The Journal of Laryngology & Otology (2007), ***121***, *1041–1047.*
© 2007 JLO (1984) Limited
doi:10.1017/S0022215107006330
Printed in the United Kingdom
First published online 26 February 2007

Main Article

Is simultaneous bilateral mastoidectomy ever advisable?

J J Klemens, E Mhoon, M Redleaf

Abstract

Introduction: We report our experience with bilateral, simultaneous tympanomastoidectomies and the results of an opinion survey of otologists.

Methods: A chart review of 116 tympanomastoidectomies revealed 12 patients who underwent bilateral, simultaneous tympanomastoidectomies. An opinion survey generated 121 responses.

Results: Of the 12 patients, none suffered any outcome which would have been avoided by staging the procedures. Twenty-three of 24 operated ears had the same or better hearing post-operatively. Of the survey respondents, 74 felt that performing bilateral, simultaneous tympanomastoidectomies was unsafe, largely because of the risk of bilateral sensorineural hearing loss.

Discussion: Although bilateral, simultaneous tympanomastoidectomies carry double the risk of unilateral sensorineural hearing loss, compared with the unilateral procedure, the risk of bilateral sensorineural hearing loss is only 0.006–0.2 per cent, as derived mathematically from historical data. Respondents to the survey were mostly opposed to bilateral, simultaneous tympanomastoidectomies, but even those opposed gave indications for simultaneous procedures. This finding probably reflects an ambivalence about the theoretical risks of the operation versus the potential patient benefits. A decision tree for proceeding to the second case is presented.

Key words: Otologic Surgical Procedures; Ear, Middle; Cholesteatoma, Middle Ear

Introduction

Patients with chronic ear disease present a difficult treatment challenge. The indolent course of the disease and the recalcitrant nature of its response to treatment often frustrate both the clinician and the patient. Traditionally, bilateral chronic mastoiditis has been treated by staged mastoidectomies. However, in patients with chronic disease who are ill or who repeatedly refuse surgery, it may be preferable to perform both procedures simultaneously. In the otologic community, this practice has been avoided due to the risks of ear surgery, primarily sensorineural hearing loss. Tympanoplasty, with or without mastoidectomy, for chronic ear disease has a 0.8–4.5 per cent incidence of post-operative sensorineural hearing loss of at least 10 dB.[1–3]

The risk of hearing loss after surgery for chronic ear disease must be weighed against the natural course of the disease. If untreated, hearing degenerates in the chronically infected ear.[4] The goal of surgery is primarily to eradicate disease and to stay the progression of hearing loss. Improvement of the patient's hearing is a secondary, albeit important goal.

We reviewed the outcomes of simultaneous bilateral mastoidectomies in 12 patients. We then surveyed US otologists to assess their experiences and opinions.

Materials and methods

We reviewed the charts of 94 patients who had undergone mastoidectomy for chronic ear disease, cholesteatoma or tumour resection. We identified 12 patients, with ages ranging from one to 56 years, who had undergone bilateral, simultaneous mastoidectomies. These patients' pre-operative evaluations, intra-operative findings, indications for simultaneous operation and post-operative courses were recorded in a spreadsheet. Forty data fields were collected for each patient. Pure tone thresholds were calculated by averaging all available air conduction thresholds on pre- and post-operative audiograms. We also recorded the middle-ear risk index, which is an indication of middle-ear pathology and hearing prognosis.[5,6] The middle-ear risk index was calculated from the history of previous surgery, otorrhoea, middle-ear granulation, middle-ear effusion, tympanic membrane perforation, presence or absence of cholesteatoma, and status of the ossicular chain. Possible index scores range from zero to 12; a low score suggests that the post-operative hearing

From the Section of Otolaryngology, Department of Surgery, University of Chicago, Chicago, Illinois, USA.
Accepted for publication: 4 December 2006.

https://doi.org/10.1017/S0022215107006330 Published online by Cambridge University Press

outcome will be good, while a high score predicts a poor post-operative hearing outcome.

A survey of US otologists was distributed to determine the otologic community's opinion of simultaneous bilateral mastoidectomy. The survey was sent to the 452 otologists who were members of the American Neurotology Society. The survey was sent via first class mail, with a detachable, stamped, self-addressed answer postcard to enable an anonymous response.

Results and analysis

Table I lists the patient's clinical evaluations, intra-operative findings and indications for simultaneous operation. Tables II and III describe the first and second ears selected for operation, respectively. The Tables show the indications for selection of the first or second ear, what operation was performed, intra-operative and post-operative complications, and hearing results. Of the 12 patients who underwent bilateral, simultaneous mastoidectomy, half were children. Twenty-two of the 24 ears had marked middle-ear or mastoid disease. (Patient number five showed little mastoid disease during his first ear mastoidectomy and therefore underwent only a tympanoplasty in his second ear; see Tables II and III.) All of the adults and one of the children had a history of ear problems lasting years, and five of the adults had been refusing ear surgery for years. Four of the six adults were non-compliant, having missed and rescheduled appointments for months or years on end.

Among the children, three were acutely ill at the time of surgery, one (patient two) with undiagnosed, disseminated tuberculosis.[7] In each paediatric case, the parents requested simultaneous procedures, even after learning of the length of the procedure. The mothers of two children (patients five and six) insisted on operations and that they be simultaneous. These mothers attributed their children's scholastic problems to their ear disease, and, indeed, all four ears showed improved hearing following surgery.

Among the six adults, one patient (patient 12) had become repeatedly ill from acute and chronic otitis media in his only hearing ear. He and three of the other adults had refused previous surgical recommendations. One of these four patients requested simultaneous bilateral surgery, one acquiesced to his mother's request, and the other two agreed to the surgeon's suggestion. The other two adults (patients nine and 11) requested simultaneous surgery for their own convenience.

Table II shows the operations and outcomes on the first ears operated upon. We selected the ear that would require the most attention to be operated on first. In cases three and 11, the clinical picture was identical in both ears, and we arbitrarily selected the first ear. In case 12, we operated on the only hearing ear first. In the remaining nine cases, we selected the ear with the most clinical disease, or the worse hearing, or both. This was so that the surgeons would be freshest while operating on the more difficult ear, and the ear that was more important to

TABLE I

PATIENTS' CONDITION AT TIME OF SURGERY

Pt no	Age (yrs)	Clinical complaint & operative pathology		Symptom duration	Chronic refusal of surgery?*	Acutely ill at surgery?	Indication for simultaneous surgery
		1st ear	2nd ear				
1	1.3	O, P, CM, OI	CM, OI	7 mths	No	No	Parental request
2	3.5	O, A, P, LOB,TB, E, EO	O, HL, P, LOB, VII, TB, OI	2.5 mths	No	Yes	Ill, parental request
3	4	O, HL, CM, OI	O, HL, CM, OI	Years	No	Yes	Ill, parental request
4	10	O, HL, TS, CM, OI	O, HL, CM, EO	5 mths	No	Yes	Ill, parental request
5	10	HL, P	HL, P	Years	No	No	PSP, parental request
6	11	O, HL, CM, OI	O, HL, CM, OI	1 yr	No	No	PSP, parental request
7	30	PM, O, HL, Chol, CM, EO	O, HL, P, Chol, CM, IO	Years	Yes	No	Noncompliant
8	30	PM, O, HL, P, CM, EO	O, HL, CM, OI	Years	Yes	No	Noncompliant, parental request
9	34	O, HL, P, TS, Chol, CM, EO	O, HL, TS, Chol, CM, EO	Years	Yes	No	Patient request
10	41	O, HL, P, CM, OI	O, HL, P, CM, OI	Years	Yes	No	Noncompliant, patient request
11	42	HL, P, TS	HL, P, TS	Years	No	No	Patient request
12	56	O, HL, CM, OI	O, A, Chol, CM, EO	Years	Yes	Yes	Ill, noncompliant

*Years = several years of symptoms. Pt no = patient number; yrs = years; O = otorrhoea; P = perforation; CM = chronic mastoiditis; OI = ossicles intact; mths = months; A = anacusis; LOB = loss of balance; TB = tuberculosis; E = exposed cerebellar dura, tegmen, jugular bulb, carotid artery and open lateral semicircular canal; EO = eroded ossicles; HL = hearing loss; VII = weak facial nerve; TS = tympanosclerosis; PSP = poor scholastic performance; PM = previous mastoidectomy; chol = cholesteatoma

https://doi.org/10.1017/S0022215107006330 Published online by Cambridge University Press

TABLE II
SURGICAL OUTCOMES: FIRST EAR

Pt no	Selection criteria	Operation	Complications	Pre-op PTT (dB)	Post-op PTT (dB)	MERI
1	Draining perforation	CWU with FR	None	73 (sf)	20 (sf)	4
2	More disease	CWD	Stapes dislocation, canal healed in blind sac	Absent*	94	7
3	Identical exam, arbitrary	CWU with FR	None	25 (sf)	25 (sf)	3
4	Worse on CT	CWU with FR	None	35	28	3
5	Worse hearing	CWU with FR	None	34	17	2
6	More drainage	CWU with FR	None	39	15	3
7	More disease	CWD	None	58*	103*	10
8	More disease	CWD	None	81	84	9
9	Worse hearing	CWD (contracted mastoid)	Facial nerve exposed, House grade II	61	26	8
10	More disease, poorer hearing	CWD (contracted mastoid)	None	83*	58*	4
11	Identical exam, arbitrary	CWU with FR	None	77	77	1
12	Only hearing ear	CWD	Only hearing ear healed in blind sac	76	77	4

*Poor reliability during testing. Pt no = patient number; Pre-op = pre-operative; PTT = pure tone threshold; Post-op = post-operative; MERI = middle-ear risk index; CWU = canal wall up mastoidectomy; FR = facial recess; sf = sound field testing; CWD = canal wall down mastoidectomy

treat, should the operation need to be interrupted between ears.

All patients underwent mastoidectomy in their first ear. One patient had such mild disease in the first ear that he received only a tympanoplasty in the second ear (patient five). There were two intra-operative complications, both of which occurred during the first ear's operation. Patient two's first ear was filled with white debris, with such erosion of bony structures that the cerebellar dura, the tegmen dura, the carotid artery and the jugular bulb were all exposed. In addition, the lateral semicircular canal was open and the stapes was loose in the oval window. The stapes was dislocated during surgery with minimal pressure and was immediately replaced on the oval window. On the other side, all care was taken not to touch the stapes at all, and there was no similar problem. Post-operatively, the hearing in the first ear improved compared with pre-operative levels.

Patient nine had such a contracted mastoid in the first ear that the second genu of the facial nerve was quite close to the tegmen and to the roof of the aditus ad antrum. This area, already difficult to access and visualise, was also filled with cholesteatoma. The second genu was exposed with the drill, and the patient subsequently had a House grade two function of the nerve on that side. The second ear had identical anatomy, also with a cholesteatoma tucked up into the narrow aditus. However, having just seen the anatomy and the necessity for dissecting in the tight area, the cholesteatoma was removed completely, with no facial nerve exposure.

There were no intra-operative complications during surgery of any of the 12 second ears. In the long term, both of patient two's external canals ended in blind sacs, as did patient twelve's first ear, although each of these three ears had undergone canal wall down mastoidectomy.

In Tables II and III, the higher middle-ear risk index values tended to be associated with worse pre-operative hearing. Patients two, seven and 10 gave unreliable responses on audiometric testing. Patient two, the child with disseminated tuberculosis, was simply too sick to test well pre-operatively. Adult patients seven and 10 were erratic in their responses both pre- and post-operatively. Patient seven's hearing was worse in the first ear post-operatively than pre-operatively. Patient eight's hearing was 3 dB worse in the first ear post-operatively, and patient twelve's hearing was 1 dB worse in the first ear post-operatively. Hearing in all the other 21 ears improved or was the same post-operatively. In the first ear operated upon, patients one, two, five, six, nine and 10 showed a greater than 10 dB hearing improvement, as did patients one, four, five, six, eight and nine in the second ear operated upon.

Post-operative recuperations were unremarkable. No patient complained of the inconvenience of bilateral external canal packing.

Of 452 surveys distributed postally, 70 were returned by the postal service, leaving a total of 382 inquiries successfully despatched. Of these 382

https://doi.org/10.1017/S0022215107006330 Published online by Cambridge University Press

TABLE III

SURGICAL OUTCOMES: SECOND EAR

Pt no	Operation	Complications	Pre-op PTT (dB)	Post-op PTT (dB)	MERI
1	CWU	None	73 (sf)	20 (sf)	1
2	CWD	Canal healed in blind sac	Present*	64	4
3	CWU with FR	None	25 (sf)	25 (sf)	3
4	CWU with FR	None	33	21	4
5	T-plasty	None	26	14	2
6	CWU with FR	None	35	22	3
7	CWD	None	45*	38*	5
8	CWU with FR	None	76	66	3
9	CWD (contracted mastoid)	None	45	31	6
10	CWU	None	77*	77*	4
11	CWU with FR	None	70	65	1
12	RM	None	Absent	Absent	4

*Poor reliability during testing. Pt no = patient number; Pre-op = pre-operative; PTT = pure tone threshold; Post-op = post-operative; MERI = middle-ear risk index; CWU = canal wall up mastoidectomy; sf = sound field; CWD = canal wall down mastoidectomy; FR = facial recess; T-plasty = tympanoplasty; RM = radical mastoidectomy

surveys, 121 anonymous reply cards were returned. Sixteen respondents added their names, addresses or telephone numbers to the reply cards. Appendix 1 shows the questions asked and the replies given.

The first three questions of the survey focussed on respondents' personal experiences and observations. One hundred and twenty of the 121 respondents answered the first question (i.e. whether they personally had ever performed simultaneous bilateral mastoidectomies on the same patient in the same sitting). Fourteen respondents had performed simultaneous mastoidectomies. Of the 106 respondents who had not performed simultaneous mastoidectomies, 28 circled the option 'absolutely not', which we had offered so that the respondents could indicate the conviction of their reply.

One hundred and ten respondents answered the second question (i.e. 'have you ever experienced or learned of any complication of bilateral mastoidectomy which would have been avoided by staging the procedure?'). One hundred respondents answered in the negative. Of the 10 respondents who had heard of complications, none had ever performed simultaneous mastoidectomies themselves, and therefore had not caused these complications themselves.

In answering question three (requesting respondents to list known complications), eight of the nine respondents who had heard of complications listed them, and one listed two. One respondent's comment was 'no need for the second operation – nor the first'. One respondent felt that the procedures were inadequately performed secondary to surgeon fatigue. One respondent who listed facial nerve injury had also heard of a case of iatrogenic sensorineural hearing loss. Six respondents reported postoperative sensorineural hearing loss. One specified that the loss was bilateral and one specified that the loss was unilateral. Three did not specify whether the loss was unilateral or bilateral. We included only those complications which would have been avoided by staging the mastoidectomies. Not included in the count was one respondent's report of two cases of bilateral sensorineural hearing loss which, according to the respondent, had probably resulted from the surgeons' skill (or lack thereof) and would not have been avoided by staging. We also excluded one report of bilateral hearing loss following bilateral stapedectomy. Therefore, respondents reported the following hearing complications due to the simultaneity of bilateral mastoidectomies: one case of sensorineural hearing loss in one ear; one case of hearing loss in both ears; and three cases of hearing loss of unspecified laterality.

The fourth and fifth questions of the survey focussed on the otologists' opinions about safety and indications. One hundred and sixteen respondents answered the fourth question (i.e. whether simultaneous mastoidectomies were ever a good treatment strategy). Seventy-four respondents replied in the negative, while 42 replied that simultaneous operations could be indicated. Of the 74 respondents who stated that simultaneous operations were never indicated, 19 went on, in the fifth question, to enumerate indications for simultaneous mastoidectomies. Therefore, 61 respondents gave possible indications for simultaneous operations, although 19 of these respondents appeared to give indications only upon second thought. Interestingly, two respondents replied that they 'absolutely had not' performed simultaneous operations, but also said that such operations could be indicated. Five more respondents, who replied that they 'absolutely had not' performed simultaneous operations, also answered that there were no indications for simultaneous operations but went on to provide indications in question five.

Discussion

Our series of 12 patients, some quite ill, included one adult who was losing his only hearing ear through his own neglect. Most of the ears were quite diseased. Fighting chronic otitis media and chronic mastoiditis, especially in the face of eustachian tube dysfunction, is often a losing battle. However, despite the patients' disease, in only one ear of the 24 studied was hearing noticeably worse post-operatively. In the other 23 ears, hearing was basically the same or better post-operatively. In

https://doi.org/10.1017/S0022215107006330 Published online by Cambridge University Press

half of the first ears and half of the second ears, hearing improved more than 10 dB post-operatively, for a total of eight of 12 patients with post-operative hearing improvement. All of the parents of paediatric patients requested simultaneous bilateral operations and were pleased to address the problem in one sitting. For the non-compliant patients, simultaneous operations interrupted the downhill course of the second ear earlier than would otherwise have been possible.

The survey respondents' objections to simultaneous procedures were based almost entirely on the risk of bilateral sensorineural hearing loss (although a few respondents worried about the risk of bilateral facial nerve injury, transient hearing loss during the recovery period, vestibular symptoms, surgeon fatigue and sterility of the operating field). We too were anxious about the possibility of bilateral complications in our patients. However, the two intra-operative complications in our series occurred only in the first-operated ear. After observing the pathology in the first ear, we were better prepared for the similar challenges in the second ear. In fact, we felt that it was safer, for the patient, to continue with the anatomy fresh in our minds. Indeed, there were no intra-operative complications in any of the second ears.

Despite our own positive experience, an undetected mistake might occur in each ear, and such a mistake might deafen the patient bilaterally. Fear of such an outcome would be especially valid if the inner ear was intentionally entered bilaterally, as in the early days of bilateral stapedectomy. Nonetheless, the same fear is valid for mastoidectomy, an operation in which the inner ear is never entered intentionally. Several respondents mentioned that this treatment strategy 'doubles the risks'. While it is true that the risk of damage to a single ear is doubled, the risk of damage to both ears is very low. A 0.8–4.5 per cent risk of sensorineural hearing loss to each ear means a 1.6–9 per cent risk of hearing damage in one ear or the other. This risk is the same if the operations are staged. However, the probability of deafening both ears is the square of the probability of deafening one ear, or 0.006–0.2 per cent. Of the 121 respondents, 10 actual cases of complications related to the simultaneity of the operations were reported. Of these complications, five were sensorineural hearing loss but only one was explicitly bilateral. Furthermore, if the argument against simultaneity is the risk of bilateral deafness, then the otologist must be committed to not operating on a diseased only-hearing ear.

Sixty-one of 121 respondents gave indications for simultaneous operations. Only 14 respondents had performed simultaneous bilateral mastoidectomies. Nineteen respondents stated that simultaneous operations were never indicated, but then gave indications. This probably reflects ambivalence about the theoretical risks of surgery versus other pressures on the patient and the surgeon. These pressures include the progressive nature of the disease, the occasional very ill patient, the problem of the non-compliant patient and patient convenience.

Perhaps the most powerful pressure on the surgeon is the early history of stapedectomy versus the unlikelihood of sensorineural hearing loss from mastoidectomy. As demonstrated above, the risk of bilateral deafness from mastoidectomy is quite low, and there are important differences between stapedectomy and mastoidectomy. The stapedectomy patient is not sick, and delay in treatment does not preclude a good outcome. Stapedectomy patients are also compliant, and present requesting surgery. Stapedectomy is an operation solely for the purpose of hearing improvement. All these features are in sharp contrast to surgery for chronic ear disease.

- **Bilateral, simultaneous mastoidectomies have been traditionally opposed due to the risk of sensorineural hearing loss**
- **A single case series of three patients is reported in the literature**
- **In certain scenarios, it may be beneficial to the patient to perform simultaneous tympanomastoidectomies, rather than staged mastoidectomies**
- **Bilateral, simultaneous mastoidectomies can be a hearing-sparing operation which can stay the progression of sensorineural hearing loss earlier in patients who were previously reluctant to undergo surgery**
- **The risk of bilateral sensorineural hearing loss following bilateral, simultaneous mastoidectomies is very low (0.006–0.2 per cent)**
- **A survey of US otologists revealed a strong aversion to performing bilateral, simultaneous mastoidectomies**
- **Bilateral, simultaneous mastoidectomies for hearing preservation can be performed safely**

Performing simultaneous bilateral mastoidectomies is not comparable to performing simultaneous stapedectomies. Instead, it is more similar to operating on a diseased only-hearing ear, and requires the same level of vigilance. In chronic mastoiditis, without intervention, that ear is at risk of continued deterioration. Nevertheless, performance of a mastoidectomy on such an ear must be undertaken with careful consideration, and the patient must be fully versed in the risks. Similarly, when performing simultaneous bilateral mastoidectomies, the surgeon must draw on the specific patient's situation and the intra-operative findings to determine the probability that the second ear has become an only-hearing ear. If the first ear was very diseased and difficult to clean, then there is more chance that the inner ear will be injured (than if the ear was easy to clean). Next, the surgeon must decide if the second ear's situation merits operation as an only-hearing ear. Finally, in simultaneous bilateral mastoidectomy, the surgeon is probably better prepared for

https://doi.org/10.1017/S0022215107006330 Published online by Cambridge University Press

the second ear than would otherwise be possible. An anatomical or pathological finding in the first ear will probably alert the surgeon to similar problems waiting in the second ear.

Conclusion

We performed simultaneous bilateral mastoidectomies on 12 patients with bilateral ear disease. We selected the more challenging ear for the first operation, and we had two intra-operative complications, both in the first of the two operated ears. There were no intra-operative complications in any of the second operated ears. In 23 of the 24 ears, hearing was the same or better post-operatively. A survey of otologists found that most opposed the idea of simultaneous bilateral mastoidectomies, citing the risk of bilateral sensorineural hearing loss. However, the statistical probability of bilateral deafness is quite low. Interestingly, 61 of 114 respondents gave indications for simultaneous mastoidectomies, despite their opposition, reflecting the tension between tradition and the low risk of complications. We suggest that, after the first ear procedure, the surgeon makes three assessments: (1) how likely it is that the first ear was injured?; (2) is the diseased second ear bad enough to warrant surgery even if it is the only hearing ear?; and (3) are the anatomical and pathological conditions of the first ear sufficiently unusual or difficult that it is safer, for the patient, to address the second ear while all the relationships are fresh in the surgeon's mind?

References

1 Smyth GD. Sensorineural hearing loss in chronic ear surgery. *Ann Otol Rhinol Laryngol* 1977;**86**:3–8
2 Palva T, Karja J, Palva A. High-tone sensorineural losses following chronic ear surgery. *Arch Otolaryngol* 1973;**98**: 176–8
3 Tos M, Lau T, Plate S. Sensorineural hearing loss following chronic ear surgery. *Ann Otol Rhinol Laryngol* 1984;**93**:403–9
4 Proctor B. Chronic otitis and mastoiditis. In: Shumrick Paed. *Otolaryngology*, 3rd edn. Philadelphia: WB Saunders, 1991; **2**:1349–76
5 Kartush JM. Ossicular chain reconstruction. Capitulum to malleus. *Otolaryngol Clin North Am* 1994;**27**:689–715
6 Pasha R, Hill SL 3rd, Burgio DL. Evaluation of hydroxyapatite ossicular chain prostheses. *Otolaryngol Head Neck Surg* 2000;**123**:425–9
7 Mongkolrattanothai K, Oram R, Redleaf M, Bova J, Englund JA. Tuberculous otitis media with mastoiditis and central nervous system involvement. *Pediatr Infect Dis J* 2003;**22**:453–6

Appendix 1. Survey and responses

(Note that data given are number of replies.)

1 Have you ever performed simultaneous bilateral mastoidectomies on the same patient at the same sitting? (Please exclude cochlear implantation.)

Many times	0
Sometimes	3
Rarely	11
Never	78
Absolutely not	28

2 Have you ever experienced or learned of any complication of bilateral mastoidectomy which would have been avoided by staging the procedure?

Yes	10
No	100

3 What was it?

Sensorineural hearing loss (laterality unspecified)	3
Profound bilateral deafness	1
Profound unilateral deafness	1
Bilateral SNHL due to surgeon skill	2
Profound bilateral deafness after stapedectomy	1
Facial nerve injury	1
Inadequate procedure secondary to fatigue	1
Operation not indicated	1
Complication not specified	1

4 Do you think bilateral mastoidectomy is ever a good treatment strategy?

Yes	42
No	74
No Answer	5
Answered no, but gave indications	19

5 Why or why not?

(a) Reasons cited as indications for performing bilateral, simultaneous mastoidectomies.	
Severe bilateral infection	8
Bilateral subperiosteal abscess or coalescent mastoiditis	5
Bilateral complications & bilateral acute mastoiditis	4
Bilateral cholesteatoma	3
High risk of developing complications	2
'Dangerous' mastoid disease	1
Immunocompromised patient	1
Bilateral acute mastoiditis with intracranial complications in an immunocompromised patient not responding to antibiotics	1
Immunosuppressed child with chronic otitis media & lateral sinus infection	1
Economic or logistic reasons	18
Cochlear implant	7
Poor follow-up risk or noncompliant	4
Severe or profound hearing loss, or already deaf	3
Extraordinary circumstances	2
Simple mastoid only	1
Bilateral necrotising otitis externa	1
Must be treated quickly & willing to have temporary disability	1
Morbidity & mortality of anaesthetic greater than surgical risk	1
Similar to doing an only-hearing ear for cholesteatoma	1
(b) Reasons cited for never performing bilateral, simultaneous mastoidectomies.	
Risk of sensorineural hearing loss	37
Transient hearing loss	9
Vestibular symptoms	8
Facial nerve injury	5
General risk	4
Length of operating time or fatigue	4
Positioning or sterile field	4
Risks of complications doubled	3
Difficult to determine side of injury	2
Poor healing or needs time to heal	2

https://doi.org/10.1017/S0022215107006330 Published online by Cambridge University Press

Appendix 1 Continued

Too difficult on patient	1
'Intuitive'	1

Address for correspondence:
Dr Miriam Redleaf,
Section of Otolaryngology, Dept of Surgery,
University of Chicago Hospitals,
5841 South Maryland Ave MC 1035,
Chicago, IL 60637-1035, USA.

Fax: (773) 702 6809,
E-mail: mredleaf@surgery.bsd.uchicago.edu

Dr M Redleaf takes responsibility for the integrity of the content of the paper.
Competing interests: None declared

https://doi.org/10.1017/S0022215107006330 Published online by Cambridge University Press