

Hearing Loss Following Microvascular Decompression for Hemifacial Spasm

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Hemifacial Spasm

- Socially disabling condition that manifests as intermittent involuntary twitching of the eyelid and progresses to muscle contractions of the entire hemiface
- Treatments include
 - Botulinum injections to facial muscles
 - Microvascular decompression of CN 7 (see surgical video at www.michaelhorowitzmd.com)

Surgical Results

- **Following MVD of CN7 (N=239 with mean FU 54.5 months (range 9-102 m))
 - 88% immediate postoperative relief
 - 90.8% relief by hospital discharge
 - 92.3% relief at FU
- **Parthasarathy TD, Horowitz MH, *et al.* Microvascular decompression for hemifacial spasm: Evaluating outcome prognosticators including the value of intraoperative lateral spread response monitoring and clinical characteristics in 293 patients. Journal of Clinical Neurophysiology. February 2011; 28:56-66.

Major Surgical Risk

- Hearing reduction or hearing loss
 - Due to the proximity of the cochlear and facial nerves, hearing loss is a potential MVD complication.
 - What are the potential causes for hearing loss after MVD
 - Stretching of CN8 when retracting the cerebellum to gain access to the brainstem and the route exit zone of CN7
 - Manipulation of CN8 and direct trauma to the nerve
 - Compression of the nucleus of CN8
 - Manipulation with occlusion or spasm of the labyrinthine artery or anterior inferior cerebellar artery (AICA) and subsequent nerve ischemia
 - Compression of CN8 by inserted Teflon pledgets
 - Fluid and bone dust in mastoid air cells
 - Drill generated noise (117-122 dB; in front of speakers at a rock concert or a nearby jet engine) with subsequent acoustic trauma from cochlear hair cell damage
 - What are the actual risks?
 - Shah A, Horowitz M, *et al.* Hearing outcomes following microvascular decompression for hemifacial spasm. *Clinical Neurology and Neurosurgery*. July 2012; 114:673-677.

Hearing Definitions

- Non-serviceable HL
 - Hearing that is not of use (cannot hear using a phone). Pure tone audiogram threshold ≥ 50 dB and speech discrimination score $\leq 50\%$
- Class A HL (Grade 1 Gardner-Robertson) Good-Excellent
 - Pure tone threshold ≤ 30 dB and $\geq 70\%$ speech discrimination at 40 dB
- Class B HL (Grade 2 Gardner-Robertson) Serviceable
 - Pure tone threshold >30 and ≤ 50 dB and $\geq 50\%$ speech discrimination
- Class C HL (Grade 3 Gardner-Robertson) Non-serviceable
 - Pure tone threshold >50 dB and 5-49% speech discrimination
- Class D HL (Grade 4 Gardner-Robertson, Poor)
 - Pure tone threshold 90-100 dB and 1-4% speech discrimination
- Gardner Robertson Grade 5 (Not-testable; Deaf)
- Conductive HL
 - Due to any condition that interferes with the transmission of sound through the outer and middle ear to the inner ear. Increase in air-bone gap on pure tone audiometry of at least 10dB at any octave frequency from 0.5 to 4 kHz. Can be successfully treated in most cases.
- Sensorineural HL
 - Due to damage to the inner ear, the acoustic nerve or both (aka nerve deafness). “Sensory” refers to the inner ear or cochlea. “Neural” refers to the acoustic nerve anywhere between the base of the hair cells and the auditory nucleus. Loss should be greater than 25 dB.
- Mixed HL
 - When both conductive and sensorineural hearing loss is present in the same ear.
- High frequency HL
 - High frequencies are 4 and 8 kHz; increase in >10 dB in pure tone audiometry constitutes HL
- Pure tone average (PTA)
 - Average in decibels of the threshold for hearing pure tones at 500, 1000, and 2000 Hz
- Speech Discrimination
 - How well an individual understands what they hear when speech is loud enough to hear comfortably
- Speech discrimination scores (SDS)
 - Percentage of words understood correctly when words are delivered at 40dB or maximum comfortable loudness

Overall Hearing Outcomes

- N=151 (January 2000 – December 2007)
- Speech discrimination scores (SDS) and air and bone pure tone averages (PTA) tested preoperatively and 7 days postoperatively
- Goal was to identify patients with no hearing change, sensorineural hearing loss, or conductive hearing loss

Results

- Absolute non-serviceable HL (Class D) 6.6%
- Functional non-serviceable HL (Class C and D) 10.6%
- Conductive hearing impairment 18.7%
- Patient complaint of hearing loss was not strongly associated with actual tested HL status

Conductive Hearing Loss (CHL)

- CHL is HL secondary to non-neural abnormalities (bone or bone related structures)
- For those patients with CHL sounds are softer and may seem muffled or garbled. It is difficult for these patients to separate one sound from another and interpret the meaning of speech and sounds.
- CHL can be treated with surgery or hearing aids

Conductive Hearing Loss

- Conductive HL in surgical ipsilateral ear 18.7% (29/151)
- No cases of contralateral conductive HL
- Mixed hearing loss seen in 8.6% (13/151) of entire group and in 4.5% (13/29) of those with conductive HL
- No relationship was seen between conductive HL and intraoperative brainstem auditory evoked potential (BAEP) changes
- Gender, age, and surgical side were not associated with CHL

Potential Etiologies For CHL

- Fluid entering mastoid air cells during surgery
- Bone dust deposition during craniotomy

High Frequency Hearing Loss (HFHL)

- Patients with HFHL often have deficiencies in high frequency components of speech such as consonant sounds and can have difficulties understanding speech in the presence of background noise
- May have associated tinnitus (ringing in ears)
- Higher frequencies may be more sensitive than lower frequencies to noise, acoustic trauma or ototoxic substances

Incidence of HFHL

- HFHL might not be detected without an audiometric evaluation
- Formal testing revealed HFHL
- Most patients had normal hearing at low and mid frequencies (0.5-2kHz) after surgery
- 50% of patients had HFHL on the ipsilateral side
- 9/47 (19%) with ipsilateral HFHL had non-serviceable HL (9.6% of entire cohort) and 13/47 (28%) also had conductive HL
- Drill generated noise significantly affects high (4-6 kHz) but not low frequency (0.25-2 kHz) hearing
- 25.53% of patients had HFHL on the **contralateral** side

Contralateral HFHL

- Hearing function in the ipsi or contralateral ear can be affected by drilling which can damage the hair cells
- Drill noise can be conducted to the ear by vibration of the intact cranium

BAEP and HFHL

- No correlation between intraoperative BAEP changes and HFHL

Prognosis with HFHL post MVD

- We lack long term follow-up
- Studies do show regeneration of the hair cell tips over 2-4 weeks