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The prevalence of facial canal dehiscence: first cross-sectional study in Iraq

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Abstract

Background The facial nerve is considered a crucial structure and is vulnerable to injury during middle ear and mastoid surgery. The facial canal could be dehiscent in certain populations; therefore, identifying it and avoiding injury to the nerve is an important step during otological surgeries. In this study, we assessed the rate of facial canal dehiscence (FCD) among patients undergoing surgery due to the presence of chronic suppurative otitis media (CSOM).

Methods A cross-sectional study was performed between June 2019 and May 2023. We included 102 patients (aged 8–70 years), admitted for primary tympanomastoid exploration due to the presence of CSOM with and without cholesteatoma at Azadi Teaching Hospital in Duhok/Iraq. Cases with a history of trauma or craniofacial abnormalities were excluded from the study. Also, none of the selected patients complained of facial nerve disorders.

Results Among the 102 patients who were admitted, 11.76% ($n=12$) had FCD; they were between the ages of 11 and 58 (average: 30.9) years (18.8% ≤ 18 years vs. 10.5% > 18 years, $p=0.396$). The dehiscence was more common in males than females (14.3% vs. 10.0%, $p=0.545$) and was also more common on the left side than the right side (13.8% vs. 9.1%, $p=0.547$). Of those with the dehiscent facial nerve, 83% ($n=10$) had the dehiscence on the tympanic segment. The dehiscence was statistically more common in patients with cholesteatoma than those without (25.9% vs. 6.7%, $p=0.014$).

Conclusion Dehiscence in the facial nerve can be encountered in patients with CSOM, particularly those with cholesteatoma. In such patients, the dehiscence is most commonly found on the tympanic segment of the facial nerve, so care should be taken during surgery for such cases to avoid injury of the nerve.

Keywords Facial canal dehiscence, Chronic suppurative otitis media, Cholesteatoma

Background

The facial nerve is one of the most important structures of the middle ear and the mastoid; damage to this nerve is concerning to surgeons and will have catastrophic effects on the patient's quality of life [1].

The rate of iatrogenic facial nerve damage is still considered high despite numerous precautions and advances in instruments and devices, including imaging and intraoperative facial nerve monitoring. The complication rate reaches 17% in otologic procedures, with the highest being reported in mastoid surgeries [2].

A very common operation in the field of otology is that for chronic suppurative otitis media (CSOM). Preoperative radiological assessment of the temporal bone by CT scan can sometimes be helpful to identify FCD, while the dehiscence may be missed on occasion [3]. Therefore, according to many surgeons in this field, the key to a successful tympano-mastoid surgery is the identification of the facial nerve, identifying and pinpointing it, rather than avoiding it; this is essential for either an intact canal wall or canal wall down approaches to the mastoid. Facial nerve injury is rarely due to an abnormal nerve pathway;

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rather, it is mainly caused by the extreme manipulation of a dehiscent tympanic segment or drilling close to the second genu or mastoid part of the nerve [4].

The dehiscence in the nerve could be congenital or disease induced. In a previous study, the rate of dehiscence in the facial nerve canal in patients undergoing surgery for CSOM with or without cholesteatoma was 11.2%; this rate was very different between individuals who had cholesteatoma and those without: 88.1% and 11.9%, respectively [5]. This was also true when only those with CSOM without cholesteatoma were evaluated, where the rate was 8.6% [6], in contrast to those with cholesteatoma undergoing surgery, with a rate in the dehiscent nerve of around 20% [7, 8].

The dehiscence in the facial nerve canal could include any of its portions; however, the tympanic segment was the most common site (Picture 1) for the dehiscence [9, 10], which could be one of the reasons why it is also the most common site for iatrogenic facial nerve damage [11].

This cross-sectional study aimed to identify the rate of FCD, determine its most affected segment and understand its relation to age and sex in patients undergoing tympano-mastoid surgery due to CSOM with and without cholesteatoma.

Methods

This cross-sectional observational study was performed at Azadi Teaching Hospital in Duhok, Iraq, from June 2019 to May 2023.

Sequentially, 102 patients aged 8–70 years were included this study. Those patients were examined and diagnosed by the authors at the outpatient clinic at Azadi Teaching Hospital in Duhok then admitted purely for tympano-mastoid exploration surgery based on either chronic suppurative otitis media (CSOM) with cholesteatoma or chronic suppurative otitis media (CSOM) mucosal type without cholesteatoma, to investigate the prevalence of dehiscent facial nerve in patients admitted for surgery due to previously mentioned indications.

Upon admission for surgery, written consent explaining the steps of the surgery and the examination that would be performed was taken by the surgeon from all patients, parents, or legal guardians.

None of the patients selected complained of any symptoms or signs of facial nerve disorders via self-report or by their families, nor were any symptoms noticed by the surgeon during the preoperative examination. Any cases presented as such were excluded from the study. Other exclusion criteria were patients with a history of previous surgery, history of trauma, or craniofacial abnormalities.

The patients underwent tympano-mastoid exploration under general anesthesia with a subsequent examination of the facial nerve in the middle ear and the mastoid under an operative microscope to look for any dehiscence. Any abnormality involving these segments was recorded.

A canal wall down mastoidectomy has performed for all patients with facial nerve erosion, while the patient with intact facial nerve underwent canal wall up surgery. None of the patients developed facial nerve palsy after the surgery.

The data were analyzed using Microsoft Excel 2016 program and Statistical Package for Social Sciences (SPSS) version 26. The age of the patient was described by mean and standard deviation and associated with gender by frequency and percentage. The side on which the operation was performed, the presence of cholesteatoma, and facial nerve canal dehiscence were all summarized descriptively as percentages and illustrated in graphs. The association of canal dehiscence with gender, side of operation, and cholesteatoma was tested by Chi-squared and Fisher's exact tests. The p value of 0.05 was used as the level of significance.

Patient consent

A written consent form was obtained preoperatively from all patients who participated in this study.

Results

Baseline data

In this study, 102 patients aged 8–70 (average: 33) years who underwent tympano-mastoid surgery were evaluated for the presence of facial nerve dehiscence; of those, 58.82% ($n=60$) were female and 41.18% ($n=42$) were male (Table 1). Among the participants, 56.86% ($n=58$) underwent surgery on the left side, while 43.14% ($n=44$) had surgery performed on the right side (Fig. 1).

Indications and type of surgery

The two main indications for surgery were either chronic suppurative otitis media (CSOM) with cholesteatoma (26.47%; $n=27$) or chronic suppurative otitis media (CSOM) mucosal type without cholesteatoma (73.53%; $n=75$) (Fig. 2).

Table 1 Age and gender distribution of the patients

Gender	No. (%)	Age in years Mean (SD)
Male	42 (41.2)	33.02 (11.009)
Female	60 (58.8)	32.3 (13.775)
Total	102 (100)	32.6 (12.655)

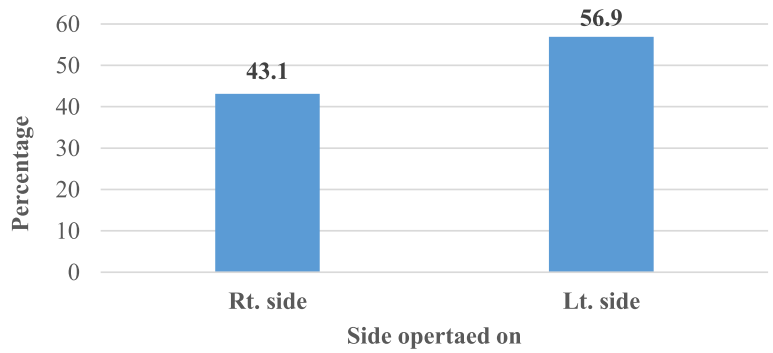

Fig. 1 Frequency of the side on which the operation was performed

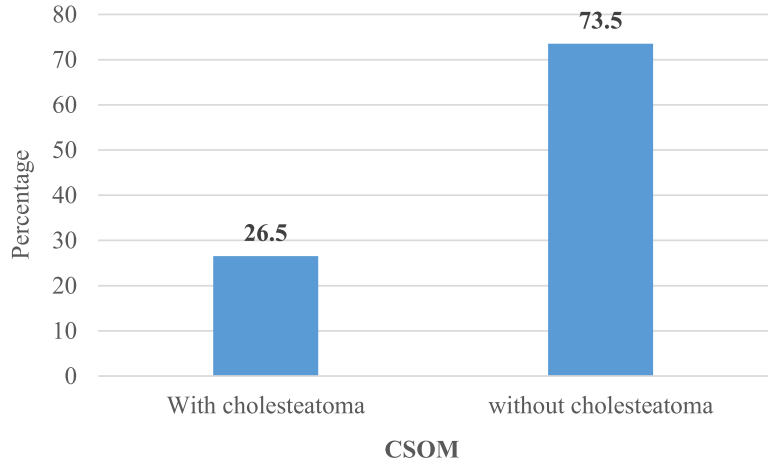

Fig. 2 Presence of cholesteatoma

All patients underwent surgery through a postauricular incision including mastoid and middle ear exploration, with subsequent repair of the tympanic membrane.

Intraoperative findings

All cases were selected based on the lack of any facial nerve problem preoperatively. Intraoperative findings showed that 11.76% ($n=12$) of the 102 patients who were admitted had a dehiscent facial nerve and were between the ages of 11 to 58 (average: 30.9) years. In total, FCD was found in 18.8% ($n=3$) of pediatric patients, aged 18 years or younger, while 10.5% ($n=9$) of cases who were older than 18 years had FCD; however, when this variation was calculated by Fisher's exact test, it was not statistically significant ($p=0.396$) (Table 2).

The association between facial nerve canal dehiscence and gender was statistically tested by Fisher's exact test. It was seen that the frequency of males with dehiscence was slightly higher than in females, but this was not statistically significant ($p=0.545$) (Table 3).

Table 2 Association between age and facial nerve canal dehiscence

Facial nerve canal dehiscence	Age		*p* Value*
	≤ 18 years No. (%)	> 18 years No. (%)	
Yes	3 (18.8)	9 (10.5)	**0.396 (NS)**
No	13 (81.2)	77 (89.5)	

* By Fisher's exact test

Table 3 Association between gender and facial nerve canal dehiscence

Facial nerve canal dehiscence	Males No. (%)	Females No. (%)	*p* Value
Yes	6 (14.3)	6 (10.0)	**0.545* (NS)**
No	36 (85.7)	54 (90.0)	

* By Fisher's exact test

Table 4 Association between side of operation and facial nerve canal dehiscence

Facial nerve canal dehiscence	Side operated on		*p* Value
	Right No. (%)	Left No. (%)	
Yes	4 (9.1)	8 (13.8)	**0.547* (NS)**
No	40 (90.9)	50 (86.2)	

* By the Chi-squared test

Table 5 Association between cholesteatoma and facial nerve canal dehiscence

Facial nerve canal dehiscence	CSOM		*p* Value
	With cholesteatoma No. (%)	Without cholesteatoma No. (%)	
Yes	7 (25.9)	5 (6.7)	**0.014***
No	20 (74.1)	70 (93.3)	

* By Fisher's exact test

Regarding the side on which the operation was performed, it was found that the percentage of left-sided operations with facial nerve canal dehiscence (13.8%) was higher than that of the right side (9.1%). However, this difference was not statistically significant with a p value of 0.547 when tested by the Chi-squared test (Table 4).

Of those with a dehiscent facial nerve, 83% ($n=10$) had the dehiscence on the tympanic segment. Of those, five cases had dehiscence over the cochleariform process, four over the stapes, and one case investigated had erosion of the entire tympanic segment; the remaining 17% ($n=2$) had dehiscence over the mastoid segment of the nerve.

A statistically significant association was seen between facial nerve canal dehiscence and the presence of cholesteatoma in CSOM. It was found that 25.9% of CSOM patients with cholesteatoma have dehiscence compared to only 6.7% of those without cholesteatoma. This association is shown in Table 5.

Discussion

Dehiscence in the facial canal is a significant finding during otological surgeries. In two different anatomical studies by Baxter and Moreano on normal temporal bones, the rate of FCD was 55% and 56% respectively [12, 13]; therefore, the dehiscence could be congenital due to a failure in the ossification of the canal or could be acquired due to erosion of the canal, as reported in multiple studies on intraoperative findings in patients undergoing surgery for chronic otitis media [9, 14].

In this study, of the 102 patients aged 8–70 years who were admitted for tympano-mastoid surgery, 11.76% ($n=12$) were found to have an FCD. These results were approximate to those of a recently published study by Kalcioglu et al., who found that among 372 patients who were admitted for surgery due to CSOM with and without cholesteatoma, 11.29% ($n=42$) had a dehiscent facial nerve canal [5] and a similar study by Bayazit et al. of 202 patients, 8.9% of whom had FCD [10].

The difference in the rate of FCD intraoperatively when compared to studies on cadaveric temporal bones by Baxter and Moreano is possibly because they focused on detecting micro-dehiscence of the facial canal and had better exposure of the canal.

In many studies of all segments of the facial canal, the tympanic segment was the most dehiscent. In the study by Ozbek et al., the tympanic segment was the dehiscent part in 89.5% of patients with FCD [9]; the same was detected by Bayazit [10]. Even when only patients with cholesteatoma were studied, the tympanic segment was the most dehiscent, as reported by Gülüstan et al. [14]. Similar findings were found when cadaveric temporal bones were studied [12]. In our study, the tympanic segment was dehiscent in 83% of patients with FCD.

When we compared CSOM with and without cholesteatoma among our operated patients, 25.9% of those with cholesteatoma had a dehiscent facial nerve compared to only 6.7% of those without cholesteatoma; this was statistically significant. This was also reported by Kalcioglu and Bayazit, who found that dehiscence was more common in patients with cholesteatoma in a statistically significant manner [5, 10]. Kim et al. found that 8.6% of individuals had FCD when they investigated only those with CSOM without cholesteatoma. Moody et al. found that 18.6% had a dehiscent nerve in their study which included only patients with cholesteatoma; in a similar study by Magliulo et al., the rate of FCD was 27.1% [7, 15].

Regarding the relationship between gender and FCD in patients with CSOM, Ozbek et al. found that the rate was higher in males than females (27.7% and 13.7%, respectively) and it was statistically significant [9]. Meanwhile, in the study by Kalcioglu, the rate was also higher in males than females (12.2% and 10.2%, respectively), but it was statistically non-significant [5]. When we performed the comparison in our study, the rate of FCD was slightly higher in males than in females (14.3% and 10.0%, respectively), but it was statistically non-significant.

In their study, Ozbek et al. concluded a statistically significant higher incidence of FCD in adults than in pediatric patients (24.8% vs. 10.5%, respectively), but they classified pediatric patients to be 16 years or younger [9]. Also, Topaloğlu et al. found that dehiscence is higher

in adult patients (>18 years), with a result that was statistically significant [16], while Kalcioglu concluded that FCD was slightly higher in pediatric than adult patients, but this was also not statistically significant (11.86% vs. 11.18%, respectively) [5]. Among our patients, dehiscence was higher in pediatric patients, but it was not statistically significant ($p=0.396$).

One of the purposes of our study was to evaluate the rate of dehiscence between the operated sides; in patients whose left side was operated upon, the rate of FCD was higher than in those whose right side was operated on (13.8% and 9.1%, respectively), but this difference was not statistically significant. This difference was infrequently evaluated by other studies, although Gülüstan et al. assessed FCD among patients undergoing surgery for cholesteatoma and reported that the right side had a higher rate of FCD than the left side (28.9% and 18%, respectively) in a statistically significant manner [14].

Conclusion

Dehiscence in the canal of the facial nerve could be congenital or acquired. Specifically in the cases of chronic suppurative otitis media and particularly in those with cholesteatoma, the dehiscence is most reported on the tympanic segment of the facial nerve according to this and many other studies and is the most commonly injured segment during otological surgeries. Therefore, care should be taken intraoperatively to avoid such complications via familiarity with the anticipated locations of dehiscence. The best way to achieve this is to identify the canal clearly and avoid excessive manipulation, especially around the sites of dehiscence.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s43163-024-00647-9.

Supplementary Material 1.

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Authors' contributions
A.R.A. has performed most surgeries and was responsible for data documentations and getting the ethical approval. L.A.M. has contributed mainly to manuscript writing.

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Availability of data and materials
The original data base of all patients included in this study are available with the authors.

Declarations

Ethics approval and consent to participate
This study received approval from the scientific and ethical committees at the University of Duhok and the Directorate of Health respectively dated on 30 August 2023 (Ref. no. 30082023–7-3). Informed written consent to participate in the study has been obtained and provided by all participants. For patients under 16 informed written consent has been obtained from their parents or guardians.

Consent for publication
Not applicable.

Competing interests
There are no competing interests in this study.

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