OTOLOGY SEMINAR
Facial Canal Course Anomaly

Introduction

- Anomalies involving the tympanic segment frequently are associated with a dysplasia of the stapes, lack of differentiation, or agenesis of the oval window
- Anomalies also occur in otherwise normal temporal bones

Embryology

- The 1st brachial arch (Meckel’s cartilage) forms the body of the incus and malleus
- The 2nd arch (Reichert’s cartilage) forms the shaft of the incus and malleus, the stapes superstructure and the facial nerve
- The footplate is derived from the 2nd arch and the otic placode
- 3 weeks
  - aggregation of ganglionic cells at the otic vesicle
  - primordium of the acoustic and facial ganglia
- 5 1/2 weeks
  - facial nerve fibers run in a lateral direction from the nucleus under the floor of the 4th ventricle
- 6 1/2 to 7 weeks
  - Chorda tympani nerve appears
- 8 weeks
  - cartilaginous condensation begins to form the stapes
- Auditory ossicles and associated structure
  - About 5 weeks from a mass of undifferentiated mesenchyme to the final stage of the complicated otic capsule (the ossicular chain with all its connections and the facial nerve canal are formed)
- 5th months
  - forms the foramen mastoideum primivitum
- 35 weeks
  - Tympanic portion of the facial canal is completed
- after birth
  - Temporal portion of the facial nerve canal is completed
In patients with congenital anomalies

- Jahrsdoerfer: in a series of 66 aural malformation
  - 20% had facial nerve anomalies, of those 2/3 had stapes deformaties
- Hideki et al.
  - Mandibulofacial dysostosis (MFD)
    - AD malformation syndrome
    - Mandibular hypoplasia, cleft palate, and microtia…
  - Patients with MFD
    - Mastoid segment of the facial nerve was 2 mm more laterally and
      3 mm more anteriorly
    - The angle between the IAC and the labyrinthine segment of the
      facial nerve was more obtuse
    - The geniculate fossa was located more posterolaterally
    - The displacement was not significantly different among the 3
      groups of microtia
  - The mastoid segment of the facial nerve was displaced more anteriorly
    depending on the severity of microtia in the patients without MFD
    - 3 mm more anteriorly in patients with Gr. II and III microtia than
      in those with Gr. I microtia

- Canalicular segment anomaly of the facial canal
  - May enter the petrous pyramid
  - May run through the center of the superior semicircular canal,
    bypassing the middle ear cavity
  - Bifurcation within the IAC

- Labyrinthine segment anomaly of the facial canal
  - Bifurcation of the facial nerve
  - Anteromedial displacement
- Association with non-Mondini-type cochlear malformation

- **Tympanic segment anomaly of the facial canal**
  - Facial nerve coursing along the superior aspect of the lateral semicircular canal
  - House had seen this type in two instances

- Bifurcation of the facial nerve anterior or proximal to the oval window
  - Associated with developmental anomalies of the vestibular fenestra and stapes

- Facial nerve coursing horizontally over the oval window

- Facial nerve coursing through the stapedial arch
  - Butler and Marquet
- Facial nerve coursing posteriorly between the oval and round window
  - Fowler
    - Congenital fixation of the footplate and a persistent stapedial artery
  - Martin
    - Bilateral congenital fixation of the footplate and ossification of the stapedial tendon
  - Mayer and Crabtree: 12 patients were reviewed
    - All had congenital conductive hearing loss and facial canal was dehiscent in tympanic segment
    - Exposed nerve appeared normal in 9 patients and appeared as a “boggy mass” in 3 patients

- Facial nerve coursing posteriorly inferior to the round window

- Facial nerve coursing from the geniculate ganglion straight downward over the promontory
  - Reported by Dickinson and colleagues
Hypoplasia of the facial nerve
- Kodama and colleagues
  - Born with a deformed auricle and facial nerve paralysis

Welling et al.: 3 degrees of FN exposure in the middle ear
- 1st degree: severe bony dehiscence of the fallopian canal
- 2nd degree: the nerve overlying the oval window
- 3rd degree: the nerve runs over the promontary

Rohrt et al.: classified FN displacement in the middle ear into 4 groups
- I: FN partially obliterates the stapes footplate
- II: bifurcation of the FN
- III: FN rests on the footplate with deformed stapes or OW
- IV: FN rests on the promontory

A persisting stapedial artery
- From ICA → floor of the hypotympanum → promontory → stapedial arch → enter facial canal
- Supply outer surface of the dura

Mastoid segment of the facial canal
- Facial nerve following an abnormal posterior, lateral, or anterior course
  - The most likely one to have been cut
  - Fowler and Angell-James
    - Posterior and lateral bulge (dorsal hump) of the canal just beneath the prominence of the lateral semicircular canal
    - The most frequent anomaly
  - Fowler and Kettel
    - abnormal posterior position of the mastoid segment with the nerve overlying the sigmoid sinus
  - Glasscock
    - S-shaped anomaly with abnormal large chorda tympani nerve joined the facial nerve at the level of the pyramidal process
- Bifurcation and trifurcation of the facial nerve posterior or distal to the oval window
  - The lateral branch of the two trunks usually is the larger and the one that receives the chorda tympani nerve
  - Basek
    - Bifurcations found in 3 of 500 normal temporal bones removed at autopsy (0.6 %)
    - left the temporal bone through two separate foramina
  - A trifurcation of the facial nerve was reported by Botmann and Jongkees and by Heermann

- Hypoplasia of the facial nerve
  - Hawley, Tobeck and Miehlke
    - The main trunk of the facial nerve to end in a blind pocket of the mastoid process with a very small branch continued the normal course of the nerve
Conclusions

- Anomalous FN segment in the middle ear may limit or preclude surgical access for stapedectomy
- Never avulse the stapedial muscle or tendon but rather cut it — it may be firmly attached to the facial nerve
- Surgeons may misdiagnosed the swollen anomalous facial nerve as a tumor, resulting in facial nerve paralysis due to injury or unnecessary biopsy
- A bifurcated facial nerve can easily be cut accidentally — the two parts are usually unequal and the smaller overlooked
- Beware of any soft tubular structure in the middle ear regardless of its location
- Anomalous FN segment through the mastoid bone may be at risk with mastoidectomy or cochlear implant placement
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