

# Management of Iatrogenic Facial Nerve Palsy and Labyrinthine Fistula in Mastoid Surgery

**Yeoh Thiam Long, Primuharsa Putra bin Sabir Husin Athar, Ridzo Mahmud and Lokman Saim**, Department of Otorhinolaryngology, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia.

A 6-year review of complications of mastoid surgery between June 1995 and June 2001 revealed five cases with serious iatrogenic complications from mastoid surgery, of which four were facial nerve palsy and two were labyrinthine fistula. One of these patients had concomitant facial nerve palsy and labyrinthine fistula. There were two cases of complete facial nerve palsy (House Brackmann grade VI) and two cases of incomplete palsy (House Brackmann grades IV and V). The second genu was the site of injury in three of the four cases. Of the four cases with facial nerve palsy, two patients had full recovery (House Brackmann grade I), one recovered only to House Brackmann grade III, and one was lost to follow-up. Both patients with labyrinthine fistula had postoperative vertigo and profound sensorineural hearing loss. The site of iatrogenic fenestration was the lateral semicircular canal in both cases. [*Asian J Surg* 2004;27(3):176–9]

## Introduction

Iatrogenic complications of mastoid surgery such as facial nerve palsy, labyrinthine fistula, vascular injury and dural injury are devastating for the patient and the surgeon. These seem to have decreased with the introduction of the surgical microscope, better otologic drill and, more recently, instruments for monitoring the facial nerve. Complications can be attributed to a number of factors, such as the surgeon's skill and abnormal anatomical structures that may be due to the disease process in the ear, or congenital abnormalities. Each complication must be thoroughly evaluated and the surgical technique reviewed to identify the possible cause of the injury. This will not only help in the immediate management of the complication but also enhance the learning curve of the surgeon so that such complications can be avoided in the future. The aim of this study was to review all cases of iatrogenic facial nerve palsy and labyrinthine fistula following mastoidectomy in patients who underwent urgent revision surgery at our institution between June 1995 and June 2001. We advocate our surgical techniques and make recommendations for prevention of the serious iatrogenic complications.

## Materials and methods

We studied the surgical records of patients treated for serious complications of mastoid surgery between June 1995 and June 2001 in the Department of Otorhinolaryngology, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia. Revision surgery was performed in all these cases. The intraoperative findings during revision surgery were noted. The grade and site of facial nerve injury, site of labyrinthine fistula and status of the surgeon were evaluated. In our country, consultant ear, nose and throat (ENT) surgeons are specialists with more than 5 years' working experience, and clinical ENT specialists are those with working experience of less than 1 year. Specialist ENT surgeons are those with working experience of more than 1 year but less than 5 years.

## Results

Between June 1995 and June 2001, we treated five patients with serious complications of mastoid surgery. Four cases were referred from other centres and only one case occurred at our centre. Of the five cases, four had facial nerve palsy. One of

Address correspondence and reprint requests to Dr. Yeoh Thiam Long, Department of Otorhinolaryngology, Universiti Kebangsaan Malaysia, Jalan Yaacob Latif, 56000 Cheras, Kuala Lumpur, Malaysia.  
E-mail: ytlong@tm.net.my • Date of acceptance: 21<sup>st</sup> March, 2003

these had concomitant labyrinthine fistula. The fifth patient had labyrinthine fistula only. There were four female patients and one male patient. Their mean age was 35.6 years.

**Facial nerve palsy**

Of the four patients with facial nerve palsy, two cases had complete palsy (House Brackmann grade VI) and two had incomplete palsy (House Brackmann grades IV and V). In all cases, electroneurography (ENOG) showed degeneration of more than 90%.

Two patients had undergone modified radical mastoidectomy, one for cholesteatoma and the other for chronic mastoiditis (Table). In the other two patients, cortical mastoidectomy was used to treat chronic mastoiditis. The two cortical mastoidectomies were performed by a clinical ENT specialist, one modified radical mastoidectomy was performed by an ENT specialist, and the other modified radical mastoidectomy was performed by a consultant ENT surgeon.

The most common site of injury was the second genu, in three patients, while one patient had injury at the tympanic segment. In all cases, urgent revision surgery was performed by a senior neurotologist. Intraoperatively, three cases had a traumatized and oedematous facial nerve and underwent facial nerve decompression over the affected area. The patient with complete facial nerve transection over the tympanic segment underwent mobilization and primary anastomosis.

In the two cases with complete palsy (House Brackmann grade VI), one recovered to House Brackmann grade I, 12

months after facial nerve exploration and decompression. The other patient defaulted follow-up after primary anastomosis of the facial nerve. In the two cases with incomplete palsy, one recovered fully (House Brackmann grade I) and the other recovered only to House Brackmann grade III, 12 months after facial nerve exploration and decompression.

**Labyrinthine fistula**

Two patients had labyrinthine fistula following cortical mastoidectomy. One also had concomitant facial nerve palsy. During exploration, both fistulas were noted at the lateral semicircular canal. Both had severe vertigo and profound sensorineural hearing loss over the affected ears. Fistula tests were negative in both cases.

**Discussion**

Mastoid surgery is becoming less common for disease in the ear due to overall improvement in the management of ear diseases. However, ENT surgeons still need to master the surgical technique and skills because the surgery can result in devastating complications. Injury to the facial nerve is probably the most serious complication of otologic surgery. The incidence of iatrogenic facial nerve injury is said to be between 1% and 5%.<sup>1,2</sup> In a study by Nilssen and Wormald, the overall incidence was 1.7%, while the incidence among surgical trainees was 2% and among consultants was 1.3%.<sup>1</sup> The tympanic and mastoid segment and the second genu are most easily

**Table.** Summary of patients with iatrogenic facial nerve palsy

Surgery	Status of surgeon	Injury		Surgical treatment	Recovery grade
		Grade	Site		
Modified radical mastoidectomy	Consultant	HB VI	Nerve transection over tympanic segment	Mobilization and primary anastomosis	Not known (lost to follow-up)
Modified radical mastoidectomy	Specialist	HB VI	Traumatized with nerve oedema over 2 <sup>nd</sup> genu and mastoid segment	Facial nerve decompression over 2 <sup>nd</sup> genu and mastoid segment	HB I
Cortical mastoidectomy	Clinical specialist	HB IV	Traumatized with nerve oedema over 2 <sup>nd</sup> genu, LSCC fistula noted	Facial nerve decompression over 2 <sup>nd</sup> genu	HB I
Cortical mastoidectomy	Clinical specialist	HB V	Traumatized with nerve oedema over 2 <sup>nd</sup> genu and mastoid segment	Facial nerve decompression over 2 <sup>nd</sup> genu and mastoid segment	HB III

HB = House Brackmann; LSCC = lateral semicircular canal.

injured. In the tympanic segment, vulnerability of the facial nerve is associated with a high percentage of dehiscence of the fallopian canal at that site.<sup>3-6</sup>

In our review of patients seen at our institution, three cases had injury of the facial nerve at the second genu. This may occur while drilling towards the aditus during mastoid surgery. The surgeon may accidentally drill more inferiorly than the actual location of the aditus. As the second genu of the facial nerve is located inferior and medial to the aditus, it is the most likely site to be injured. The other vulnerable structure in this area is the lateral semicircular canal. We had one patient with iatrogenic injury to the second genu of the facial nerve and the lateral semicircular canal. A sclerotic mastoid and presence of granulation tissue in the middle ear and mastoids may hinder proper identification of the aditus. Furthermore, cholesteatoma may also erode the area of the second genu, thus making it more vulnerable to injury during drilling.

Therefore, we advocate drilling directed more superiorly and anteriorly towards the attic when encountering difficulty in identifying the aditus during mastoid surgery. Exposure of the attic is a much safer step to avoid injury to the second genu of the facial nerve and the lateral semicircular canal. Adequate exposure of the bony external auditory canal is helpful as the superior part of the canal is a useful landmark in locating the attic region. Once the attic and its contents have been identified, granulation tissue, polyps or cholesteatoma can be gently removed for proper exposure before further drilling posteroinferiorly to identify the aditus, short process of incus, lateral semicircular canal and the second genu and mastoid segment of the facial nerve.

To further avoid iatrogenic facial nerve injury during mastoid surgery, many authors advocate intraoperative monitoring and facial nerve stimulation.<sup>6-10</sup> Silverstein et al believe intraoperative facial nerve monitoring has several advantages: it allows mapping of the nerve through soft tissue, tumour and bone; it predicts dehiscences in the bony covering of the nerve; and it allows confirmation of the electrical integrity of the nerve before and after surgery.<sup>7</sup> Noss et al showed that facial nerve monitoring aided in the surgical decision-making process and averted a potential injury to an abnormal-course facial nerve, allowed early identification and confirmation of the facial nerve, and allowed atraumatic dissection of cholesteatoma matrix.<sup>10</sup> Thus, there is a greater margin of safety in surgical dissection with intraoperative facial nerve monitoring.

In all our patients, ENOG showed degeneration of more than 90% prior to surgical exploration. ENOG is based on

recording of the evoked summing potentials of the facial muscles with bipolar surface electrodes. It gives objective quantitative information on the evolution of degeneration as early as 24 hours after the onset of facial palsy.<sup>11</sup> Daily ENOG testing is indicated at our institution when there is immediate complete facial nerve palsy and the operating surgeon has absolute confidence that the nerve is anatomically intact or when there is progressive deterioration in facial nerve function in cases with immediate incomplete facial palsy. Urgent surgical revision is indicated when degeneration is more than 90% within 1 week following injury. When immediate facial nerve palsy occurs with an uncertain event or difficult pathology during mastoid surgery, urgent exploration and decompression is indicated.<sup>12</sup>

Injury to the labyrinth during mastoid surgery can cause sensorineural loss and lead to more serious suppurative and intracranial infections. It is thought to be more common during manipulation of the stapes while removing granulation tissue or cholesteatoma in the area. In our study, two patients had labyrinthine fistula occurring at the lateral semicircular canal. In both cases, it is most likely that the semicircular canals were accidentally injured while drilling towards the aditus. If fenestration of the semicircular canal occurs during the process of drilling or removal of disease, the fistula should be repaired immediately. The first step is to stop further dissection and irrigation. If the periosteal membrane is still intact, it should be covered with fascia. If the periosteal membrane or entire endolymphatic compartment has been disrupted, the open ends can be plugged with bone wax and covered with fascia. In cases with suspected labyrinthine fistula after mastoid surgery, urgent surgical exploration is warranted. Exposure of the semicircular canal is performed delicately under high magnification and the fistula repaired as described above.

A recent study by Dawes showed that the incidence of surgically created fistula was 0.07% (1/14 patients with post-operative vertigo).<sup>13</sup> Both our cases had fistula over the lateral semicircular canal and fistula tests were negative. Fistula signs are an unreliable indication of the presence of labyrinthine fistula, with a false negative rate of 54%.<sup>14</sup> In a review by Kvestad et al, seven of 20 patients had a negative fistula sign, negative computed tomography (CT) scan, and no history of vertigo.<sup>15</sup> High-resolution CT has a reported sensitivity of 80% to 97%, and a false positive rate of less than 5%.<sup>16,17</sup> By virtue of its anatomical location, the lateral semicircular canal is the portion of the labyrinth most often exposed to surgical trauma and to erosion by cholesteatoma.<sup>4,18</sup>

In conclusion, serious iatrogenic complications of mastoid surgery commonly involve the second genu and tympanic segment of the facial nerve and fenestration of the lateral semicircular canal. When one encounters difficulty in identifying the aditus during mastoid surgery, exposure of the attic is a much safer step to avoid injury to the second genu of the facial nerve and the lateral semicircular canal. We advocate adequate exposure of the bony external canal and drilling superiorly and anteriorly towards the attic as key steps in avoiding these serious complications. Although not a substitute for anatomic identification of the facial nerve and surgical ability, intraoperative facial nerve monitoring is recommended during mastoid surgery. Temporal bone dissection in the laboratory is the gold standard in the learning curve for all ENT surgeons to avoid devastating iatrogenic complications.

## References

1. Nilssen EL, Wormald PJ. Facial nerve palsy in mastoid surgery. *J Laryngol Otol* 1997;111:113-6.
2. Harner SG. Iatrogenic facial paralysis prevention. *Ear Nose Throat J* 1996;75:718-9.
3. Takahashi H, Sando I. Facial canal dehiscence: histologic study and computer reconstruction. *Ann Otol Rhinol Laryngol* 1992;101:925-30.
4. Mancini F, Taibah AK, Falcioni M. Complications and their management in tympanomastoid surgery. *Otolaryngol Clin North Am* 1999;32:567-83.
5. Green JD. Iatrogenic facial nerve injury during otologic surgery. *Laryngoscope* 1994;104:922-6.
6. Selesnick SH, Lynn-Macrae AG. The incidence of facial nerve dehiscence at surgery for cholesteatoma. *Otol Neurotol* 2001;22:129-32.
7. Silverstein H, Smouha EE, Jones R. Routine intraoperative facial nerve monitoring during otologic surgery. *Am J Otol* 1988;9:269-75.
8. Pensak ML, Willging JP, Keith RW. Intraoperative facial nerve monitoring in chronic ear surgery: a resident training experience. *Am J Otol* 1994;15:108-10.
9. Prass RL. Iatrogenic facial nerve injury: the role of facial nerve monitoring. *Otolaryngol Clin North Am* 1996;29:265-75.
10. Noss RS, Lalwani AK, Yingling CD. Facial nerve monitoring in middle ear and mastoid surgery. *Laryngoscope* 2001;111:831-6.
11. Fisch U. Facial paralysis. In: Maran AG, Stell PM, eds. *Clinical Otolaryngology*. Oxford: Blackwell Scientific Publications, 1979:65-85.
12. Sofferan RA. Facial nerve injury and decompression. In: Schuknecht HF, Nadol JB, eds. *Surgery of the Ear and Temporal Bone*. New York: Raven Press Ltd, 1993:329-43.
13. Dawes PJ. Early complications of surgery for chronic otitis media. *J Laryngol Otol* 1999;113:803-15.
14. Gormley PK. Surgical management of labyrinthine fistula with cholesteatoma. *J Laryngol Otol* 1986;100:1115-23.
15. Kvestad E, Kvaerner KJ, Mair IW. Labyrinthine fistula detection: the predictive value of vestibular symptoms and computerized tomography. *Acta Otolaryngol* 2001;121:622-6.
16. O'Reilly BJ, Chevretton EB, Wylie I. The value of CT scanning in chronic suppurative otitis media. *J Laryngol Otol* 1991;105:990-9.
17. Fuse T, Tada Y, Aoyagi M, Sugai Y. CT detection of facial canal dehiscence and semicircular canal fistula: comparison with surgical findings. *J Comput Assist Tomogr* 1996;20:221-4.
18. Jahrsdoerfer RA. Labyrinthine trauma during ear surgery. *Laryngoscope* 1978;88:1589-95.