

Fallopian Canal Dehiscence in Modified Radical Mastoidectomy and Facial Nerve Status

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ABSTRACT

A prospective study was conducted in a tertiary hospital to observe the number of cases of fallopian canal dehiscence in patients who underwent modified radical mastoidectomy. The objectives of this study were to determine the cases of fallopian canal dehiscence intraoperatively and to evaluate the middle ear cleft pathology and ossicular status. Relationship between the fallopian canal dehiscence with the disease pathology and ossicular status were also evaluated. The study included 108 patients, ranging from a 3 to 60 years of age, with the mean age being 28.06 years. The study period was two years from January 2013 to December 2015. Fallopian canal dehiscence was seen in 19.4% cases. The most common location for dehiscence was the tympanic segment (76.19%), mastoid segment (19.05%) and both the tympanic and mastoid segment (4.76%). The disease pathology encountered were cholesteatoma with granulation (52.8%), granulation (29.6%) and cholesteatoma (17.6%). Among the ossicles, incus was found to be the most commonly affected ossicle. Relationship between the fallopian canal dehiscence and the middle ear cleft pathology was not found to be statistically significant (p value= 0.647). Whereas, the relationship between the fallopian canal dehiscence and ossicular status was found to be statistically significant (p value < 0.05). Hence, an otologist must note that the presence of ossicular erosion is related to fallopian canal dehiscence, which may increase the risk of facial nerve injury if not careful.

Key words: Disease pathology, Fallopian canal dehiscence, Modified radical mastoidectomy, Ossicular status

INTRODUCTION

The complex anatomy of the facial nerve within the temporal bone, poses a challenge during mastoidectomy to all otologists. While operating the surgeon must be well versed with the anatomy of the facial nerve and its course in the middle ear. Fallopian canal dehiscence (FCD) due to an anatomical defect or due to disease is an occurrence that can be observed during middle ear surgery. Even patients without any prior complications of chronic otitis media (COM) squamous type, are at risk of facial nerve palsy while undergoing mastoidectomy. This can be due to iatrogenic causes during surgery or due to the dehiscence of the fallopian canal, which exposes the facial nerve, increasing the risk of injury. The facial nerve within the temporal bone is divided into three segments: labyrinthine, tympanic, and mastoid. The tympanic and mastoid segments are more vulnerable to injury during otologic surgery.^{1,2} Hence, it is imperative that the facial nerve be identified prior to drilling around these areas.

The bony fallopian canal is defined as the portion of the facial nerve within the temporal bone, with ossification of the structure commencing in utero and ending about one year after birth.¹ Ossification may not be complete in some parts of the fallopian canal with resultant FCD. The course of inflammation in chronic otitis media

or cholesteatoma, involves local destruction, which induces dehiscence of the fallopian canal. Previous surgery, granulation tissue, and cholesteatoma distort normal anatomy and increase the risk of iatrogenic injury.³

Mastoid surgery performed without a microscope has been associated with rates of facial nerve injury as high as 15%.⁴ With the use of modern technology (high-magnification microscopy, motorized drills, etc.), the incidence of facial nerve injury has been reduced significantly to between 0.6% and 3.6% for an initial procedure, although it escalates to 4%-10% for surgical revisions.⁵

Most theories of bony destruction or resorption in cholesteatoma with chronic otitis media involve pressure necrosis, osteolysis, or contact between the inflammatory granulation tissue and bone, which causes a series of enzymatic bony destruction.^{6,7} Recent theories say that interleukin-1, 6, 11, matrix metalloprotein and platelet derived growth factors are also causes of the bony erosion by the cholesteatoma.⁸ When cholesteatoma and FCD coexist, the risk of facial nerve injury is heightened because the natural bony overlay otherwise shielding the nerve from microdissection trauma is absent.⁶ Patients with cholesteatoma often exhibit a higher incidence of FCD than those with other middle ear pathologies.^{1,9}

The study was conducted to observe the number of cases with fallopian canal dehiscence and to find out its relationship with middle ear disease pathology, and the ossicular status intraoperatively.

MATERIALS AND METHOD

A prospective study was conducted at Nepal Medical College Teaching Hospital, Department of Otorhinolaryngology and Head and Neck Surgery from January 2013 to December 2015, a period of two years. One hundred and eight patients (n=108) diagnosed with COM, squamous type, who underwent modified radical mastoidectomy (MRM) under general anaesthesia were included in the study. Patients with history of previous middle ear surgery fracture of the temporal bone, congenital anomalies and those undergoing radical mastoidectomy were excluded from the study. Preoperative counseling was done and consent was taken from the patients or parents (in case of children below 18 years of age). Permission for the study was obtained from the Research and Ethical Sub Committee (RESC) of Nepal Medical College.

Diagnosis of COM, squamous type, was made on the basis of history and clinical examination, pure tone audiogram and x-ray of the mastoid. Further confirmation of the diagnosis was done by examination under microscope prior to surgery. In cases where there was a suspicion of complications, high resolution computed tomography (HRCT) of the temporal bone was done. Facial nerve examination was done preoperatively and postoperatively (House-Brackman classification) to assess its status. A motorized drill was used to perform the surgery (MRM). Fallopian canal dehiscence was assessed by visual inspection using high magnification microscopy and also by palpating the canal with a blunt probe peroperatively. Middle ear disease pathology and ossicular status were also evaluated under the microscope, and these findings were recorded. Assessment of the facial nerve was done soon after the patient gained consciousness. Patients were monitored every day following the operation and were discharged on the 7th day postoperative day. Follow up in the otorhinolaryngology and head and neck surgery outpatients department was done on the 2nd, 6th and 12th week from the day of the surgery.

Statistical analysis was done using SPSS version 17. Descriptive statistics such as frequency, mean and standard deviation were calculated. Chi-square test was used to find the association between the variables. Statistical test was done at 95% confidence interval. Results were analyzed using statistical chi square test taking value $p < 0.05$ as significant level.

RESULTS

One hundred and eight patients who underwent modified radical mastoidectomy were included in the study. The age group ranged from 3 to 60 years with the mean age of 24.06 years. Out of these cases, 21 (19.4%) showed fallopian canal dehiscence intraoperatively. The site of fallopian canal dehiscence was identified in the study. Out of 21 patients with FCD the most common location was the tympanic segment 16 (76.19%), followed by the mastoid segment 4 (19.05%) and tympanic and mastoid segment in 1 (4.76%) (Table 1).

Table 1: Site of fallopian canal dehiscence

Fallopian canal segment	Number	Percentage
Tympanic segment	16	76.19%
Vertical segment	4	19.05%
Tympanic and vertical segments	1	4.76%
Total	21	100%

The middle ear cleft pathology included cholesteatoma and granulations in 57 cases (52.8%), granulations in 32 (29.6%) and cholesteatoma in 19 (17.6%) (Fig 1).

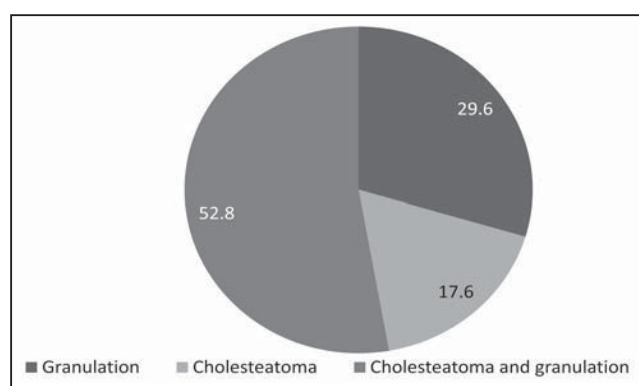


Fig. 1. Distribution of Pathology

Incus was seen to be the most commonly affected ossicle. In 28 (25.9%) cases incus was absent, eroded in 75 (69.4%) and intact in only 5 (4.6%) cases. The stapes suprastructure was absent in 26 (24.1%) eroded in 32 (29.6%) and intact in 50 (46.3%) cases. The malleus was found to be intact in 51 (47.2%), eroded in 46 (42.6%) and absent in 11 (10.2%) cases (Fig. 2.)

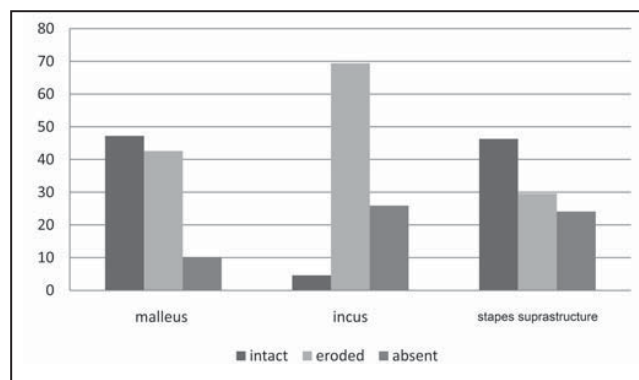


Fig 2. Ossicular status(%)

Table 2: Fallopian Canal dehiscence and middle ear cleft pathology

Fallopian canal		Pathology N(%)		
		Cholesteatoma	Cholesteatoma and Granulation	Granulation
FCD	Not intact	5(23.8)	11(52.4)	5(23.8)
	Intact	14(16.1)	46(52.9)	27(31)
p-value		0.647		

Table 3: Relationship of fallopian canal dehiscence and ossicular status

Fallopian canal		Malleus N(%)			Incus N(%)			Stapes suprastructure N(%)		
FCD	Not intact	Intact 3(14.3)	Eroded 11(52.4)	Absent 7(63.6)	Intact 0(0)	Eroded 6(28.6)	Absent 15 (71.4)	Intact 7(33.3)	Eroded 3(9.4)	Absent 14 (66.7)
	Intact	48 (55.2)	35 (40.2)	4 (4.6)	5(5.7)	69 (79.3)	13 (14.9)	75 (86.2)	29(90.6)	12 (13.8)
P-value		<0.05			<0.05			<0.05		

Chi-square test was used to analyse the statistical significance between the fallopian canal dehiscence with the disease pathology and ossicular status. The relationship between the middle ear disease pathology, and fallopian canal dehiscence was not found to be statistically significant, p value = 0.647 (Table 2), whereas, relationship between the ossicular status and fallopian canal dehiscence was found to be statistically significant, p value < 0.05 (Table 3).

There were two patients who had unilateral facial nerve paralysis grade 2 and 3 as a complication of COM, squamous type and who underwent MRM. After surgery both the patients recovered fully from the paralysis. Two patients had facial paralysis grade 2 on the second postoperative day. These two patients had canal dehiscence in the tympanic segment, with cholesteatoma and granulation in the middle ear cleft and they recovered within 2 weeks with conservative management. Grade 3 iatrogenic facial nerve paralysis was seen in one patient with cerebellar abscess, which did not improve during the follow up period.

DISCUSSION

Fallopian canal dehiscence is a known anatomical variation that is encountered in mastoid surgery. The dehiscence may be developmental or due to bony resorption associated with COM squamous type. The frequency of intraoperatively detected dehiscences varies from 6.0 to 35% in the literature.^{6,10,11} In our study the fallopian canal dehiscence observed was 19.4% intraoperatively. Similar rates of FCD, from 8.8% to 37.3%, were observed in reported studies of cholesteatoma surgery.¹²⁻¹⁷ Acharya K *et al* also reported 22% of FND in their study.¹⁸ Most microdehiscences may not be detected intraoperatively because of their small

size, which specially includes the inferior or underside of the facial canal. The frequency of microdehiscences in studies suggests that a substantial number of findings may be intraoperatively overlooked, since they can be usually recognized in the denuded bone only.¹² The lack of bony coverage causes a locus minoris resistentiae for the facial nerve, and although these alterations are easily recognized during otosurgery in the normal tympanic mucosa, they may be difficult to detect in mucosal changes due to longstanding inflammation, extensive scarring and large cholesteatomas.^{4,19}

Various studies have reported that the tympanic segment is the most common site of FCD, with the site being involved in 50%, 74% and 92.8%.^{18,20,21} In our study we have also observed similar findings with 76.19% dehiscence in the tympanic segment. This may be due to the tendency of cholesteatomas near the tympanic segment of the facial nerve to invade more extensively.⁶ The bony covering of the fallopian canal at this point is relatively thin and more vulnerable to the mechanical trauma of surgical microdissection. The direct abutment of cholesteatoma matrix or granulation to the dehiscent facial nerve strongly suggests that bony erosion by cholesteatoma plays a vital role in FCD development.²² Cholesteatomas at posterior, epi or mesotympanic sites are known to spread along the ossicular chain, eroding the fallopian canal just above the oval window.²³ In our study the middle ear cleft pathology both cholesteatoma and granulation were observed in 52.8%, granulations in 29.6% and cholesteatoma in 17.6%, which are similar to findings in a study done by Shrestha S.²⁴ However, the findings were different in a study conducted by Acharya K, where cholesteatoma with granulation (75.2%) was still

found to be the most common pathology, but was followed by cholesteatoma alone (18.4%) and with granulation tissue (6.4%).¹⁸ Erosion of the ossicles are frequent findings observed during mastoidectomy. The present study showed incus was the most commonly affected ossicle, being absent in 25.9%, eroded in 69.4% and intact in only 4.6% of the cases, which was also observed in other studies.²⁴⁻²⁶ Similarly, the stapes suprastructure was absent in 24.1%, eroded in 32 (29.6%) with the malleus being the least affected ossicle. The relationship between the fallopian canal dehiscence and middle ear cleft pathology was statistically analysed and was found not significant with a p-value = 0.647. Similar result was seen in the study carried out by Archarya k et al.¹⁸ The relationship between fallopian canal dehiscence and the status of all three ossicles were assessed and it was found to be statistically significant in our study, (p-value < 0.05). Chan KC only looked at the relationship between the FCD and status of the stapes suprastructure, his study included revision cases and the malleus and incus were subjected to manipulation in previous surgeries. It was found that the intraoperative absence of the stapedia suprastructure correlated statistically with FCD.²²

Another study conducted by Filiz Gulustan concluded that FCD was found to be more common with incus and stapes defect. An eroded stapes suprastructure should alert surgeons to the potential for FCD and to facial canal involvement with cholesteatoma.²⁷ Fallopian canal dehiscence may be a preexisting condition that is seen during MRM, which can lead to facial nerve injury if the surgeon is not careful. Along with this, the study has also shown a relationship between FCD and ossicular status. Hence, the surgeon must be careful if ossicular erosions are detected during surgery as this is related to fallopian canal dehiscence.

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