

Myringostapediopexy and myringolenticulopexy in mastoid surgery

P P CHEANG, D KIM*, T J ROCKLEY†

Abstract

Objective: To compare hearing results in patients undergoing myringostapediopexy or myringolenticulopexy in canal wall down mastoidectomy.

Study design: Case series of one surgeon. A retrospective review of 83 consecutive mastoid cavity operations for primary cholesteatoma. Only those patients who had undergone either myringostapediopexy or myringolenticulopexy were included.

Setting: District general hospital.

Patients: Forty-two procedures were performed in 40 patients. The mean age was 42 years old. The average follow up was 5.9 years.

Intervention: Seventeen patients underwent myringolenticulopexy (the incus head was excised, leaving the lenticular process attached to the stapes prior to graft placement) and 25 underwent myringostapediopexy (type III tympanoplasty).

Main outcome measures: Audiometry three to six months after surgery, and status of mastoid cavity after a minimum follow up of one year.

Results: Comparison of post-operative hearing results for the two groups showed a statistically significant hearing advantage for myringolenticulopexy ($p = 0.029$). In the myringolenticulopexy group, 92 per cent achieved a post-operative air–bone gap of less than 30 dB, compared with 62 per cent in the myringostapediopexy group. The mean post-operative air–bone gaps in the two groups were 17.5 and 24.7 dB, respectively.

Conclusion: When surgically feasible, the technique of myringolenticulopexy is a useful method of preserving serviceable hearing in single-stage mastoid cavity surgery.

Key words: Cholesteatoma; Mastoidectomy; Tympanoplasty; Incus; Hearing

Introduction

There are many surgical options in the management of cholesteatoma. No single procedure is appropriate for every case.^{1–3} The surgical approach, excision and reconstruction need to be tailored to the anatomy and disease extent in each individual patient. There is agreement in the literature that the primary goal of surgery is eradication of disease and prevention of recurrence; preservation or reconstruction of hearing is an important but secondary consideration.^{3–6} However, there continues to be much discussion regarding ‘canal wall up’ versus mastoid cavity (‘canal wall down’) techniques, and regarding one-stage versus delayed ossicular reconstruction.^{3,5,7,8} Tos’s 1989 recommendation remains true today: ‘cholesteatoma treatment should be individualised: both canal wall up and canal wall down methods have their place in cholesteatoma surgery’.¹ Although a canal wall up procedure gives

a better chance of eventual good hearing, this gain is not without expense. Compared with canal wall down surgery, canal wall up techniques are associated with a higher risk of residual or recurrent cholesteatoma, and an ossiculoplasty often requires a second-stage operation.^{5,8,9} Thus, the operating surgeon may find that the two main aims of surgery, namely disease eradication and hearing preservation, are actually in conflict with each other.

A particular problem which highlights this surgical dilemma is frequently encountered in clinical practice. This occurs when the surgeon operates on an ear in which the ossicular chain is in continuity, with serviceable hearing, but the ossicular heads are diseased and need to be excised to ensure cholesteatoma removal. In this situation, the surgeon may need to sacrifice some hearing in order to ensure disease eradication. If a mastoid cavity operation is being performed as a single-stage procedure, it is

From the Department of Otolaryngology, Worcestershire Royal Infirmary, Worcester, the *Department of Otolaryngology, University Hospital Birmingham, and the †Department of Otolaryngology, Queens Hospital, Burton-on-Trent, UK.
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common practice to remove the entire incus and the malleus head in order to ensure disease eradication, and then to place a temporalis fascia graft onto the stapes head at the end of the procedure. This technique, known as myringostapedioplexy or type III tympanoplasty, has been practised for many years.⁶ It re-establishes sound continuity between the grafted tympanic membrane at the ossicular remnant, without compromising cholesteatoma excision. However, the hearing results of this technique are somewhat unpredictable; reported case series describe a post-operative air–bone gap (ABG) of anywhere between 10 and 60 dB.^{7,10–12}

Another surgical option for preserving hearing when performing canal wall down surgery in this situation was suggested by Tos.¹³ In his monograph on middle-ear surgery, he described an operation in which the diseased incus head was removed, leaving the lenticular process still attached to the stapes. He recommended that a temporalis fascia graft be laid onto the lenticular process at the end of the procedure, to reconstruct the sound conduction mechanism. This mechanism (myringolenticuloplexy) might be expected to enable better sound conduction than simple myringostapedioplexy, as the lenticular process adds height to the stapes and thus resembles a columella ossiculoplasty. However, the hearing results of this procedure have hitherto not been described, and it is not known whether this confers any advantage over simple myringostapedioplexy.

This study reviewed a case series of canal wall down procedures in which myringolenticuloplexy or myringostapedioplexy had been performed. The hearing results following myringolenticuloplexy are described, and compared with the hearing results following myringostapedioplexy.

Patients and methods

Clinical cases

Between 1991 and 2005, 128 operations for primary acquired cholesteatoma were performed by one surgeon in a district general hospital. Of this total, 83 were single-stage mastoid cavity canal wall down operations for tympanomastoid disease. The remainder were atticotomy procedures for limited attic cholesteatoma. The case notes of all 83 canal wall down operations were reviewed. Cases were selected for inclusion in this study if they fulfilled the following criteria: (1) clinical diagnosis of cholesteatoma; (2) no previous otological surgery; (3) single-stage canal wall down procedure; (4) intact mobile stapes, with myringolenticuloplexy or myringostapedioplexy attempted; and (5) follow up for at least 12 months after surgery.

A total of 42 procedures (from 40 patients) fulfilled these criteria. For each procedure, the following data were recorded: (1) clinical findings at operation; (2) cavity status at least one year after surgery; and (3) air and bone conduction audiometric thresholds at 0.5, 1, 2 and 4 kHz, both pre-operatively and three to six months post-operatively. From the audiometric data, the average air conduction threshold, average bone conduction threshold and

ABG were calculated. The hearing results after myringolenticuloplexy were then compared with those after myringostapedioplexy.

Technique of myringolenticuloplexy and myringostapedioplexy

An endaural approach was used. The posterior canal wall was taken down and the attic and mastoid were cleared completely of cholesteatoma. In cases with necrosis of the incus long process, a type III tympanoplasty (i.e. myringostapedioplexy) was performed with a temporalis fascia graft laid directly onto the head of the stapes (Figure 1). If disease of the ossicular chain was limited to the ossicular heads and the stapes was mobile, the long process of the incus was cut, using a micro-alligator malleus nipper, and the incus head removed. This left a few millimetres of the long process and the lenticular process intact, attached to the incudostapedial joint. The temporalis fascia graft was then laid onto the remains of the incus, forming a myringolenticuloplexy (Figure 2).

Results

Forty-two procedures were performed in 40 patients. Seventeen underwent myringolenticuloplexy and 25 underwent myringostapedioplexy. The mean age was 42 years old. The average follow up was 5.9 years; patients were deemed suitable to be discharged from follow up if the mastoid cavity had remained stable for three years.

Hearing results after surgery

Audiometric data were incomplete in six patients, three in each treatment group, due to mental incapacity, default from follow up or missing audiometric records. Hearing results were therefore analysed for 14 patients who had undergone myringolenticuloplexy and 22 patients who had undergone myringostapedioplexy.

The mean pre- and post-operative thresholds of air and bone conduction in the myringolenticuloplexy and myringostapedioplexy groups are shown in Table I. The mean pre-operative ABG was 25.98 dB in the myringolenticuloplexy group and 28.25 dB in the myringostapedioplexy group. Three to six months after surgery, the mean ABGs were found to be 17.5 and 24.7 dB, respectively. Using Student's

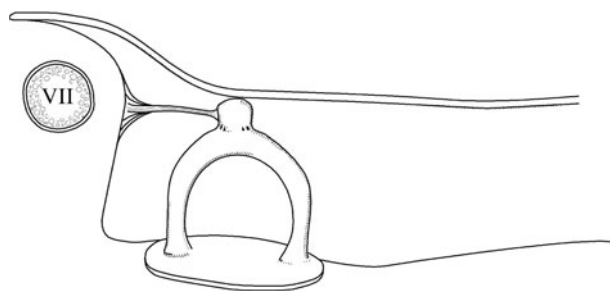


FIG. 1
Myringostapedioplexy.

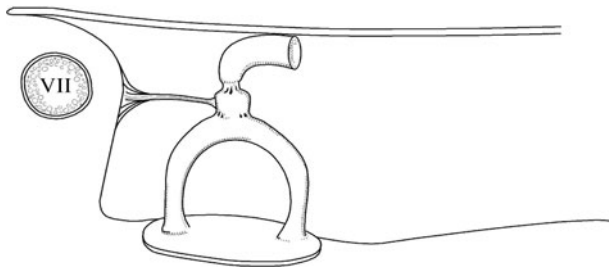


FIG. 2
Myringolenticulopexy.

t-test, this difference between the two groups was found to be statistically significant ($p = 0.029$).

Figure 3 shows the distribution of the post-operative ABG values in each treatment group. Ninety-two per cent of the myringolenticulopexy group achieved ‘social’ hearing (ABG less than 30 dB),¹⁴ compared with only 61.9 per cent of the myringostapediopexy group. Similarly, 64 per cent of the myringolenticulopexy group achieved an ABG of less than 20 dB, compared with 43 per cent of the myringostapediopexy group.

There was one patient in the myringostapediopexy group who suffered a worsened bone conduction threshold post-operatively, whereby the 4 kHz threshold dropped from 30 to 60 dB.

Cavity status after 12 months

Four patients, three of them from the myringostapediopexy group, were lost to follow up after six months, and so long-term cavity status was analysed for 38 patients. At the most recent out-patient review (a minimum of 12 months after surgery), 35 out of 38 evaluated patients had achieved a dry mastoid cavity. Out of the three with persistently discharging ears, two had undergone myringostapediopexy. One patient in the myringolenticulopexy group required revision surgery for residual cholesteatoma five years post-operatively. Two patients, one from each group, required revision surgery for recurrent cholesteatoma six years post-operatively.

TABLE I

MEAN AIR CONDUCTION, BONE CONDUCTION AND ABG BEFORE AND AFTER SURGERY, FOR BOTH TREATMENT GROUPS

Parameter	Myringolenticulopexy	Myringostapediopexy
<i>Air conduction</i>		
Pre-op	37.23 (13.12)	50.60 (17.51)
Post-op	31.88 (13.16)	47.20 (16.14)
<i>Bone conduction</i>		
Pre-op	11.25 (11.51)	23.04 (14.26)
Post-op	14.38 (13.28)	22.50 (12.82)
<i>ABG</i>		
Pre-op	25.98 (10.32)	28.25 (16.19)
Post-op	17.50 (6.86)	24.70 (12.47)

Data are shown as means (standard deviation), in dB. ABG = air-bone gap; pre-op = pre-operative; post-op = post-operative

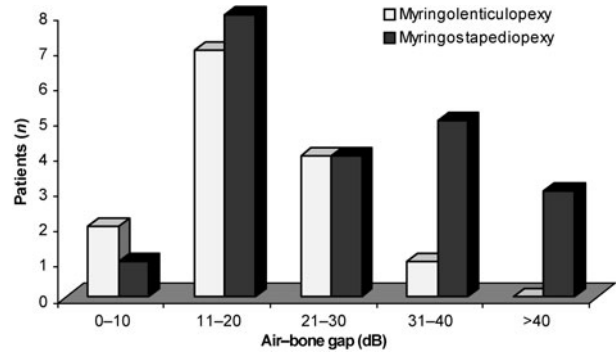


FIG. 3

Patients stratified by post-operative ABG, for the two treatment groups.

Discussion

Myringolenticulopexy

Achieving the best outcome in the treatment of cholesteatoma requires good decision making, both in planning and in performing surgery. The operating surgeon needs to weigh up the merits of several different techniques in order to ensure thorough disease eradication while achieving optimal preservation of hearing in each individual case. In order to be effective, such decision making needs to be informed by a good knowledge of the likely outcome of each technique. The hearing results from myringolenticulopexy have not been previously reported. In this study, we found that myringolenticulopexy repair achieved good hearing results in a single-stage mastoid cavity procedure, without compromising disease clearance.

We deliberately reported only short-term hearing results, because the long-term success of any ossicular repair is largely dependent on factors outside the control of the surgeon, i.e.: patient follow-up rates; eustachian tube function; middle-ear stability; and the condition of the mucosa. The short-term results are hence a more accurate reflection of the actual reconstructive technique.^{14,15} However, we observed in our case series that in cases in which the mastoid cavity remained stable, the hearing results also remained stable in the long term.

Comparison with myringostapediopexy and other sound reconstruction techniques

Myringostapediopexy has been a commonly used repair technique in mastoid surgery for many years.^{10,11,16,17} The hearing results after myringostapediopexy in our series therefore make an interesting comparison group. It should be noted that these patients were not a true control group, as the degree of ossicular erosion was not the same as in the cases undergoing myringolenticulopexy. Our hearing results after myringostapediopexy are comparable with those in the published literature. It is generally found that the success of myringostapediopexy is rather variable, the post-operative ABG being anywhere between 10 and 60 dB.^{7,10-12} Our results after myringolenticulopexy are better and

less variable, with only one case having an ABG greater than 30 dB.

Our hearing results following myringolenticulopexy compare well with those that may be obtained by interposing cartilage between the stapes head and the tympanic membrane graft as a single-stage ossiculoplasty during canal wall down mastoid surgery. Moustafa and Khalifa observed the hearing results of this technique in 95 cases, compared with 145 cases who had undergone simple myringostapedioplasty. They showed that 84 per cent of the myringo-cartilage-stapedioplasty patients had an ABG of less than 20 dB.¹¹ Similar results were obtained by Artuso *et al.*,⁷ who showed a similar advantage when comparing myringostapedioplasty with single-stage ossiculoplasty.

- **The main aim of mastoid cavity surgery is to eradicate disease**
- **Myringostapedioplasty or ossiculoplasty is commonly performed if the incus is diseased; however, hearing results after myringostapedioplasty are hugely variable**
- **A modified method is described in which the lenticular process is preserved where possible**
- **The hearing results for this modified procedure were significantly better than those for myringostapedioplasty, being comparable to staged ossiculoplasty, with no compromise of disease clearance**

The myringolenticulopexy results in our study also compare well with the results of second-stage ossiculoplasty. Kim *et al.* reported hearing results after staged ossiculoplasty following cholesteatoma surgery in 13 patients in whom the stapes was intact.³ All 13 patients had had canal wall down surgery followed by an ossiculoplasty using a partial ossicle replacement prosthesis. Kim *et al.* found a mean post-operative ABG of 25.9 dB; four patients (31 per cent) achieved an ABG of less than 20 dB, while ten patients (77 per cent) had an ABG of less than 30 dB. In our study, the mean post-operative ABG after myringolenticulopexy was 17.5 dB, and 64 per cent of this group achieved an ABG of 20 dB or less.

Theoretical considerations in sound conduction repair

With such variable hearing results, several investigators have tried to define the surgical factors which might confer better sound conduction after myringostapedioplasty. Lee and Schuknecht⁶ advised taking the posterior canal wall down to the level of the facial nerve so that the tympanic membrane was medialised. Mehta and co-workers^{10,18} systematically investigated factors that might influence sound conduction in myringostapedioplasty in a temporal bone preparation. They emphasised the importance of stapes mobility and middle-ear aeration. They found that varying the type of graft

material or the tightness of stapes contact made no significant difference. Interposing a disc of cartilage between the stapes head and the graft improved sound conduction. In clinical studies,^{12,18} they found that this modification translated to ABGs of 10–25 dB. It is generally agreed that interposing bone or cartilage between the stapes head and the grafted tympanic membrane confers better sound conduction.^{7,11} However, single-stage mastoid surgery with ossiculoplasty has the disadvantage that the ossicular reconstruction on the stapes may mask clinical evidence of residual cholesteatoma in the oval window area.

Myringolenticulopexy therefore seems to confer a hearing advantage over myringostapedioplasty by the presence of additional ossicle between the stapes head and the grafted tympanic membrane, as described above. Theoretically, the fact that the lenticular process receives its blood supply from the mucosal vessels and the stapedialexus¹⁹ should mean that avascular necrosis of the reconstruction will not be a problem. Another advantage, when considering post-operative surveillance to check for residual cholesteatoma, is that any regrowth of disease in the oval window will not be obscured by the physical presence of the lenticular process on the stapes, unlike more bulky cartilage reconstructions.

Conclusion

Myringolenticulopexy is a simple technique which may be used in single-stage mastoid cavity surgery. Where feasible, it allows the surgeon to remove the heads of the ossicles and still to preserve reasonable hearing, without compromising cholesteatoma clearance.

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Address for correspondence:
Miss Pei Pei Cheang,
10 Canterbury Close,
Birmingham B23 7QL, UK.

E-mail: ppcheang@gmail.com

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