages have become the workhorse of tympanoplasty. They are easily available, low cost and bio-compatible. TORP and PORP are not only expensive but also have high rates of extrusion [4].

Canal wall down surgery is 95 % effective in removing the disease and prevents recurrence of cholesteatoma.

✉ C. Ravishankar
ravientbmc18@yahoo.in

¹ Bangalore Medical College and Research Institute, Bangalore
560002, India

When the disease can be completely cleared to the satisfaction of the surgeon, reconstruction can be undertaken in the same sitting. When this cannot be done, reconstruction should be postponed to a later date. Staging of tympanoplasty gives a chance to relook and clear residual disease. Conditions in which this is to be done and the audiological outcome resulting out of such staging of reconstruction needs to be evaluated. Herein we undertook the study to know the specific role of staging in improving audiological outcomes.

Aims and Objectives

1. To know the impact of staging the procedure on audiological results in canal wall down surgery for cholesteatoma.
2. To determine factors which demand staging of canal wall down surgery.
3. To determine is there any difference in audiological outcome between different materials used for reconstruction (cartilage and TORP).

Materials and Methods

This is a prospective study conducted between December 2011 to January 2013 on 30 patients, who are willing to undergo surgical treatment.

The patients were categorized into two groups. Those in Group A had 15 patients who underwent canal wall down surgery with concurrent reconstruction of middle ear with temporalis fascia graft and autograft or homograft incus, homograft septal cartilage or TORP. The Group B had 15 patients with previous canal wall down surgery without reconstruction, reconstruction of middle ear was done as a staged procedure.

The cartilage used was taken from the thick septal spur of other patients who had undergone septoplasty. The removed cartilage had been stored in 70 % alcohol and was used whenever required.

The study was carried out at Sri Venkateshwara ENT institute and Bowring and Lady curzon hospital attached to Bangalore medical college and Research Institute, Bangalore. The data collected was analysed using Student “t” test.

Inclusion Criteria

All patients with confirmed preoperative cholesteatoma and who had undergone previous surgery after confirmation for fitness to undergo surgery and written informed consent.

Exclusion Criteria

1. Sensorineural deafness.
2. Exposure to ototoxic drugs.
3. Intracranial complications due to cholesteatoma.

Observations and Results

Our study included 30 patients in the age group of 11–50 years, 13 were male and 17 were female, divided into two groups.

Age and Sex Distribution

The age of patients in this study varied between 11 and 50 years. The mean age in the Group A was 25 years and in the Group B it was 29.3 years. In Group A five (34 %) were male and remaining ten (66 %) were female patients. Group B too had eight (53.3 %) males and seven (46.6 %) females (Table 1).

Symptoms

Ear discharge and hard of hearing were the most common complaints, present in majority of the patients in both the groups.

Side of Presentation

Group A had three bilateral, three right sided and nine left sided disease. Group B had eight right sided disease, seven left sided disease and no bilateral disease.

Clinical Examination

Initially all the patients underwent clinical and microscopic examination in the our patient department. In Group A, all had cholesteatoma, along with cholesteatoma (3) 20 % had granulations, (2) 13.33 % had aural polyp, (2) 13.3 % had attic perforation, (1) 6.67 % had retraction pocket and in Group B, the majority 66.66 % had dry cavity, 33.33 % had discharging cavity, (1) 6.67 % had granulations (1) 6.67 % had cholesteatoma within the cavity.

Pre Operative Investigations

Aural swab was taken and sent for culture and sensitivity tests. Pure tone audiometric evaluation was done for all the patients in a sound proof room with GSI 68 diagnostic audiometer following the standard procedure by the same

Table 1 Age and sex distribution

Age group	Group-A		Total	Group-B		Total
	Male	Female		Male	Female	
11–20	1	5	6	3	2	5
21–30	2	2	4	2	2	4
31–40	2	2	4	1	2	3
41–50	0	1	1	2	1	3
Total	5 (34 %)	10 (66 %)	15	8 (53.3 %)	7 (46.6 %)	15

Table 2 Comparative results of mean Pre and post-operative Pure tone average results of Group A and B

	Pre operative	Post operative
Group A	56.90	36.20
Group B	53.32	38.31

audiologist. Pre and post operative audiometric testing was performed at 500, 1000, 2000 and 4000 Hz.

Follow Up

The patients in both the groups were followed up every month. Post-operative audiometry was performed at the end of two, fourth and sixth months. We observed for findings of recurrent cholesteatoma, tympanic atelectasis, and tympanic effusion in subjects with reconstructed tympanic cavities. There was no evidence of residual disease at the time of post-operative audiometry. On further follow up three patients showed discharging cavities. This responded well to daily aural toileting and antibiotics.

Results

In Group A the mean pre and post operative Pure tone average results was 56.90 and 36.20 dB respectively. In Group B pre-operative Pure tone average results was 53.32 dB which improved to 38.31 dB post operatively. The results are depicted in Table 2.

The hearing gain was compared and analysed using Student “t” test and the mean hearing gain in Group A was

found to be 20.70 dB and that of Group B was found to be 15.01 dB. $p = 0.041$.

Discussion

The cholesteatoma is a disease which is having propensity to involve various hidden areas in temporal bone, which leads to incomplete removal and recurrence of the disease. Lack of certainty of complete removal and extensively diseased mucosa were the reasons for staging in our study. Similarly presence of compromised mucosa was the reason for staging in study done by Berenholz et al. [3].

The hearing outcome was same in concurrent and staged ossicular reconstruction in the study done by us. Similar audiological results were observed in studies done by Kim et al. [6], Sasakit et al. [7] and Berenholz et al. [3]. The successful outcome is defined as improvement of 15 dB. In our study mean hearing improvement was 20.7 dB in patients who underwent concurrent reconstruction and 15.01 dB in patients who underwent staged reconstruction.

The Table 3 showing the comparison of success rate in various studies using autograft ossicle or homograft cartilage with that of other prosthesis revealed more or less the same results as with synthetic prosthesis. In our study most of the reconstruction was done with septal spur cartilage, only in two patients TORP was used. Results were almost similar in view of hearing gain and reconstruction with septal cartilage is cost effective and efficacious. However, since in only two cases TORP was used, the comparison cannot be generalized. Hence there is a necessity to do

Table 3 Hearing results using different materials

Authors	Material used	n	Excellent (<10 dB)	Good (11–20 dB)	Fair (21–30 dB)
Berenholz et al. [3]	PORP(Silastic)	33	7 (21.2 %)	9 (27.2 %)	5 (15.1 %)
	Hydroxyl apatite	20	2 (10 %)	9 (45 %)	6 (30 %)
R A Chole [2]	Cartilage	102	26 (25.5 %)	40 (39.2 %)	24 (23.5 %)
Robert C O'Reilly [8]	Autograft Incus	137	35 (25.5 %)	56 (40.9 %)	23 (16.8 %)

randomized controlled study to validate the efficacy of TORP in comparison with autologous or homologous grafts.

Conclusion

Although audiological results are same for both concurrent and staged reconstruction following canal wall down tympanomastoidectomy, concurrent reconstruction is preferred in limited disease, while staged reconstruction in severe disease.

Extensively diseased mucosa of middle ear and lack of certainty of complete removal of cholesteatoma are the factors which demand staging.

Autologous or homologous incus or homologous septal cartilage and TORP are equally effective in improving hearing outcome. TORP is more expensive compared to others.

Compliance with Ethical Standards

Conflict of interest None.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

1. Browning G (2008) Scott-Brown's otorhinolaryngology-head and neck surgery, vol 3, 7th edn. Hodder Arnold, London, p 3407 (**Ch 237C**)
2. Chole RA (1999) Ossiculoplasty with banked cartilage. *Otolaryngol Clin North Am* 27:717–726
3. Berenholz LP, Rizer FM, Burkey JM, Schuring AG, Lippy WH (2000) Ossiculoplasty in canal wall down mastoidectomy. *Otolaryngol Head Neck Surg* 123:30–33
4. Ikeda M, Yoshida S, Ikui A, Shigihara S (2003) Canal wall down tympanoplasty with canal reconstruction for middle ear cholesteatoma: post-operative hearing, cholesteatoma recurrence, and status of re-aeration of reconstructed middle ear cavity. *J Laryngol Otol* 117(4):249–255
5. Jahn AF (1989) Cholesteatoma: what is it, how did it get there, and how do we get rid of it? *Otolaryngology clin North Am* 22(5):847–857
6. Kim HH, Battista RA, Kumar A, Wiet RJ (2006) Should ossicular reconstruction be staged following tympanomastoidectomy. *Laryngoscope* 116:47–51
7. Sasakit T et al (2007) Results of hearing tests after total middle ear reconstruction. *Acta Otorhinol* 127(5):474–479
8. O'Reilly RC, Cass SP, Hirsch BE, Kamerer DB, Bernat RA, Poznanovic SP (2005) Ossiculoplasty using incus interposition: hearing results and analysis of the middle ear risk index. *Otol Neurotol* 26(5):853–858