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Conductive Hearing Loss Due to a Dehiscent Facial Nerve

Authors
Dr Hamjol Singh Chakkal[1], Dr Sandip M Parmar[2], Dr Meenu Chaudhary[3]
[1]Dept. of ENT&HNS, Muzaffarnagar Medical College & Hospital, Muzaffarnagar, U.P INDIA
[2]Faculty Campus, Muzaffarnagar Medical College & Hospital, Muzaffarnagar, U.P INDIA
Email: *anmol_chk@hotmail.com, Phone No.-9888882901*
[3]Faculty Campus, Muzaffarnagar Medical College & Hospital, Muzaffarnagar, U.P INDIA
Phone No.-9888882902
Corresponding Author
Dr Hamjol Singh Chakkal
House No.1185, Sector 34-C, Chandigarh-160022 INDIA
Email: *hamjol_chk@yahoo.co.in, Phone No.-9888882961*

Abstract
Objective- *The relative position of the developing tympanic segment of facial nerve (fallopian canal) to that of the stapes and oval window niche may lead to Ossicular anomalies responsible for a conductive hearing loss. We hereby present five cases of unilateral conductive hearing loss due to a dehiscent tympanic segment of the facial nerve causing impingement and/or anomalous development of the stapes crura.*
Result-*The stapes was found to be mobile in each of five patients suspected of having a conductive or mixed hearing loss due to otosclerosis. A dehiscent, inferiorly malpositioned, tympanic segment of facial nerve was found to be impinging on the stapes crura in all the cases and to be associated with malformed stapes crura in one of the case. No further middle ear surgery was performed in any of the cases.*
Keywords: - *hearing loss, dehiscent, facial nerve.*

Introduction

- Congenital dehiscence of the facial (Fallopian) canal is common. It has been described in 57% of temporal bone specimens.
- Dehiscence occurs predominantly along the tympanic segment (83%), adjacent to the oval window niche. The facial nerve may be found protruding outside the fallopian canal in up to 23% of cases.
- 10% to 15% percent of these dehiscences were considered clinically significant in terms of the presence of the nerve in the surgical field during middle ear exploration.
- Various clinical studies on stapes surgery estimate the incidence of facial canal dehiscence to be between 3% and 11.4% and for nerve prolapsed to occur in 7%.
- Facial nerve anomalies are commonly associated with congenital anomalies of structures derived from the first and second branchial arch and otic capsule and may be expected in conditions such as aural atresia and Treacher-Collins syndrome.

- The most consistent audiologic characteristic in patients with an anomalous facial nerve is congenital conductive hearing loss.
- The degree of hearing loss is often associated with a concurrent Ossicular malformation and not due to the nerve's effect on sound conduction.
- We present five cases of unilateral conductive hearing loss thought to be due to a dehiscent tympanic segment of the facial nerve causing impingement and/or abnormal development of the stapes crura.

Patients and Methods

- Retrospective case review of clinical and operative records for patients who had middle ear exploration between 2015 and 2016 and found to have facial nerve dehiscence with impingement on the stapes crura were recorded.
- Average age at surgery was 30 years.
- Four patients had primary surgical procedures.
- One patient had a suspected diagnosis of otosclerosis.

Results

- All but 2 of the patients (patients 3 and 5) complained of gradual worsening hearing loss of adult onset.
- Patient 3 had a previous history of cholesteatoma and had a tympanoplasty procedure two years prior.
- Patient 5 had hearing loss recognized during childhood.
- Table 1 summarizes the audiometric and intra-operative findings.
- None of the patients who had primary middle ear exploration had temporal bone CT scan findings consistent with otosclerosis.
- All patients had intra-operative evidence of facial canal dehiscence, nerve prolapse, and impingement on the stapes crura.
- None had evidence of stapes fixation or Ossicular anomalies/abnormalities, aside from patient 3, who previously had a tympanoplasty procedure.
- Tympanic membrane grafting was performed in patient 2 and a cartilage was used to repair a deep retraction pocket in patient 4.
- Postoperative hearing was unchanged in these two patients (3, 4).
- All other procedures were concluded without further intervention (no manipulation of nerve or stapes).

Table-1 Summary of Findings

SNo.	Age	Sex	Presenting Complaints	Audiometric Findings	Operative Findings
1.	30	M	Hearing loss	Mod-Severe mixed HL ABG 65dB	Dehiscent overhanging facial nerve impinging on the stapes crura; > 50% oval window niche obstructed; stapes mobile
2.	55	F	Hearing loss, Tinnitus	Mod-Profound mixed HL ABG 28dB	Right TM perforation with intact mobile stapes; dehiscent facial nerve impinging on the anterior and posterior crura
3.	15	F	Hearing loss	Mild-Mod CHL ABG 40dB	Absent malleus and incus; stapes eroded; dehiscent tympanic Facial nerve contacting with the anterior crus of stapes; malformed posterior crus; small stapes superstructure
4.	33	M	Hearing loss, Intermittent ottorrhea, H/O CSOM	Mild-Mod CHL ABG 30dB	Left deep retraction pocket extending into posterior epitympanum; dehiscent tympanic Facial Nerve impinging on stapes crura; intact ossicles
5.	20	F	Hearing loss	Moderate-Mixed HL ABG 25dB	Ossicles intact; stapes intact and mobile; dehiscent Facial Nerve at tympanic segment adherent to stapes crura.

Discussion

- The presenting complaints, audiometric results, and intra-operative findings suggest that a dehiscent tympanic segment of the facial (Fallopian) canal with nerve prolapse was a significant factor in causing conductive hearing loss in this group of patients.
- Facial canal dehiscence with nerve prolapse is best understood in the context of the embryology of the facial canal:-

I. By 5-6 weeks of gestation, the horizontal and vertical segments of the facial nerve appear.

II. It is not until 10 weeks of gestation that the facial canal begins to form around the facial nerve primordium.

III. The facial canal develops as a result of the fusion between the cartilaginous primordial otic capsule and Reichert's cartilage (second branchial arch derivative).

IV. Complete ossification of the canal is not complete until about 1 year postnatally.

- Congenital dehiscence of the facial canal may result from improper communication between the derivatives of the second branchial arch and the otic capsule.
- Failure or delayed union of the stapes crura (second brachial arch derivative) and the lamina stapedialis (otic capsule derivative) can neither contribute to, or be affected by, an abnormally coursing facial nerve.
- Conductive hearing loss due to an abnormally coursing facial nerve, in the absence of a congenital Ossicular malformation and/or inherent syndromic features, is a rare phenomenon, reported in less than 60 cases in the literature.
- Clinical presentation can be similar to that of otosclerosis or congenital cholesteatoma.
- Patients may have no significant history of ear disease or trauma and demonstrate no evidence of abnormalities on clinical examination or imaging studies.

Conclusions

- Dehiscence of the tympanic segment of the facial canal is a common occurrence and should be a consideration during safe middle ear surgery.
- The combination of facial canal dehiscence with facial nerve prolapse and impingement on the stapes crura is an, otherwise, rare finding during middle ear exploration for conductive hearing loss.
- Clinical examination, audiometry, and radiographic studies may suggest the possibility of this occurrence; however, surgical exploration is typically required to make the diagnosis.

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