

# NAVIGATING AN ACOUSTIC NEUROMA DIAGNOSIS

ACOUSTIC NEUROMA PATIENT EDUCATION EVENT

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Assistant Professor, Neurotology  
Mayo Clinic Florida

# OBJECTIVES

Stop 1

- Education

Stop 2

- Further evaluation

Stop 3

- Meeting the team

Stop 4

- Settling on a plan



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# WHAT IS AN ACOUSTIC NEUROMA?

# DEFINITION



Benign, most often, sporadic tumors



Arise from cells that cover nerves



8<sup>th</sup> cranial nerve responsible for hearing and part of balance

# IMPORTANCE



Slow growing



Next to nerves that control facial expression and sensation, brainstem, cerebellum



Can lead to hearing loss, imbalance, face numbness, pressure on the brain

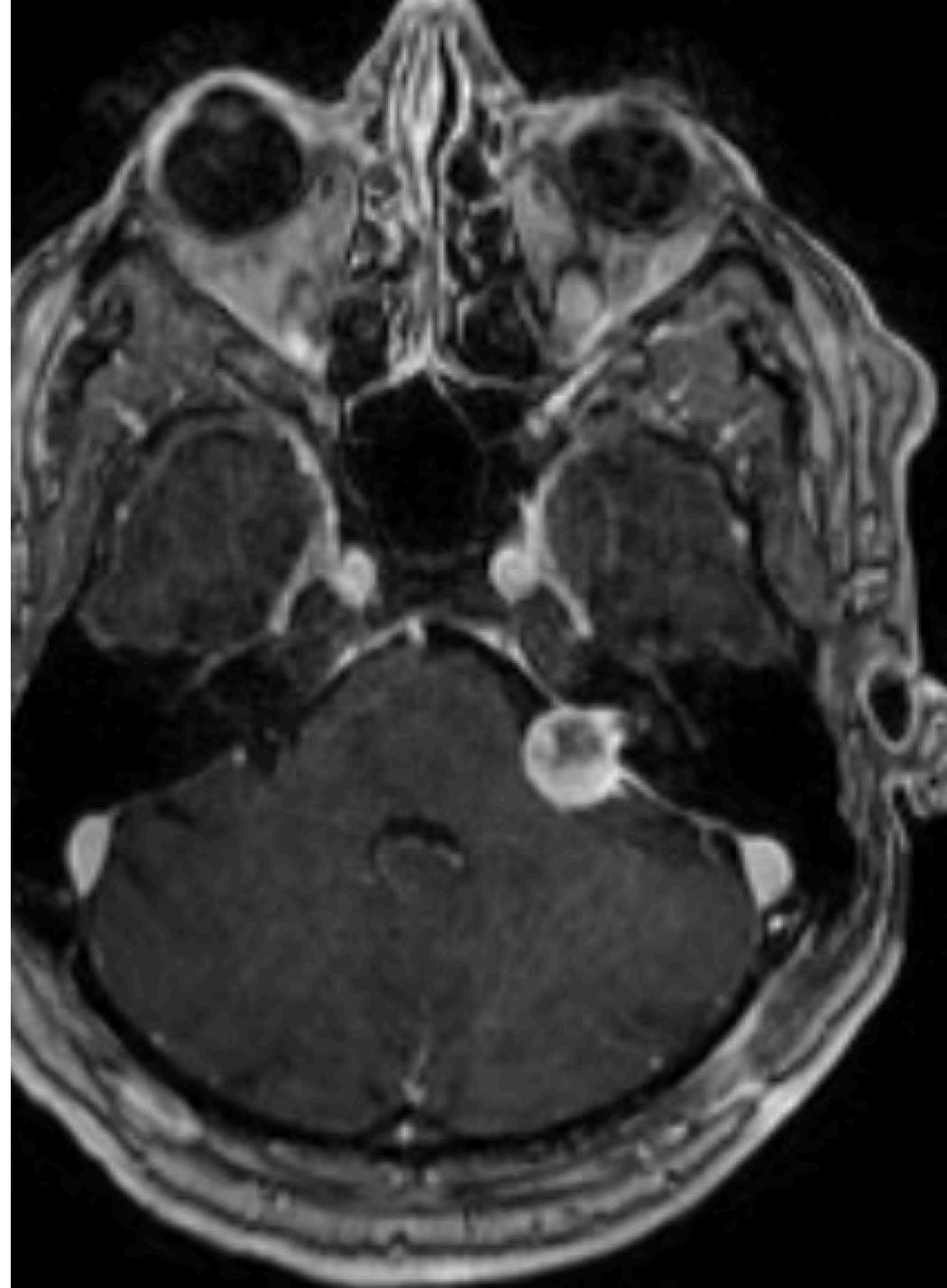
# HOW AND WHY ARE THESE DIAGNOSED?

- MRI (magnetic resonance imaging)
- Most commonly done for:
  - Hearing loss
  - Unrelated reasons (incidental)
- Less commonly done for:
  - Face numbness or weakness
  - Dizziness
  - Symptoms of high pressure around brain



# LOOKING AT A DIAGNOSIS

- Radiologist phrasing
  - Location
  - Size
  - Quality
  - Proximity to other anatomy





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**NOW WHAT?**

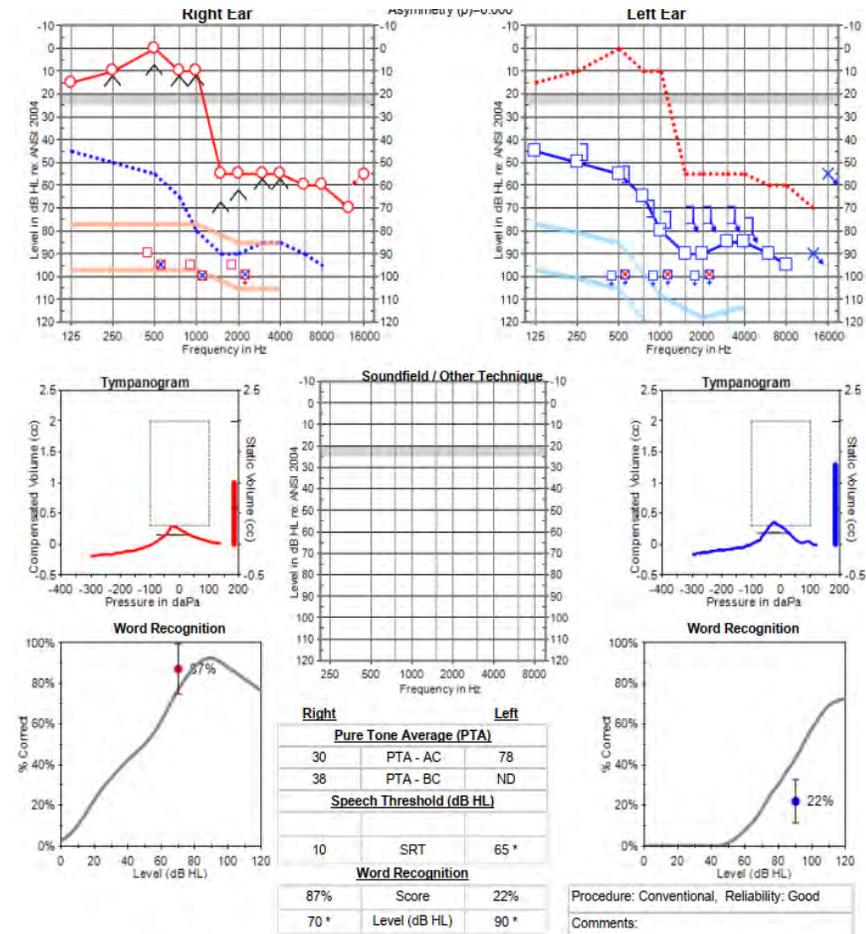
# COMMON FEELINGS/THOUGHTS

- Anxiety
- Denial
- Curiosity
- Fear
- Urgency
- Regret
- Mistrust
- Confusion



# GET MORE INFORMATION ABOUT THE CURRENT SITUATION

- Hearing test
- Ear and neurologic exam
- Balance exam
- More/different imaging



# TREATMENT TEAM

- Work together to treat tumors
- Have overlapping experience, but complimentary perspectives
- Helpful to hear information multiple times
- Combine knowledge to make decisions
- Hold regular meetings: “multidisciplinary board”

# FLORIDA ACOUSTIC NEUROMA TEAM

## TEAM MEMBERS

- Neurosurgeon
- Neurotologist
- Radiation oncologist
- Neurologist
- Geneticist
  
- Consider second opinions from different locations

Rich W. Byrne, M.D.  
Neurosurgery



Mallory Raymond, M.D.  
ENT/Neurotology

Kaisorn Chaichana, M.D.  
Neurosurgery



Joseph Breen, M.D.  
ENT/Neurotology

Alfredo Quinones-Hinojosa, M.D.  
Neurosurgery



Greta Stamper, Ph.D.  
Audiology

Daniel Trifiletti, M.D.  
Radiation oncology



Jennifer L. Peterson, M.D.  
Radiation Oncology



# 3

# INDIVIDUAL BASED PLAN

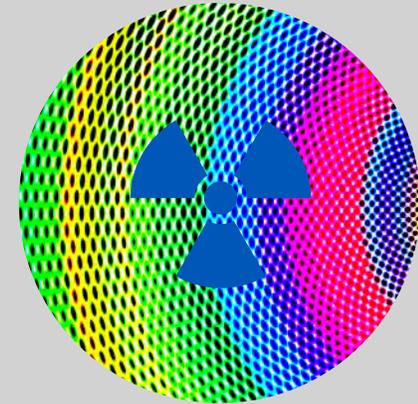
# THREE MAIN OPTIONS



OBSERVATION



SURGERY



RADIATION

# OBSERVATION - COMMON SCENARIOS

- Small sized tumor
  - Incidentally diagnosed AND/OR
  - Associated with minimal hearing loss OR
  - Associated with significant hearing loss
- Medium sized tumor
  - Minimal impact on surrounding anatomy
  - Associated with minimal or significant hearing loss
  - No associated symptoms
  - Few symptoms, but personal or medical reasons to avoid surgery/radiation

# HOW GROWTH IDENTIFIED?

## SURVEILLANCE PERIOD

- Surveillance protocols
  - Typically, MRI 4-6 months after first treatment, then yearly thereafter
- MRIs
  - Can have gadolinium (contrast), but for some its not necessary
  - Not radiation
- Visits
  - Virtual or in-person, depending on symptoms

# CONTINUED OBSERVATION

## WHAT DOES THIS MEAN?

- After a period of growth, some tumors stop growing (1)
- Some tumors regress in size after a period of growth (2)
  - Maybe up to 10%!
- TAKE-AWAY → NOT ALL TUMOR GROWTH MUST BE ACTED UPON

# SURGERY - COMMON SCENARIOS

- Large sized tumor
  - Incidentally diagnosed
  - Associated with any degree of hearing loss
- Medium sized tumor
  - Evident impact on surrounding anatomy
  - Bothersome facial numbness

# RADIATION - COMMON SCENARIOS

- Medium sized tumor
  - Incidentally diagnosed
  - Associated with any degree of hearing loss
  - Older age
  - Medical or personal reasons to avoid surgery
  - Tumor growth



4

**LONG TERM**

**PHILOSOPHY:**

**NEVER DO TO  
PATIENT WHAT  
TUMOR IS NOT  
ALREADY DOING  
OR GOING TO DO**

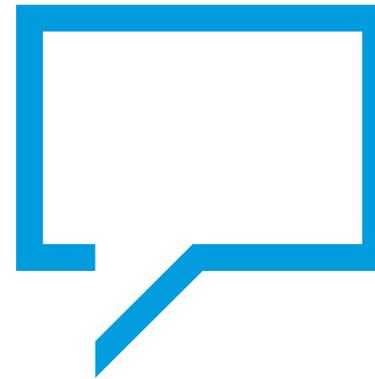


**DO NO  
HARM**

# IMPORTANT CONSIDERATIONS

- Consider your personal situation and values
- Take your time
  - Rarely an urgent situation
  - Sometimes tumors stop growing and even shrink
- Manage symptoms
- Understand treatment goals
- Look for a team-based and patient-centered approach
  - There is no single right answer for everyone!

**THANK YOU FOR  
JOINING US!**



# ABOUT MAYO CLINIC



Mayo Clinic is the largest integrated, not-for-profit medical group practice in the world.



Ranked the #1 hospital in Florida according to U.S. News & World Report 2023-2024.



Mayo Clinic has one of the largest ENT practices in the world, with more than 50 specialists committed to providing care at our campuses in Florida, Arizona and Minnesota.



Mayo Clinic has one of the largest and most comprehensive neurosurgical practices in the world, with world-renowned neurosurgeons performing more than 9,000 surgeries every year in Florida, Arizona and Minnesota.

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ACOUSTIC NEUROMA  
ASSOCIATION

# MANAGING ACOUSTIC NEUROMA SYMPTOMS

ANA PATIENT EDUCATION EVENT  
MAYO CLINIC IN FLORIDA

JOSEPH BREEN M.D.  
3/7/2026

# LEARNING OBJECTIVES

- Understand how symptoms lead to AN diagnosis
- Review the most common AN-related symptoms
- Discuss management strategies for AN symptoms
- Explore the impact of treatment on symptoms

# WHY DO WE FIND ACOUSTIC NEUROMAS?

**No Symptoms**

**Hearing Loss  
and Tinnitus**

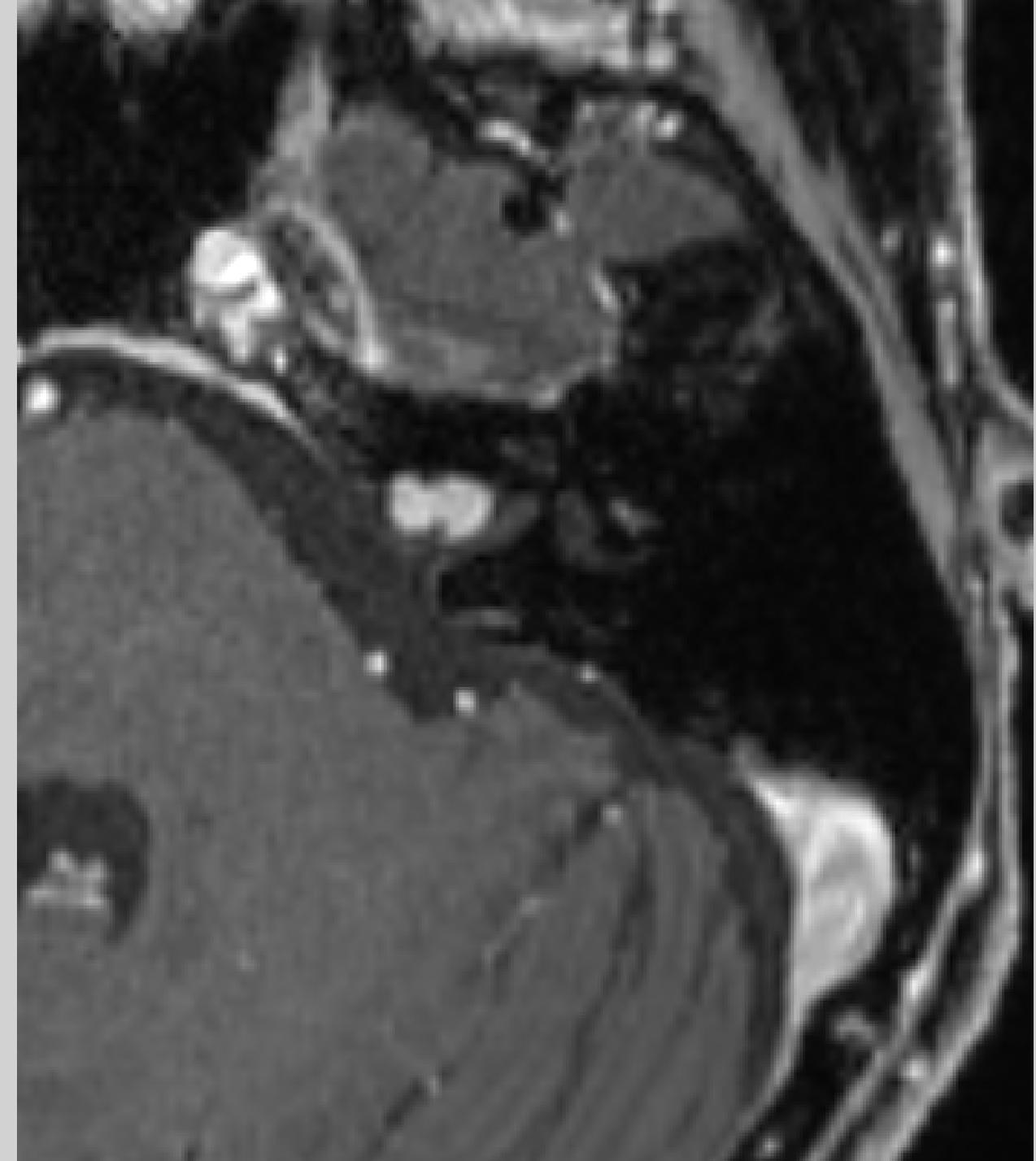
**Dizziness**

**Other Cranial  
Nerve Effects**

# NO SYMPTOMS

- “Incidentally” found tumors
- MRI scans for headaches or other brain-related symptoms
- Roughly 25% of all sporadic VS diagnoses in the United States

(Maranelli and colleagues, 2022)



# DOES THIS CHANGE WHAT WE DO?

- Absolutely!
- Patients diagnosed with low/no symptoms will tend to be older.
  - Usually leads to less “aggressive” management
- Symptoms are a primary consideration in making treatment decisions.
  - *It is rare for treatment to make patients feel better in the short term.*
- Asymptomatic patients should only be treated if there is serious concern that further delay in treatment will worsen the long-term outcome.
  - For patients with no symptoms, this is uncommon.



# WHAT SHOULD I DO?

- Take solace in the fact that you are the least likely patient group to need symptoms.
- Remember to follow up as directed.
- Do not let the knowledge of your diagnosis worsen your quality of life!

**No Symptoms**

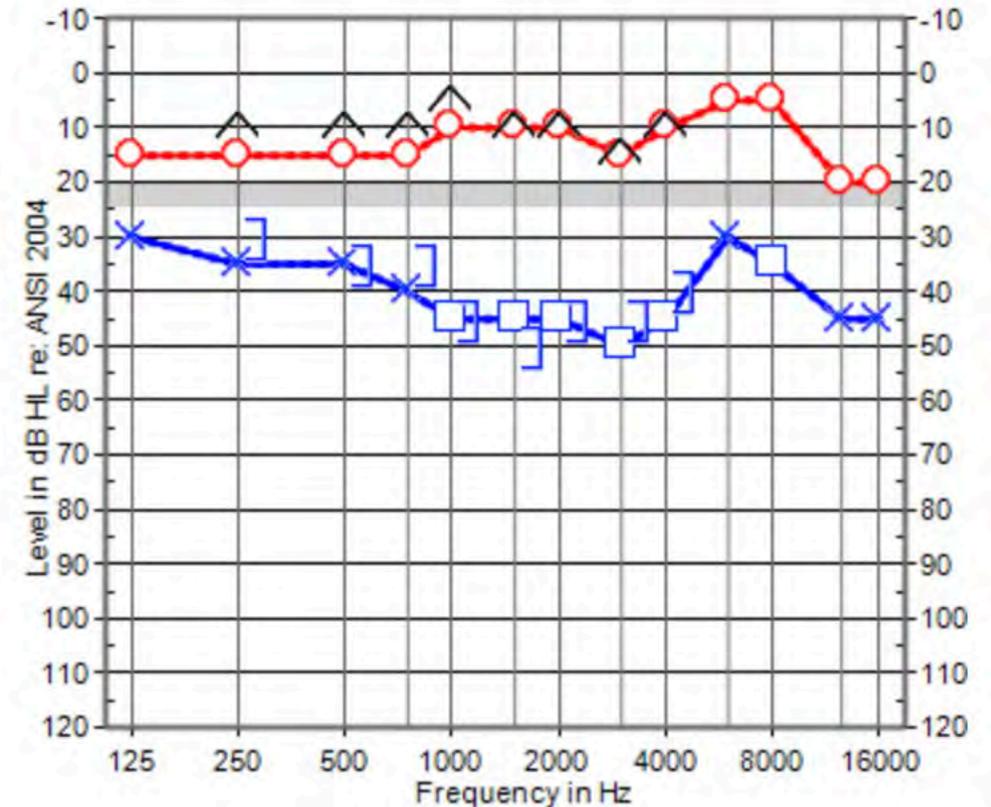
**Hearing Loss  
and Tinnitus**

**Dizziness**

**Other Cranial  
Nerve Effects**

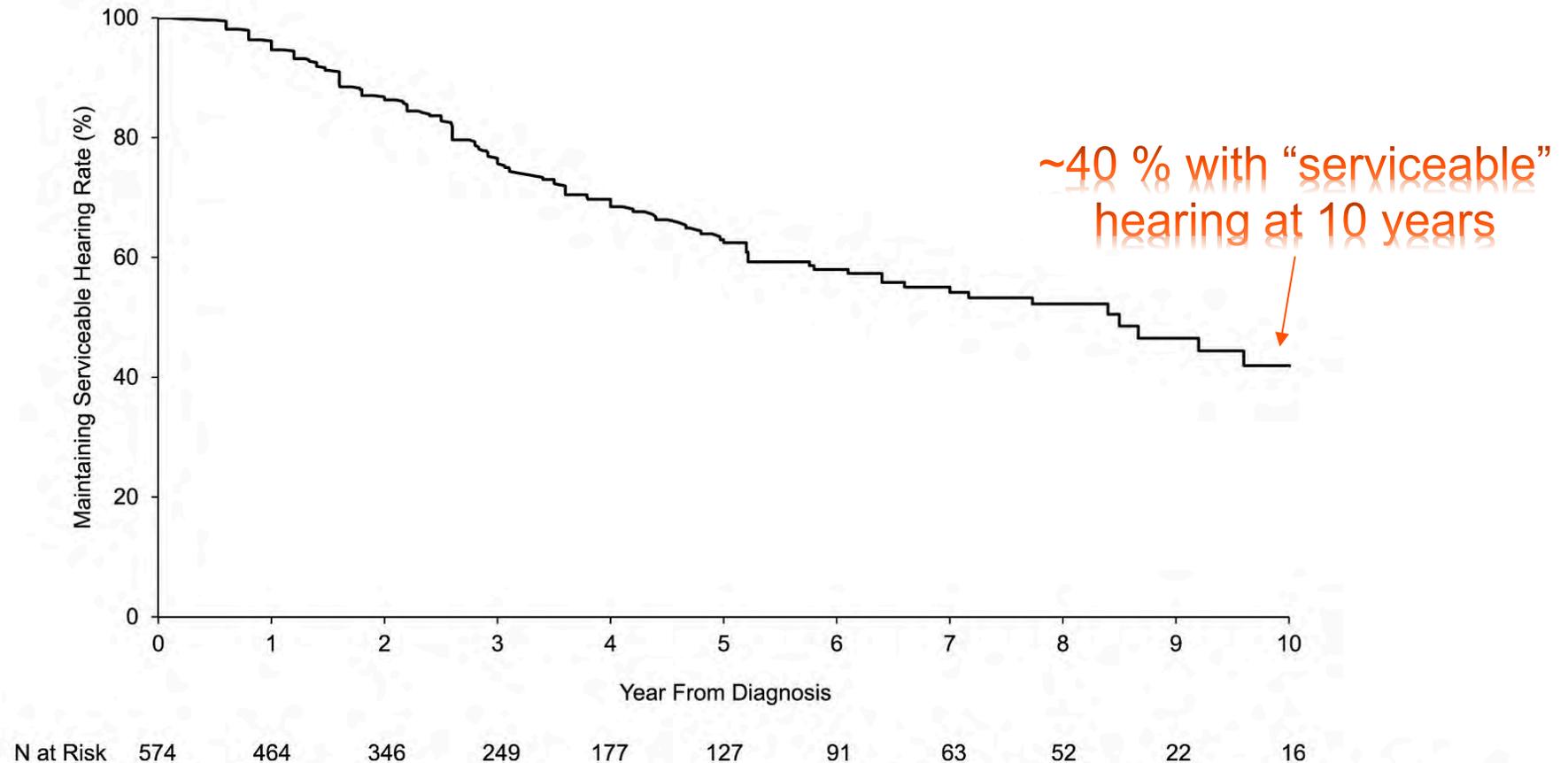
# HEARING LOSS

- One-sided hearing loss is the most common symptom associated with AN.
- Hearing measures:
  - “Pure tones”
  - **Word understanding**
- The vast majority of patients (>90%) have a measurable hearing loss (though not everybody finds it noticeable).
- Hearing is considered “serviceable” if word understanding on tests is >50% and pure tones are better than 50 dB.



# HEARING LOSS

*Hearing tends to worsen, even if the tumor doesn't grow!*

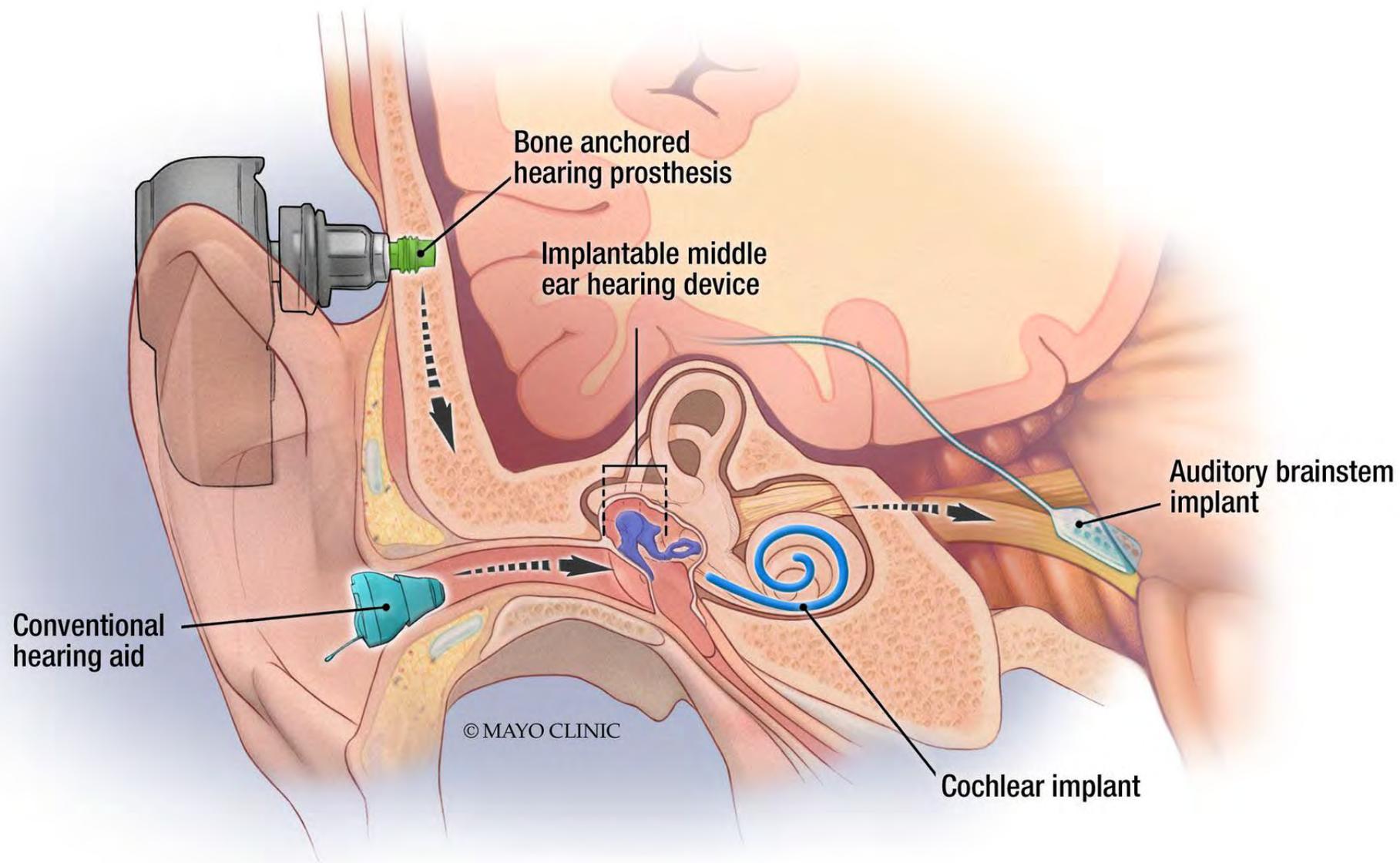


**FIG. 2.** Subgroup analysis only including studies that reported survival outcomes using the Kaplan–Meier method for rates of maintaining serviceable hearing in patients with sporadic vestibular schwannoma who presented with serviceable hearing at diagnosis.



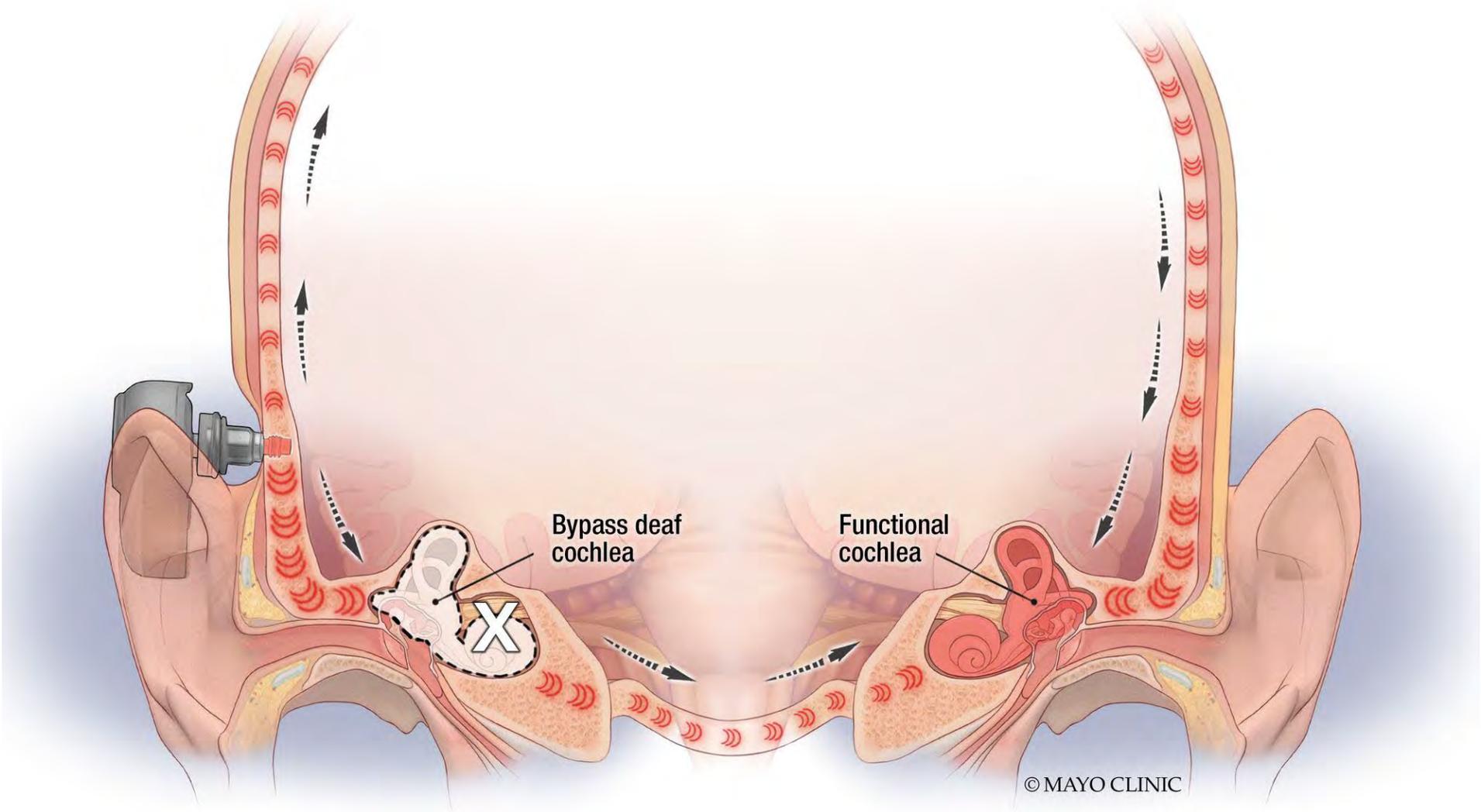
# TINNITUS

- Thought to be a brain (rather than an ear or tumor) phenomenon.
- Hearing loss of any type or cause can cause it!
- Spontaneously improves over time, though rarely goes away completely.



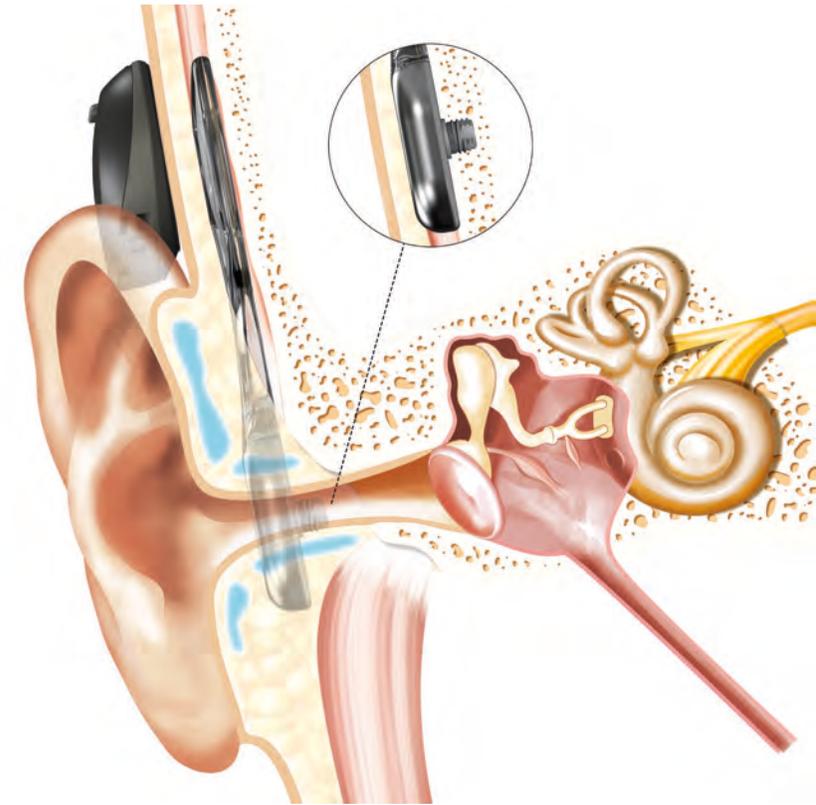
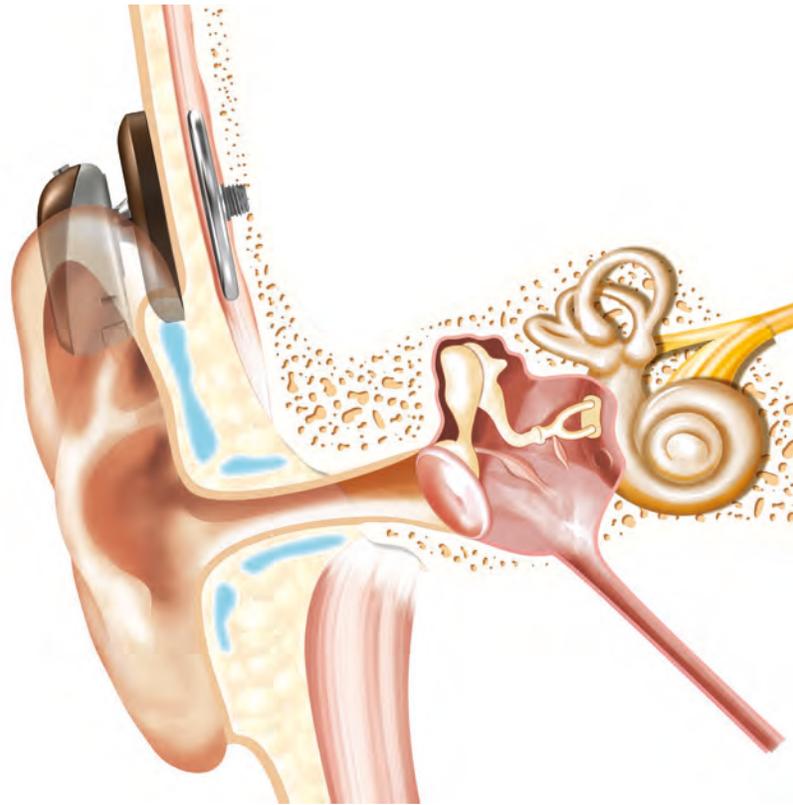
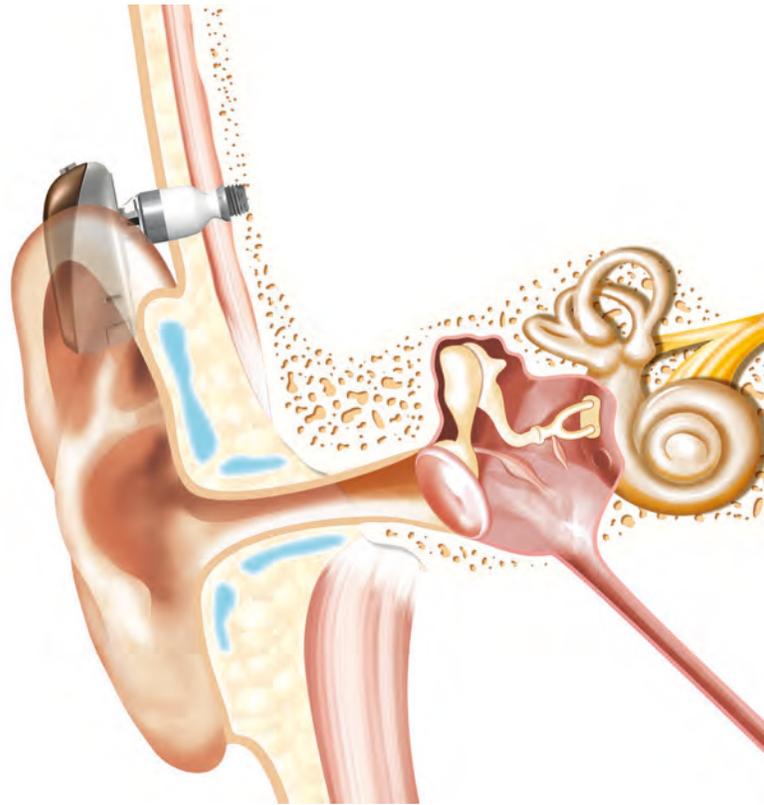
# BONE CONDUCTION HEARING DEVICES

## CONCEPT



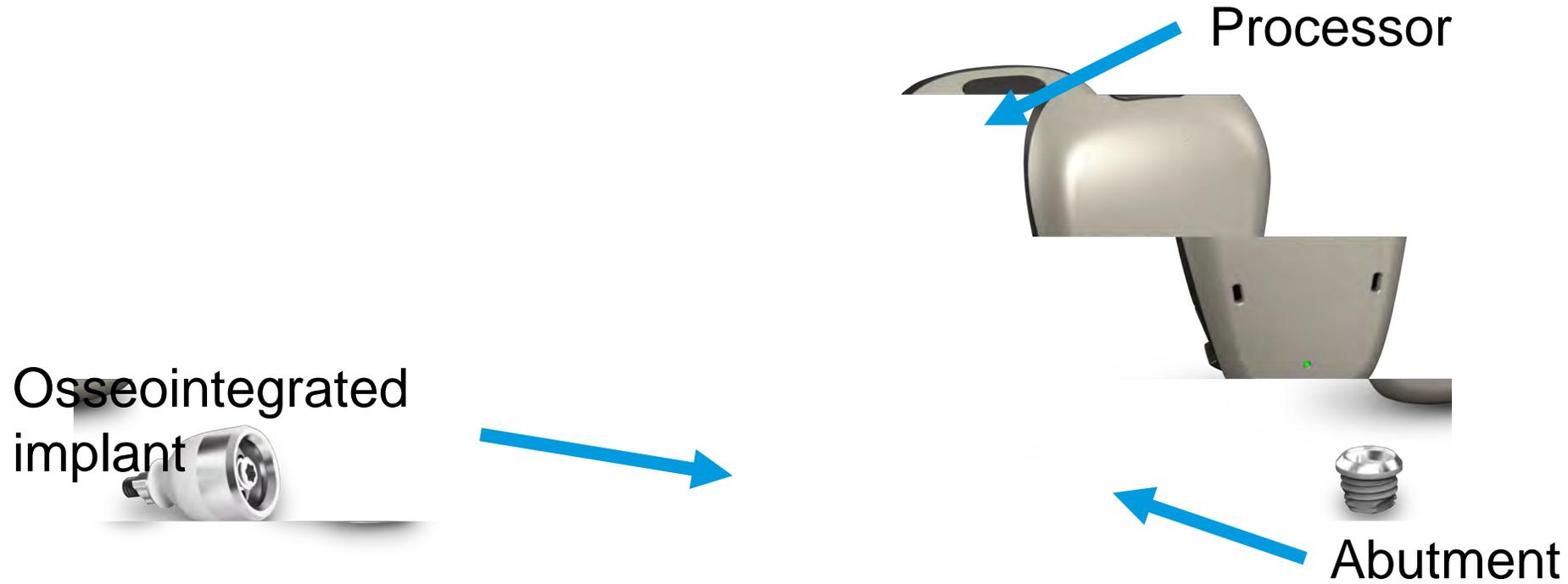
# BONE CONDUCTION HEARING DEVICES

## FORM FACTOR OPTIONS



*Images courtesy of Cochlear Americas.*

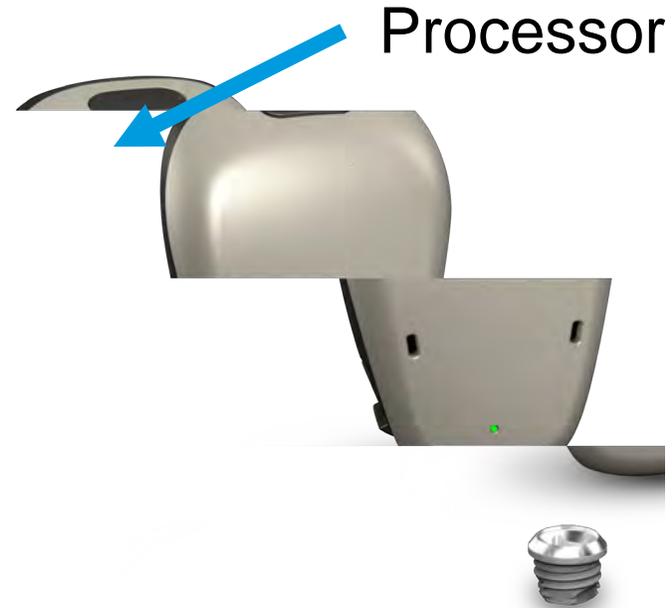
# COCHLEAR BAHA CONNECT



*Image courtesy of Cochlear Americas.*

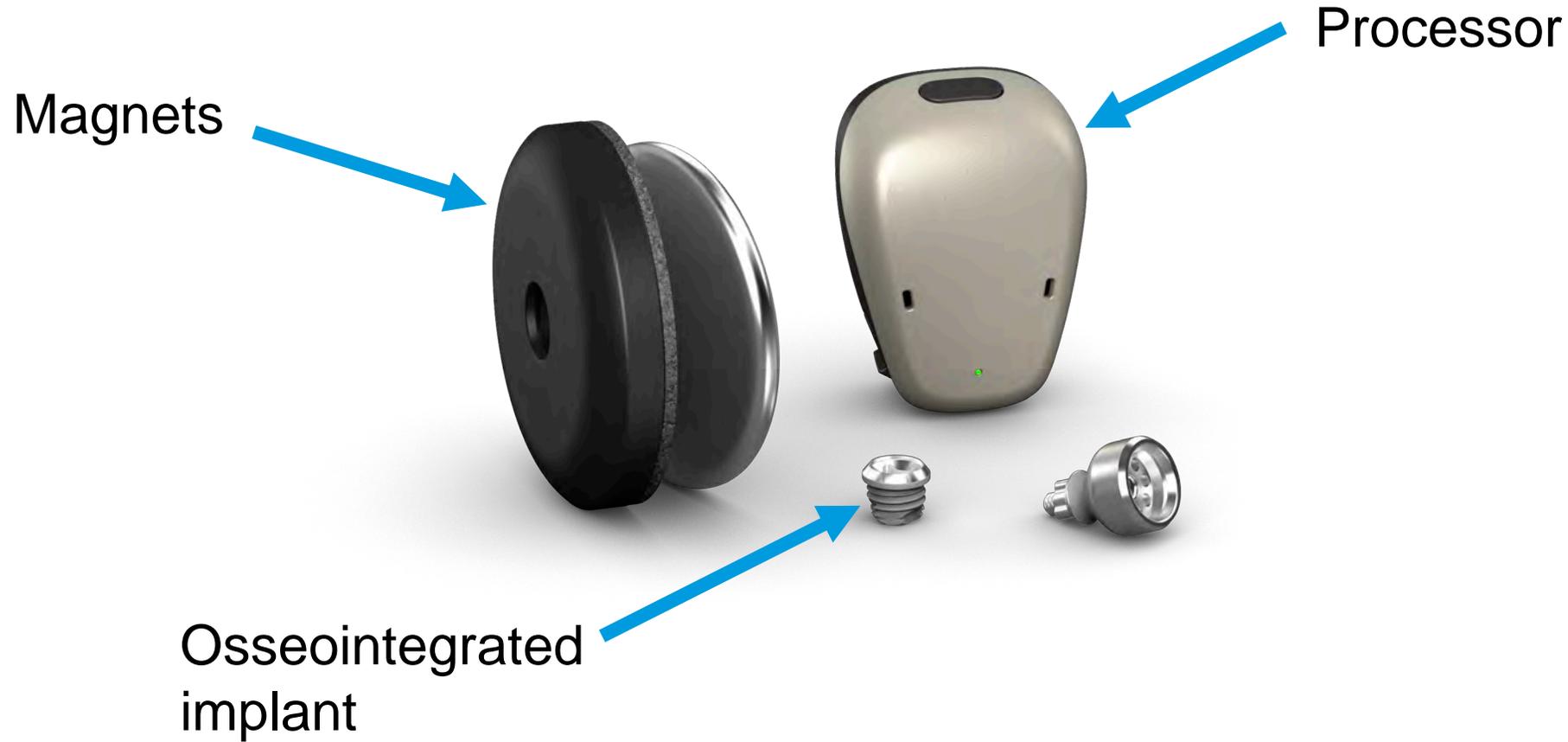
# COCHLEAR BAHA CONNECT

Osseointegrated  
implant



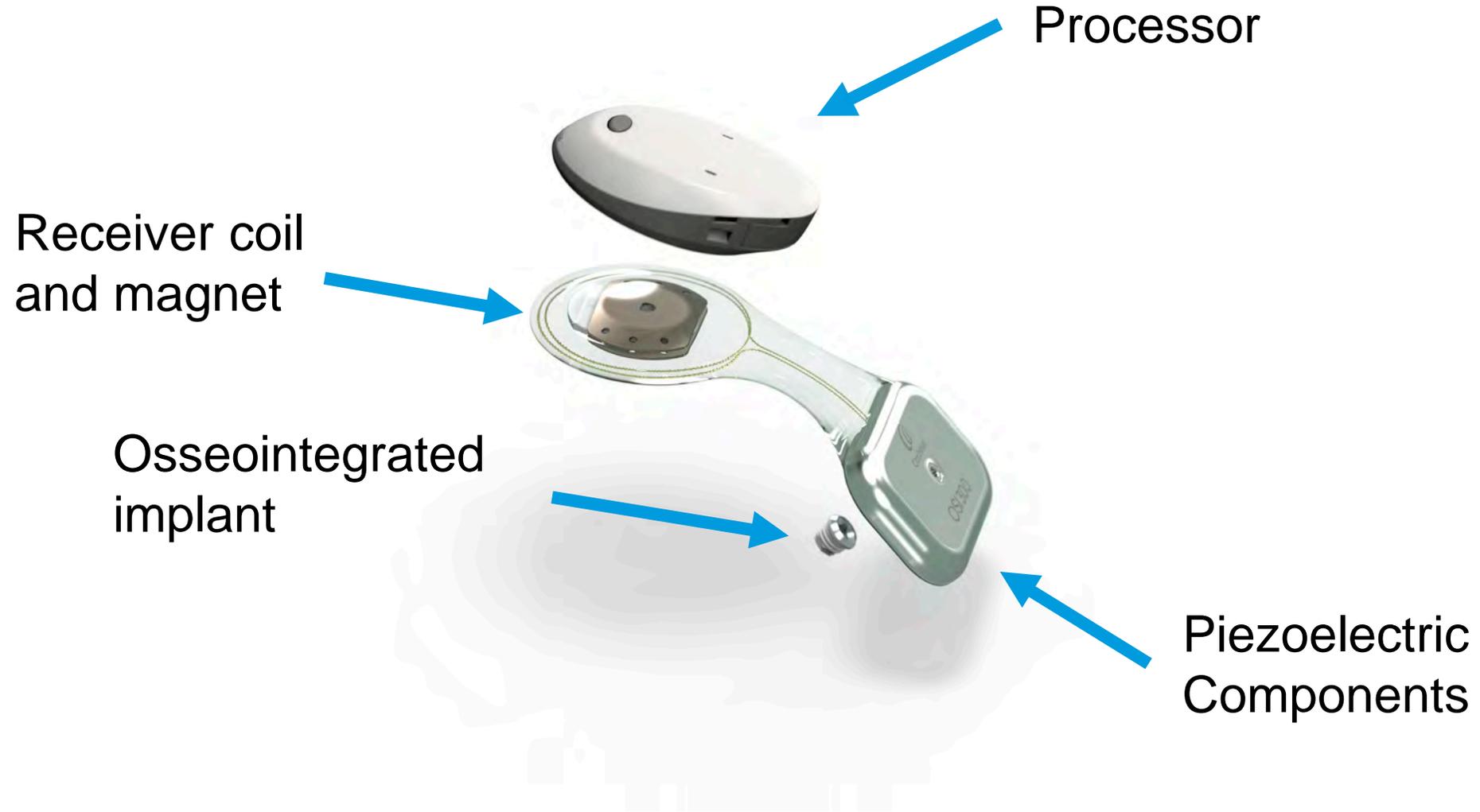
Processor

# COCHLEAR BAHA ATTRACT



*Image courtesy of Cochlear Americas.*

# COCHLEAR OSIA



*Image courtesy of Cochlear Americas.*

# MEDEL BONEBRIDGE

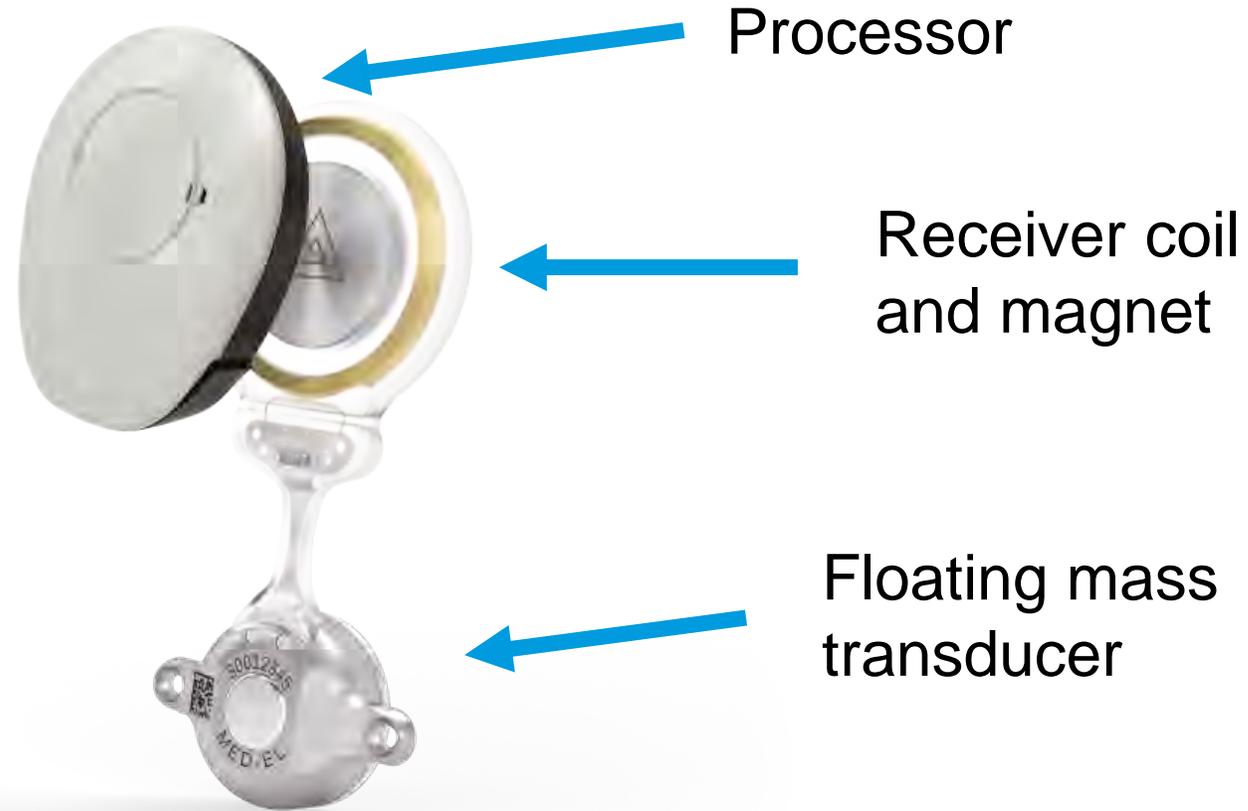


Image credit: MED-EL Media Center. <https://www.medel.com/press-room> Retrieved March 10, 2024.

# MEDEL BONEBRIDGE

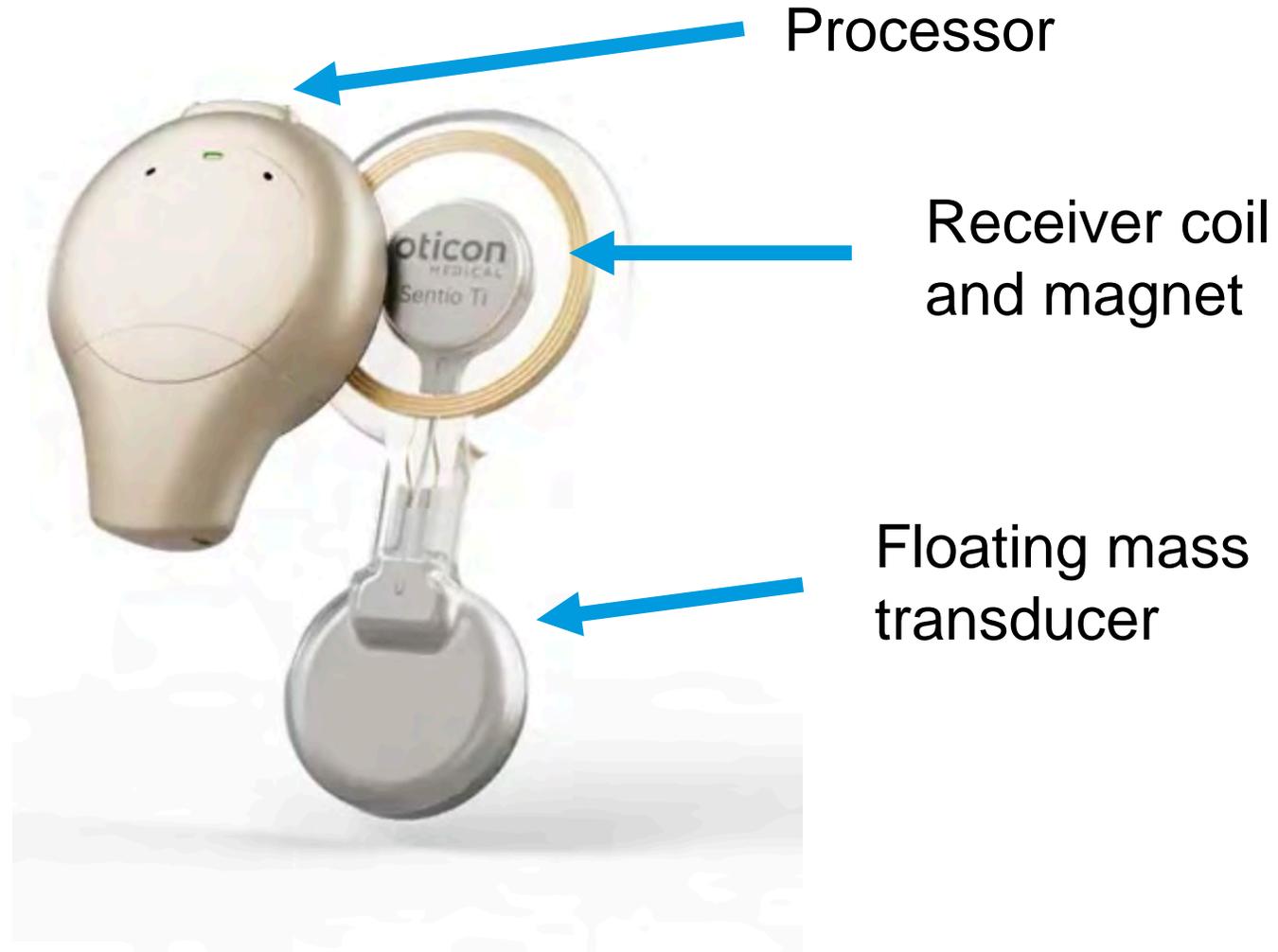


Image credit: <https://sentio.oticonmedical.com> Retrieved 3/4/2026

# HEARING REHABILITATION SUMMARY

Technology	Pros	Cons
Hearing Aid	Simple, helps tinnitus	Doesn't improve clarity for those with worse hearing.
CROS/BiCROS	Awareness on bad side. No surgery.	Doesn't restore hearing in bad ear.
Bone conduction devices	Awareness on bad side No need for HA in good ear	Doesn't restore bad ear. Requires surgery.
Cochlear implant	Restores hearing in bad ear. Most helpful for severe tinnitus.	Sound is "different". Not possible for all patients.

**No Symptoms**

**Hearing Loss  
and Tinnitus**

**Dizziness**

**Other Cranial  
Nerve Effects**

# WHEN YOU SAY YOU'RE "DIZZY"...

It's important to clarify what you mean when you say that you're "dizzy".

Do you really mean that you are experiencing...

## **Vertigo**

"Spinning"

Movement sensation

## **Disequilibrium**

Imbalance

"I feel off"

"I'm just dizzy"

"Going to fall"

## **Lightheadedness**

"Going to pass out"

## **Cognitive effects**

"Brain fog"

Concentration lapses

Easily fatigued

# VESTIBULAR = INNER EAR BALANCE FUNCTION

- Just like how you can lose hearing, you can lose balance function.
- But **UNLIKE** hearing loss, your brain can compensate for balance loss!



# MANAGING BALANCE

- Balance is complicated, but the recommendation for maintaining balance function with an acoustic neuroma is simple...
  - **KEEP MOVING!**
- Other senses can compensate:
  - Other inner ear
  - Vision
  - Proprioception

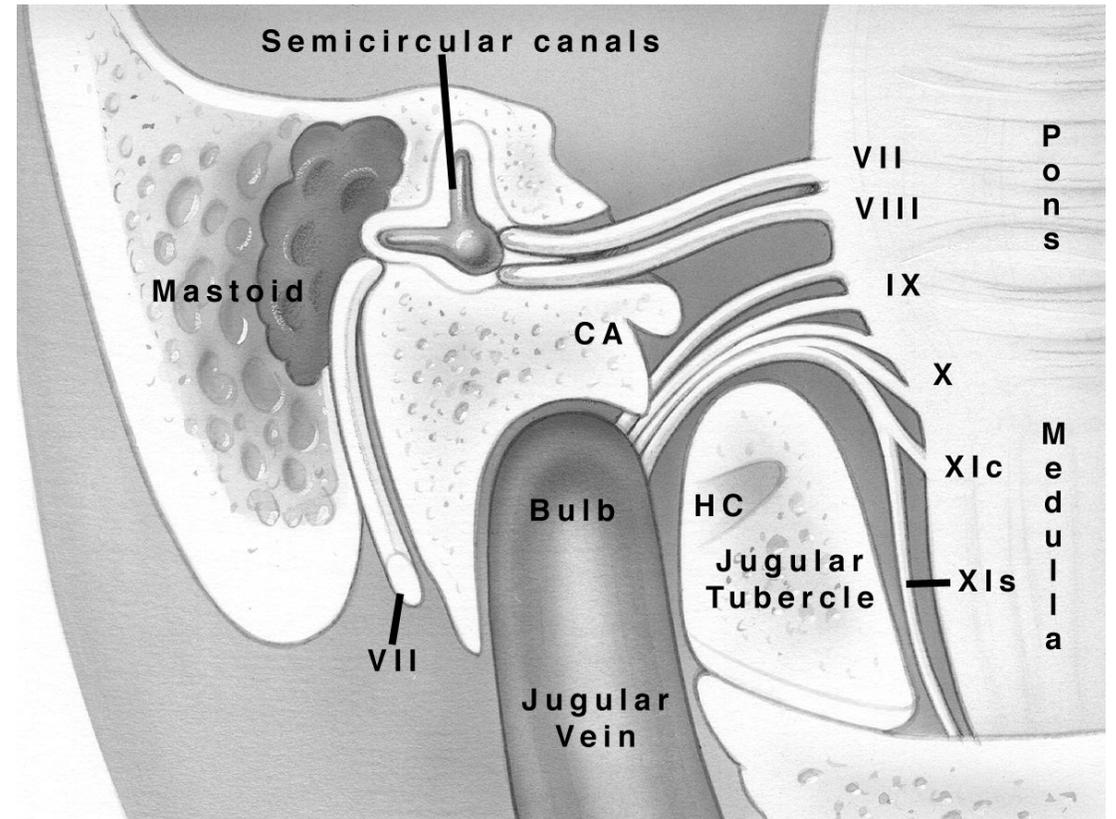
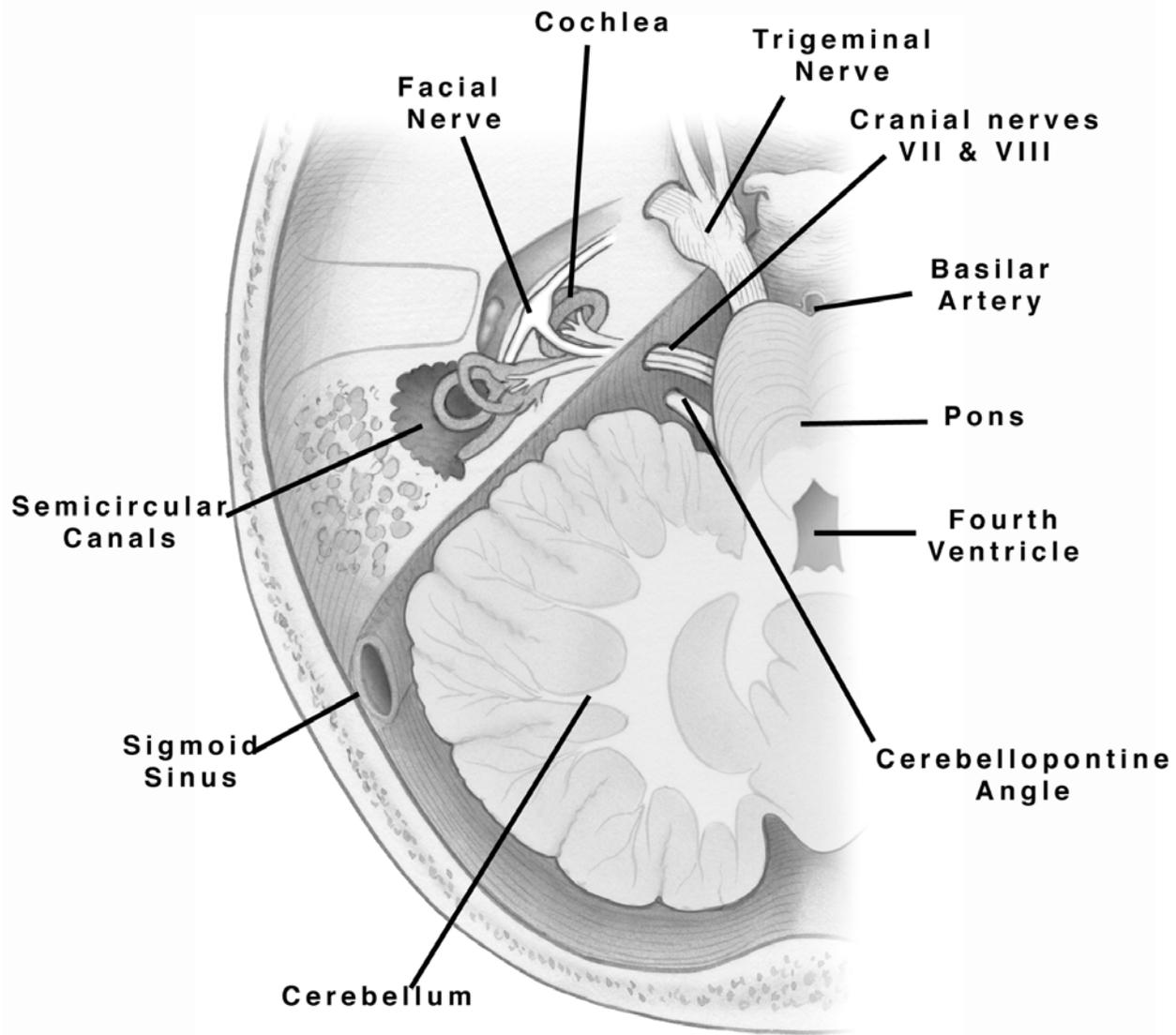


**No Symptoms**

**Hearing Loss  
and Tinnitus**

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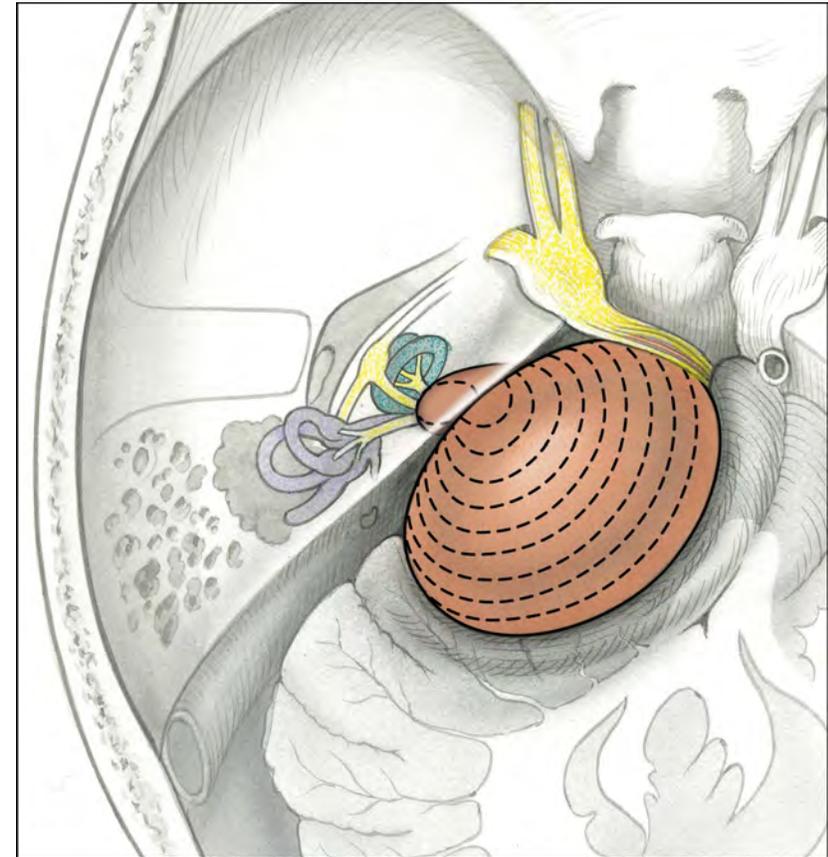
# CRANIAL NERVE FUNCTION

- Vestibular Schwannoma/Acoustic Neuroma grows on the vestibular division of the vestibulocochlear nerve. (8<sup>th</sup> cranial nerve)
- Important nearby nerves include:
  - Facial (7<sup>th</sup>) nerve – rarely affected by an untreated tumor unless large
  - Trigeminal (5<sup>th</sup>) nerve – facial numbness common with large tumors
    - Often gets better with surgery!
  - Glossopharyngeal and Vagus (9<sup>th</sup> and 10<sup>th</sup>) nerves – swallowing/voice
  - Abducens (6<sup>th</sup>) nerve – least commonly affected, injury can cause double vision

New symptoms involving any of these nerve functions should be reported to your doctor!

# A WORD ON HEADACHES...

- Headaches are very common
- ... but headaches caused by acoustic neuromas are rare.
- Only in rare circumstances would treatment of your AN be likely to improve headaches.
- Speak with your doctors about headache – they are likely to be treatable without AN surgery!

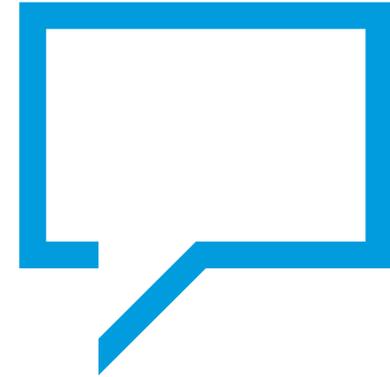




Department of  
Radiation Oncology

# BEYOND THE SCALPEL

## MODERN RADIATION AND NON-SURGICAL MANAGEMENT

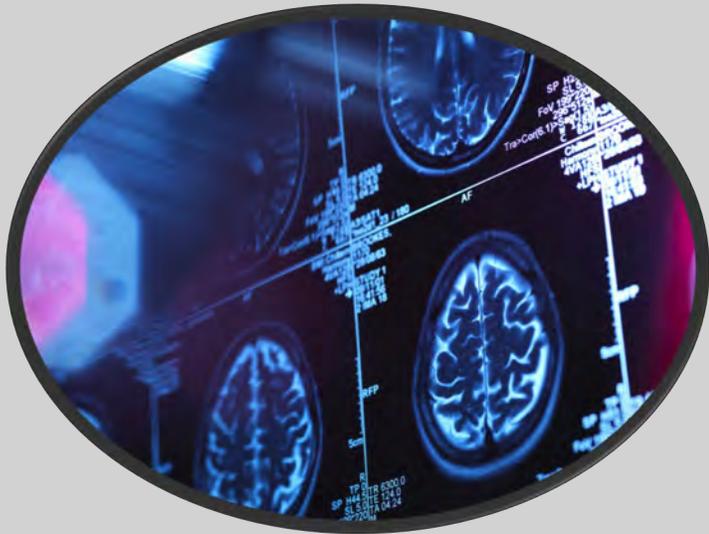


Jennifer Peterson, MD  
Associate Professor of Radiation Oncology

Mayo Clinic Florida  
March 7<sup>th</sup>, 2026

# MANAGEMENT OF ACOUSTIC NEUROMAS

3 main treatment approaches



Active Surveillance



Radiation Therapy



Surgery

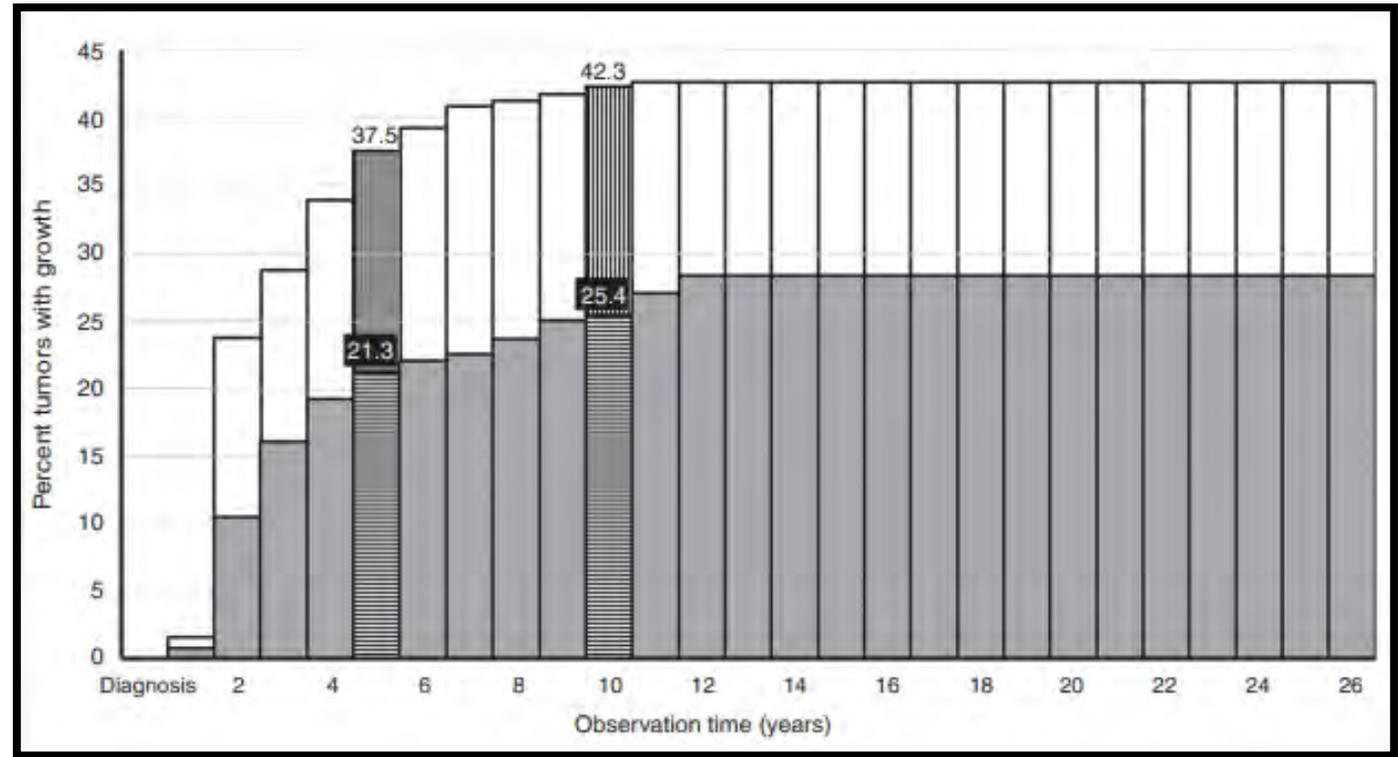


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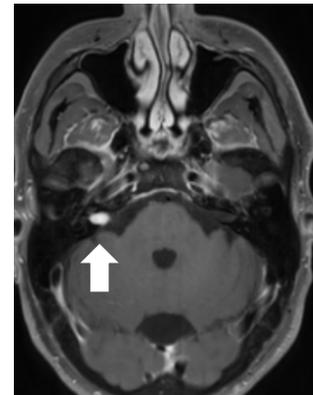
# CONSERVATIVE MANAGEMENT

# NATURAL HISTORY

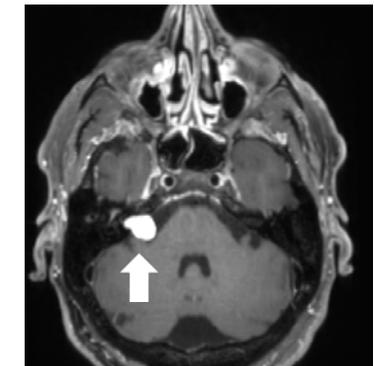
- Average growth: 1–2 mm/year
- 30–50% show growth
  - Variable growth patterns
  - Up to 10% spontaneous shrinkage
- Hearing may decline even without growth
- **Clinical implication:** Not all tumors require immediate treatment



**Intracanalicular  
Acoustic neuroma**

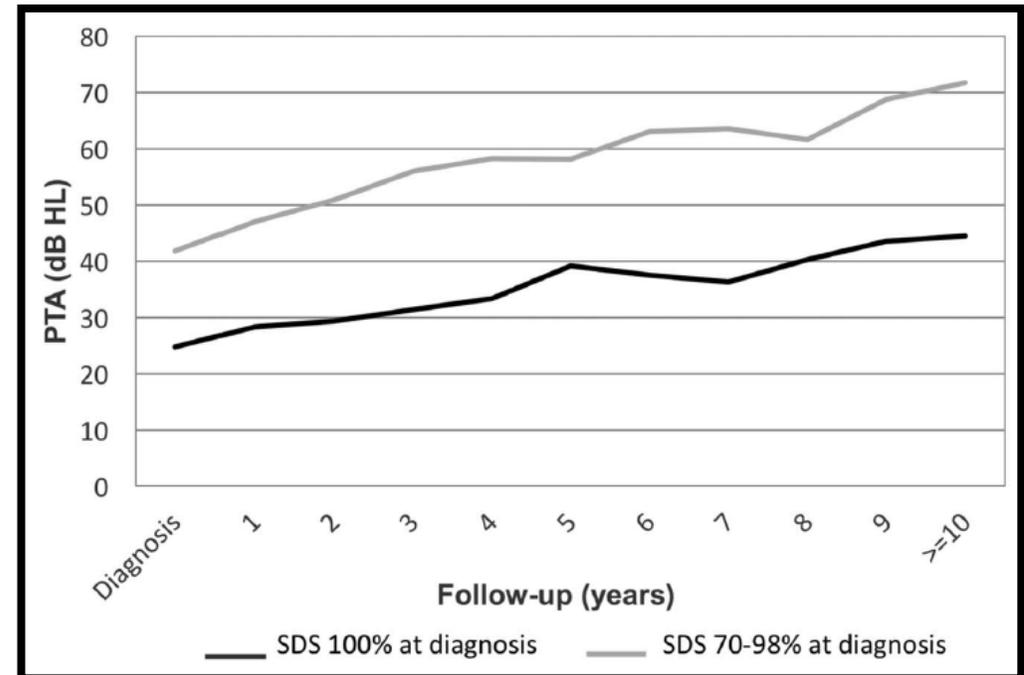
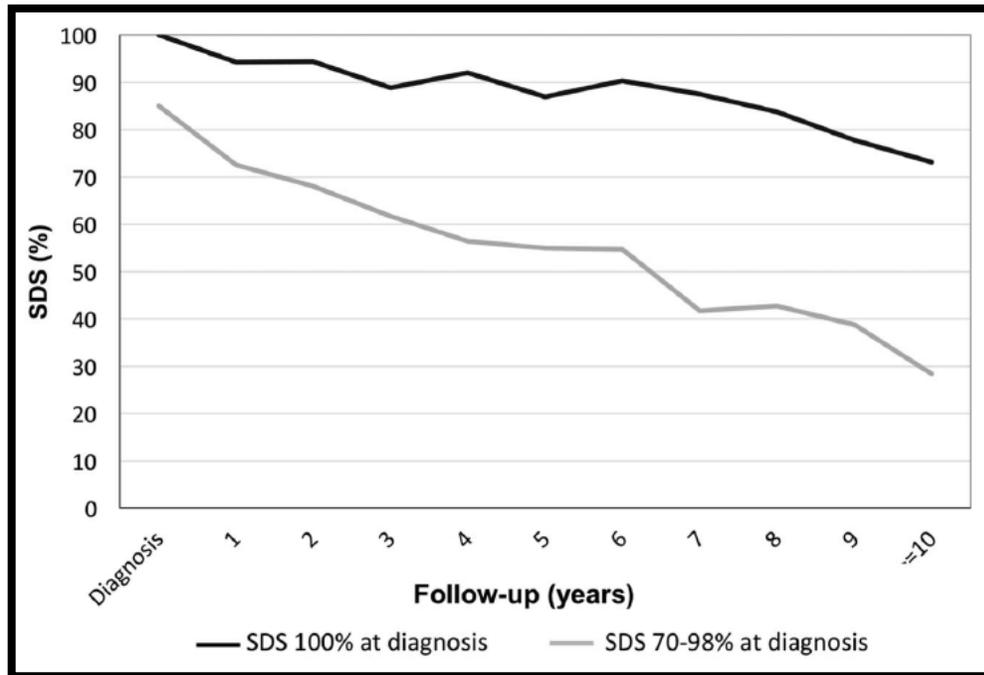


**Extracanalicular  
Acoustic neuroma**



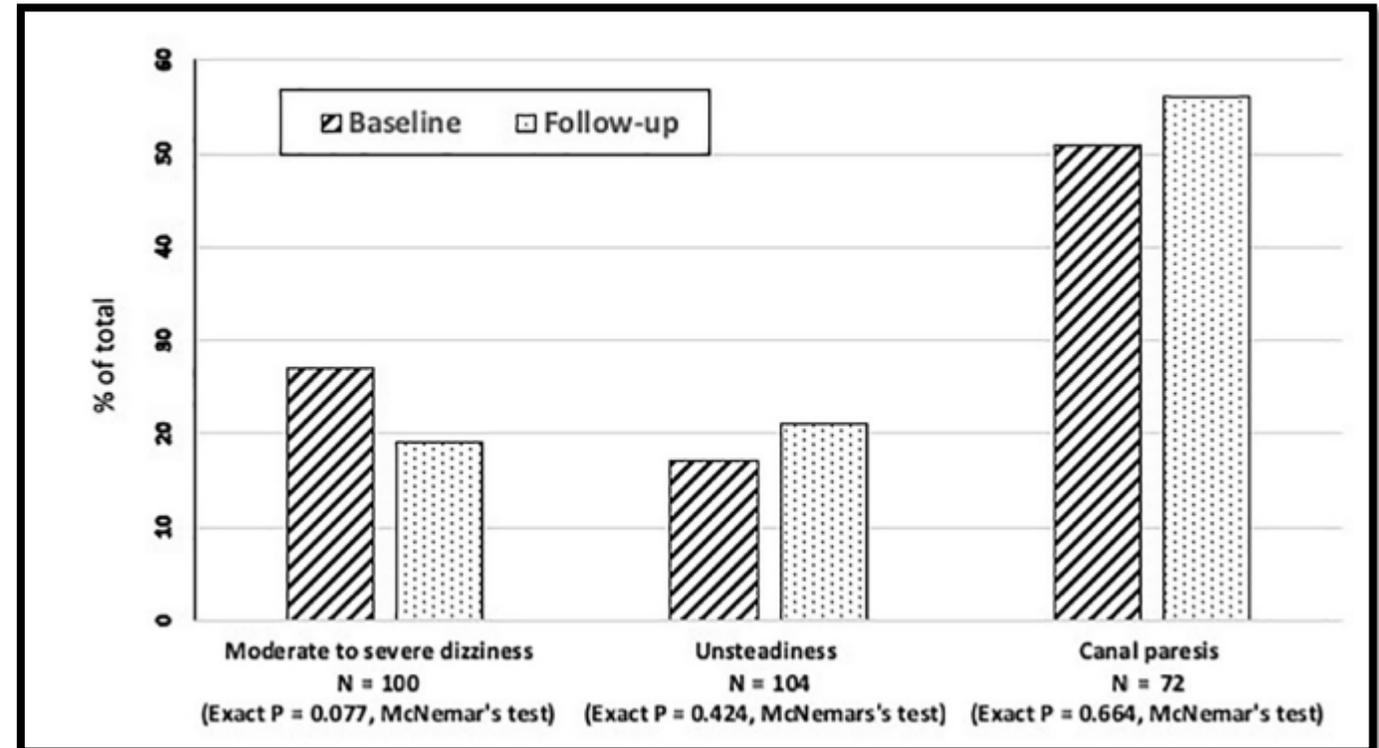
# NATURAL HISTORY HEARING PRESERVATION

- Maintenance of useful hearing:
  - 75% @ 3 yrs
  - 60% @ 5 years
  - 40% @ 10 years



# NATURAL HISTORY VESTIBULAR FUNCTION

- Hypofunction of the vestibular nerve
  - Slow, progressive process
  - Not a function of tumor growth
- Allows for central compensation over time
- **Take Home:** Dysfunction of the vestibular nerve  $\neq$  symptoms



# WHAT IS CONSERVATIVE MANAGEMENT?

- “Wait-and-watch” strategy
  - Serial MRI monitoring
  - Audiometric follow-up
  - Follow up visit
- Frequency
  - Initial 6-month scan
  - Yearly if stable
- Goal: Over treatment

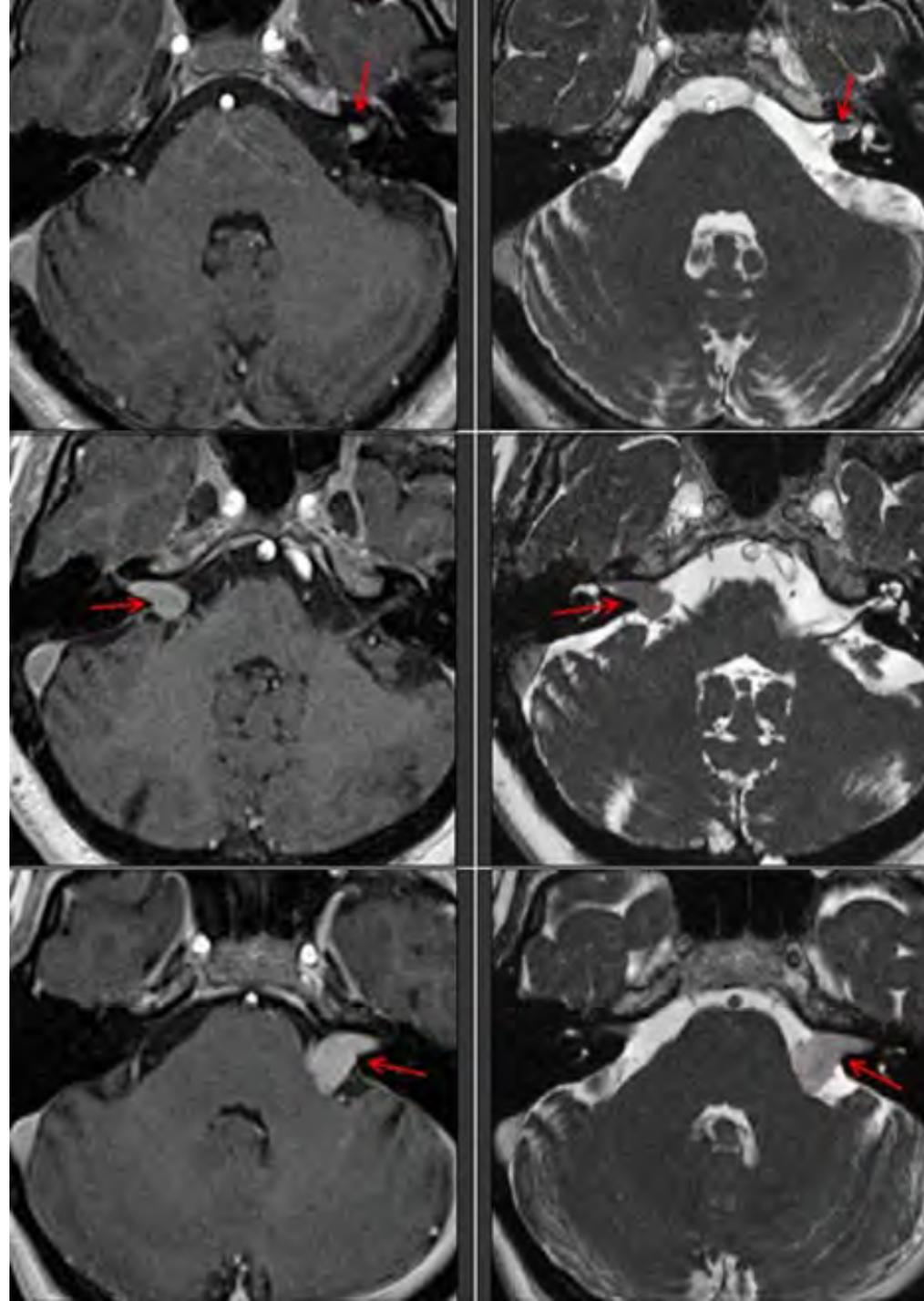


# **IDEAL CANDIDATES FOR CONSERVATIVE MANAGEMENT**

- Incidentally diagnosed tumors
- Small to medium size, < 1.5-2 cm
- Minimal symptoms
- Elderly or other comorbidities

# WHEN TO CONSIDER TREATMENT

- Growth > 2mm
- Extension into cerebellopontine angle
- Narrowing of space between tumor and brainstem
- Development of new symptoms

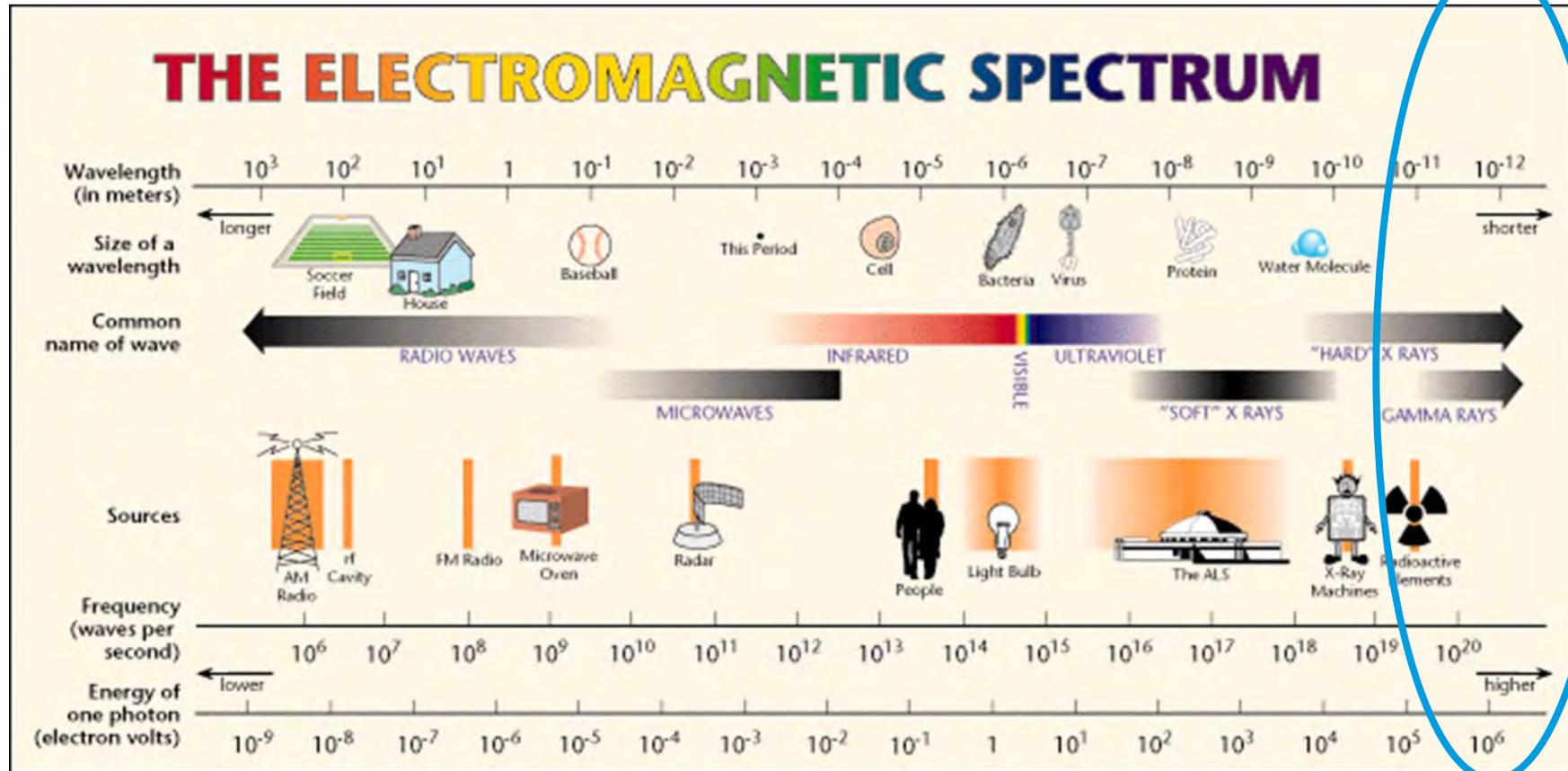




# 2

# RADIATION THERAPY

# WHAT IS RADIATION?



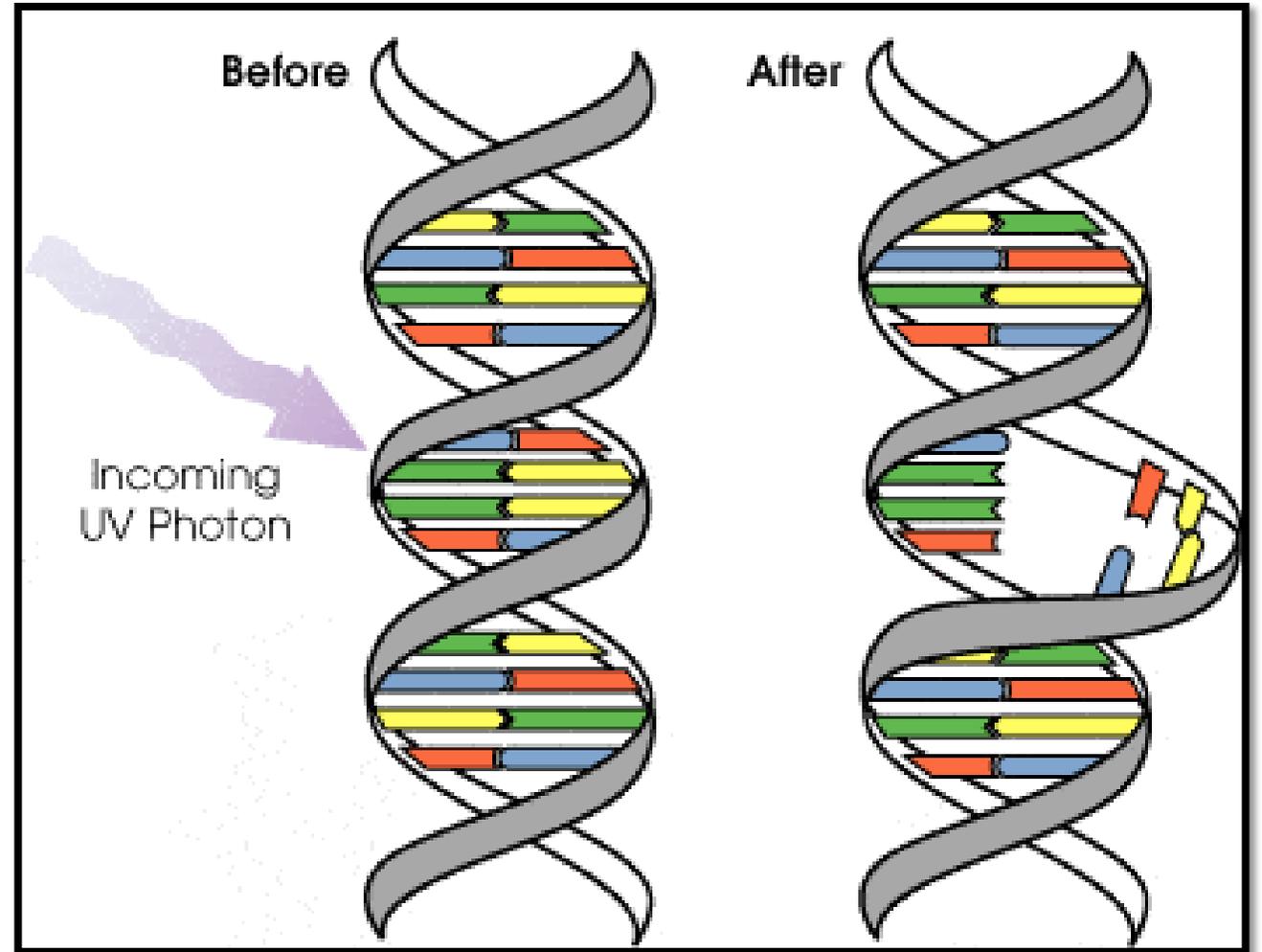
Ionizing radiation ~ 15 eV

X-rays operate in kV range

**Radiotherapy** operates in MV range

# HOW DOES RADIATION WORK?

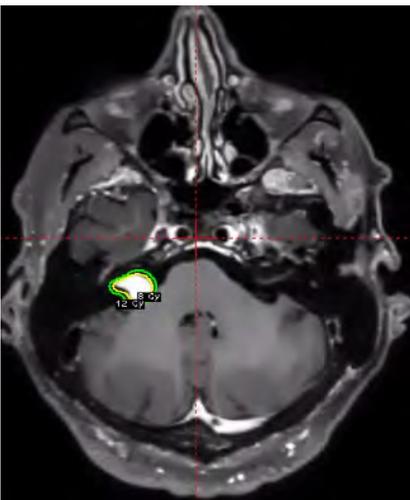
- Radiation → damages cellular DNA
- Inhibits tumor cell replication
- Normal cells have repair mechanisms



# FORMS OF RADIATION THERAPY

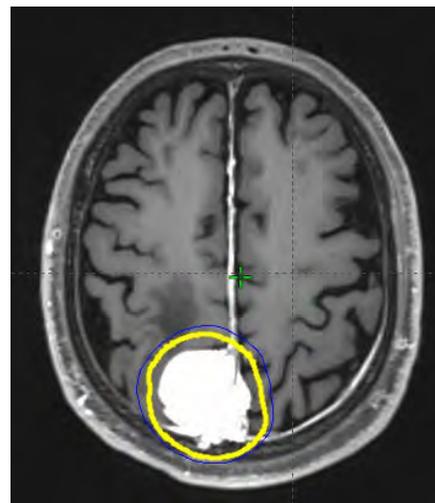
## Radiosurgery (SRS)

- Single high dose treatment
- Highly conformal
- Minimizes dose to surrounding normal tissue
- Well-defined, small target



## Fractionated Stereotactic Radiotherapy (fSRT)

- Multiple, smaller dose treatments
- Allows normal tissue to repair
- Larger, invasive tumors/near critical structures
- Photon and particle therapy



# MODALITIES FOR RADIOSURGERY

**Gamma Knife**



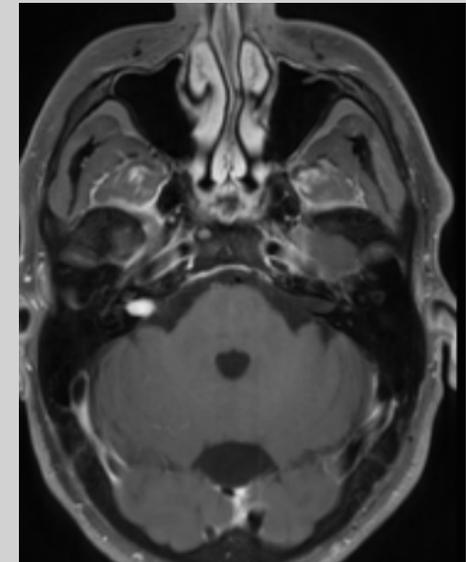
**CyberKnife**

**Linear Accelerator  
Varian Edge**

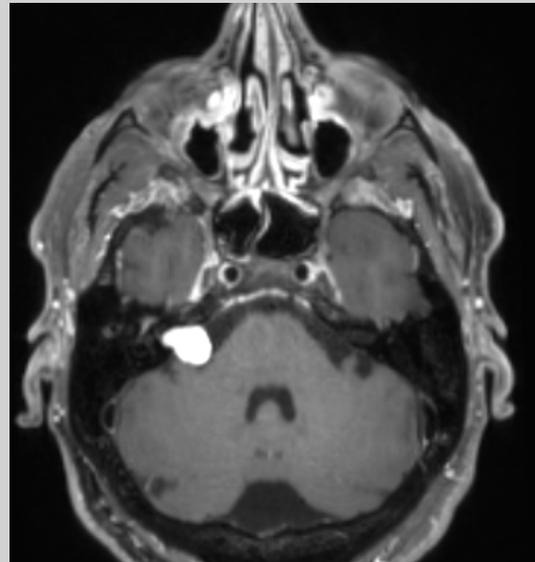
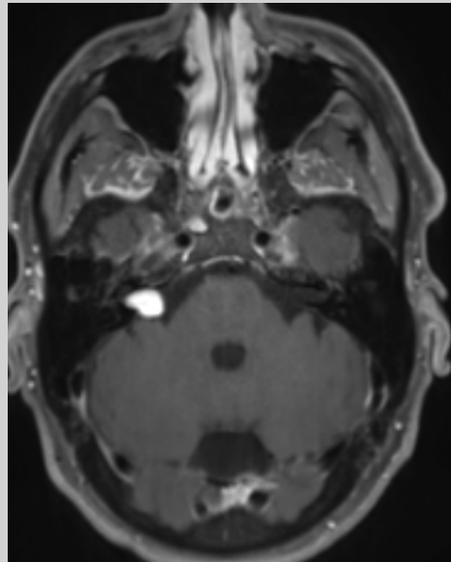


# GOAL OF RADIATION THERAPY

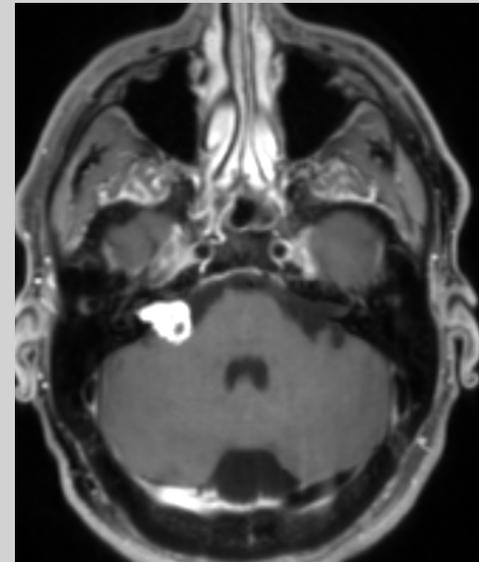
- Goal to halt tumor growth
- Subtle tumor shrinkage over time
- May experience transient enlargement post-treatment → pseudoprogression



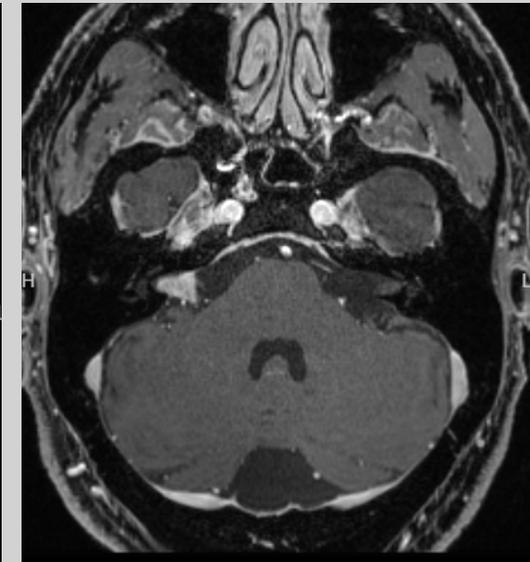
Pre-treatment



SRS  
Treatment



6 months  
Post-SRS



4 years  
Post-SRS

# IDEAL RADIATION CANDIDATE

## Indications

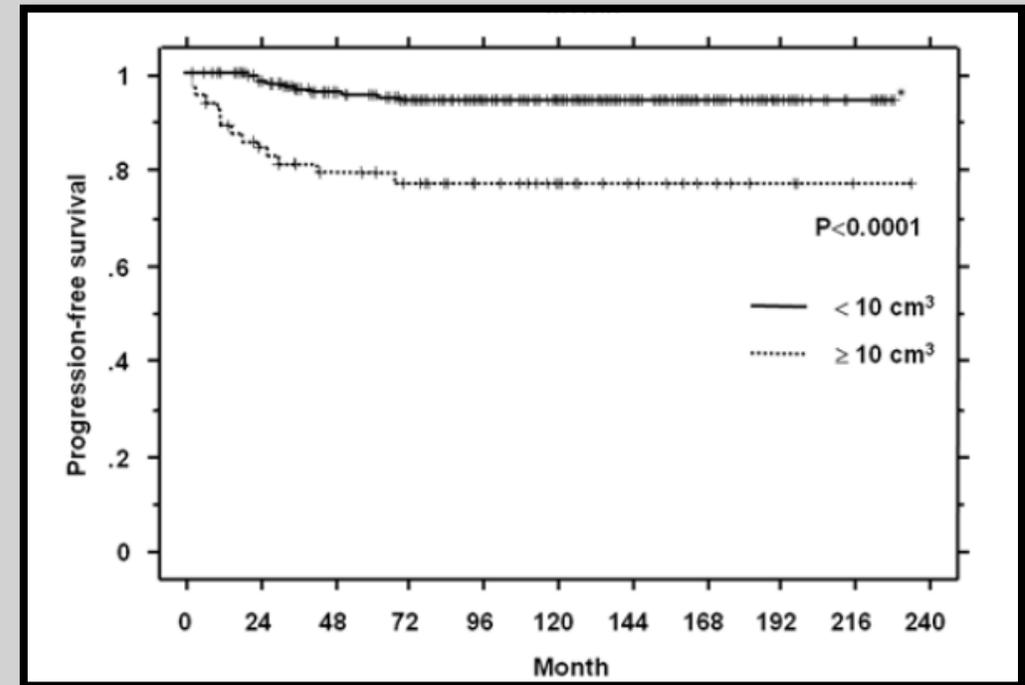
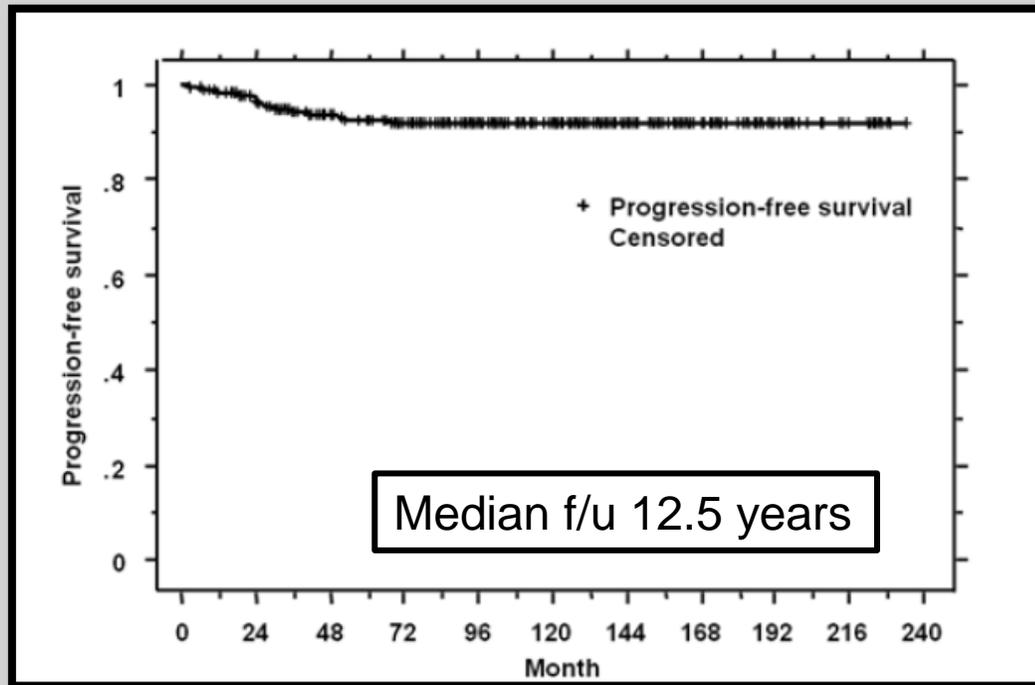
- Documented growth
- Upfront treatment
- Residual tumor after surgery

## Individual Factors

- Small to medium size tumors
  - < 2-2.5 cm
  - Minimal/no abutment of brainstem
- Age
  - Favored in older patients
- Hearing
  - Minimal hearing loss
  - Significant hearing loss

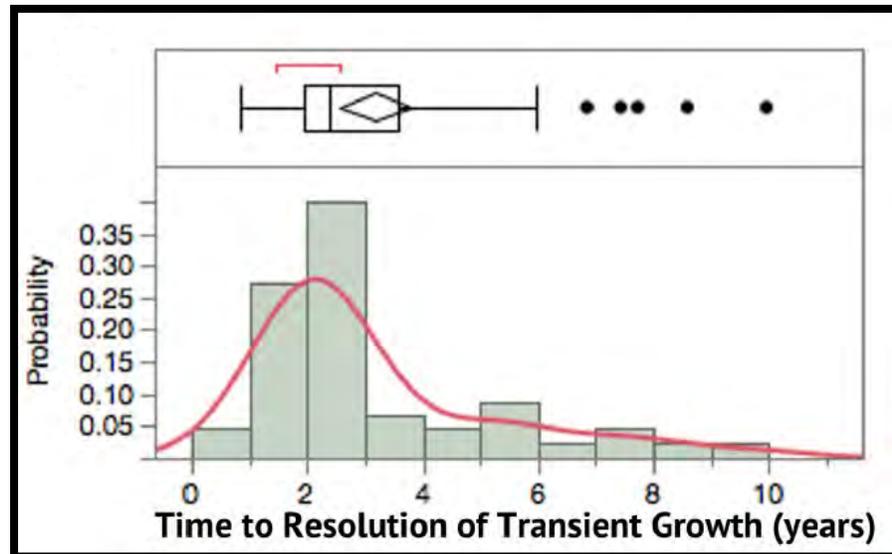
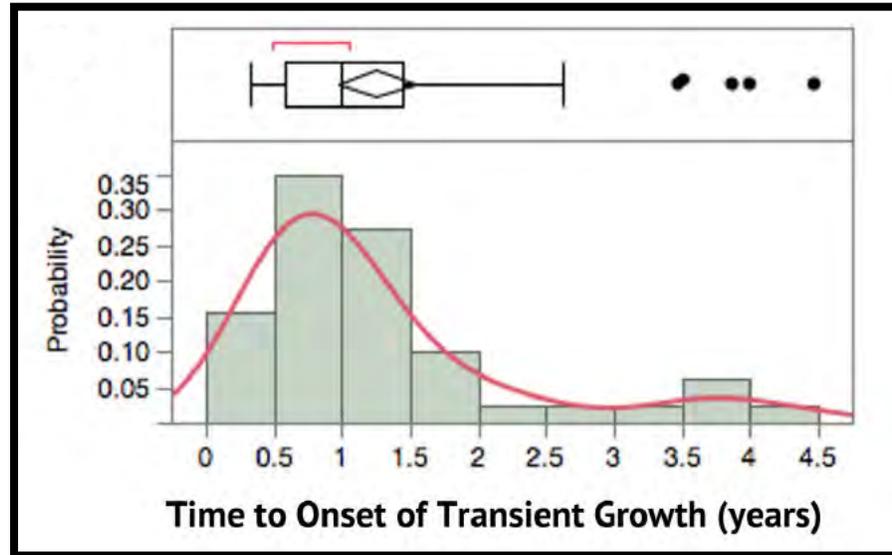
# SUCCESS OF RADIOSURGERY

- Tumor control 90-95%
  - Low risk of recurrence > 10 yrs
  - Slightly lower control rates with larger tumors
- No difference between Gamma Knife and LINAC based SRS



# PSEUDOPROGRESSION

- Transient increase in size after SRS
  - 40-50%
- Timing: 6-12 months
- Majority resolves over 2-3 years
  - Up to 6 years
- 70-80% show some shrinkage by 5 years post-SRS

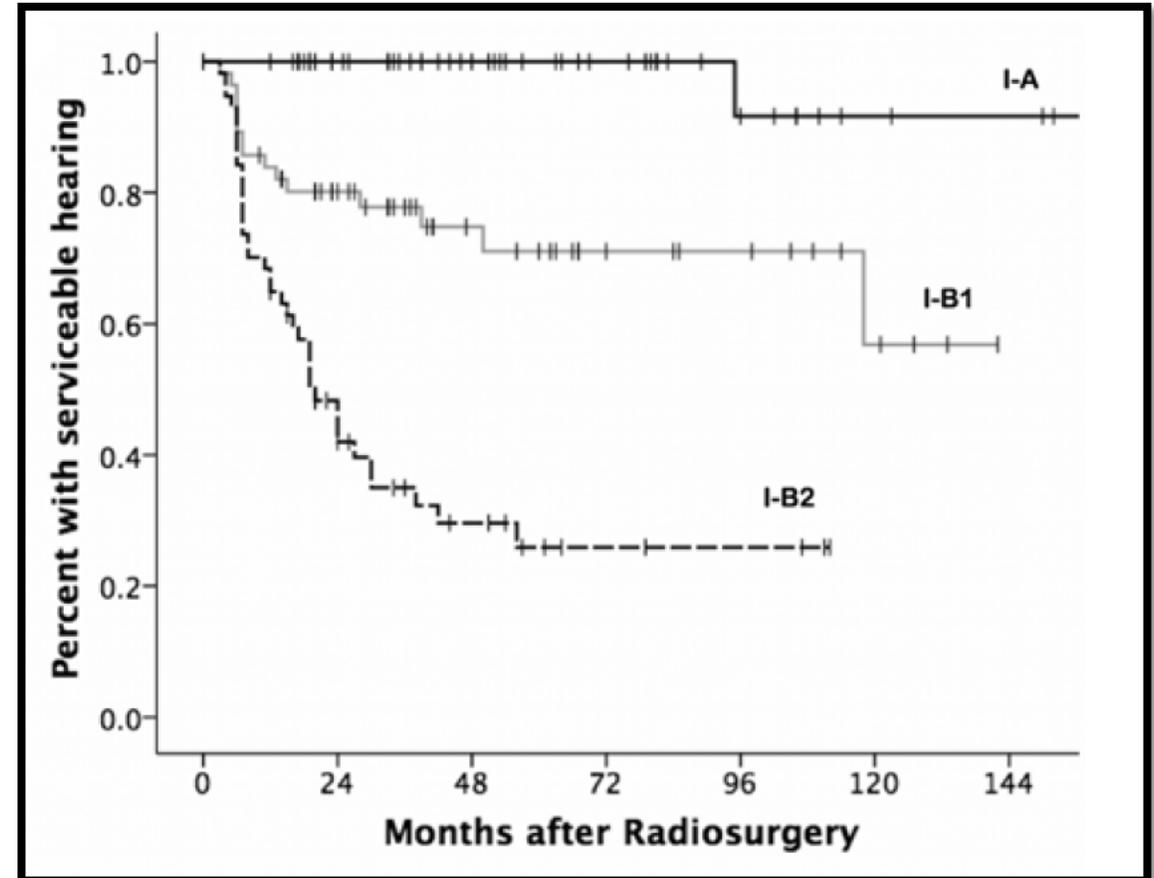


# **COLLATERAL IMPACT OF RADIATION**

- Hearing
- Balance
- Facial nerve function
- Trigeminal nerve
- Brainstem
- Risk of secondary cancers
- Delayed cyst formation

# IMPACT ON HEARING

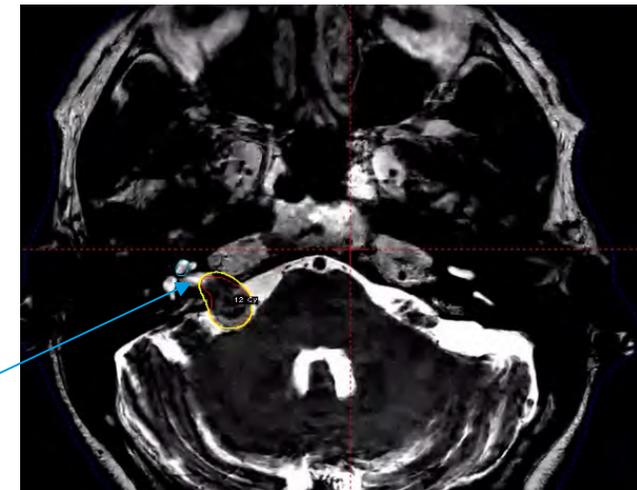
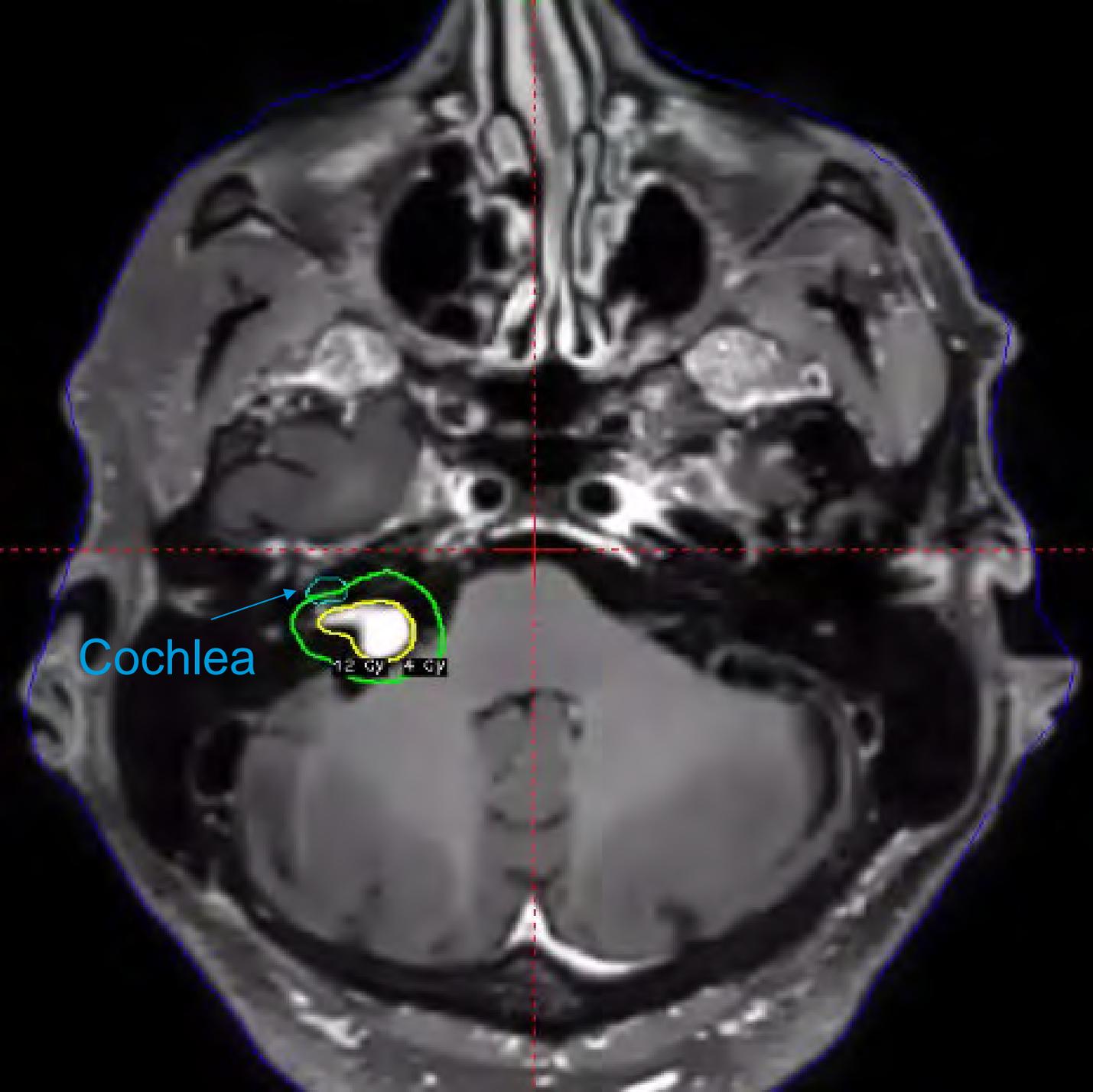
- Hearing preservation rates
  - 60-70% @ 3-5 years
  - 40-50% @ 10 years
- Highly variable
  - Better baseline hearing
  - Younger age
  - Smaller tumor volume
  - Lower cochlear dose



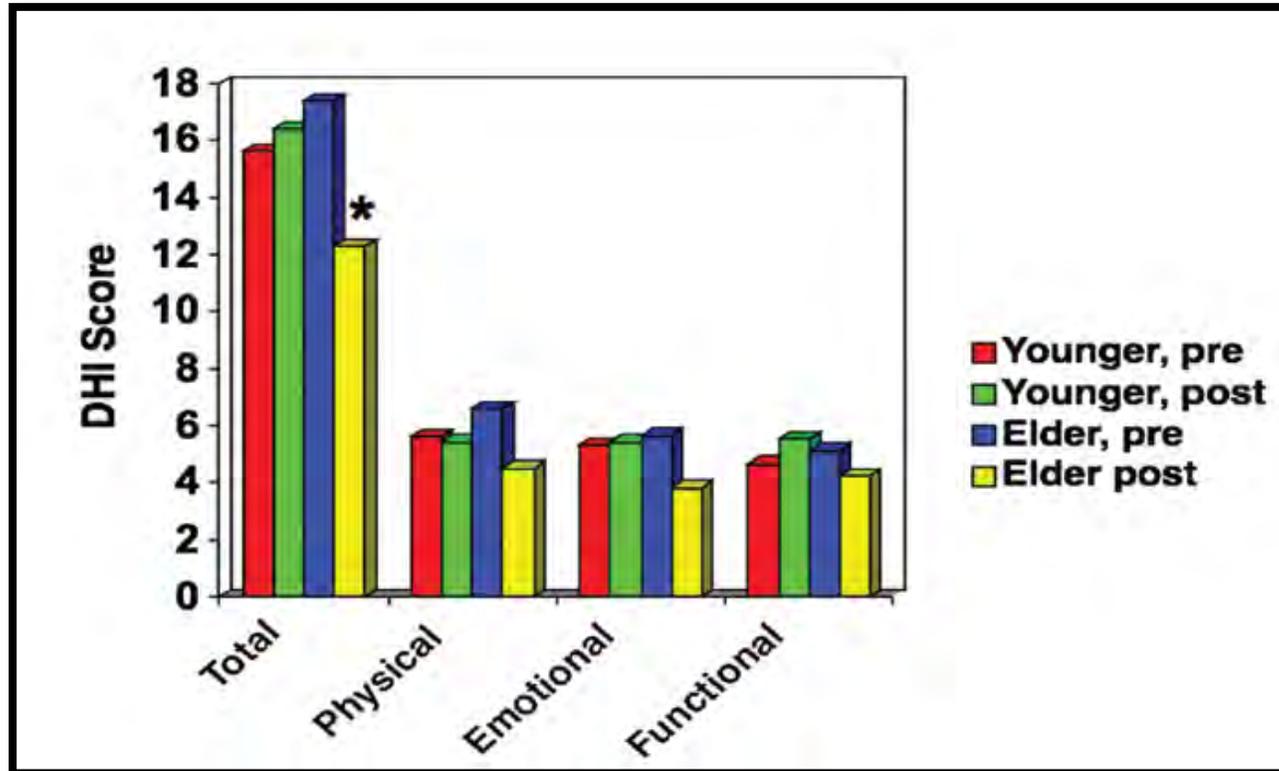
**Take Home:** Expect gradual loss with time; sudden hearing loss rare

# COCHLEAR DOSE

- Modifiable risk factor
- Limit cochlear dose
  - Mean < 4 Gy
- Greater tumor free canal space = favorable anatomy



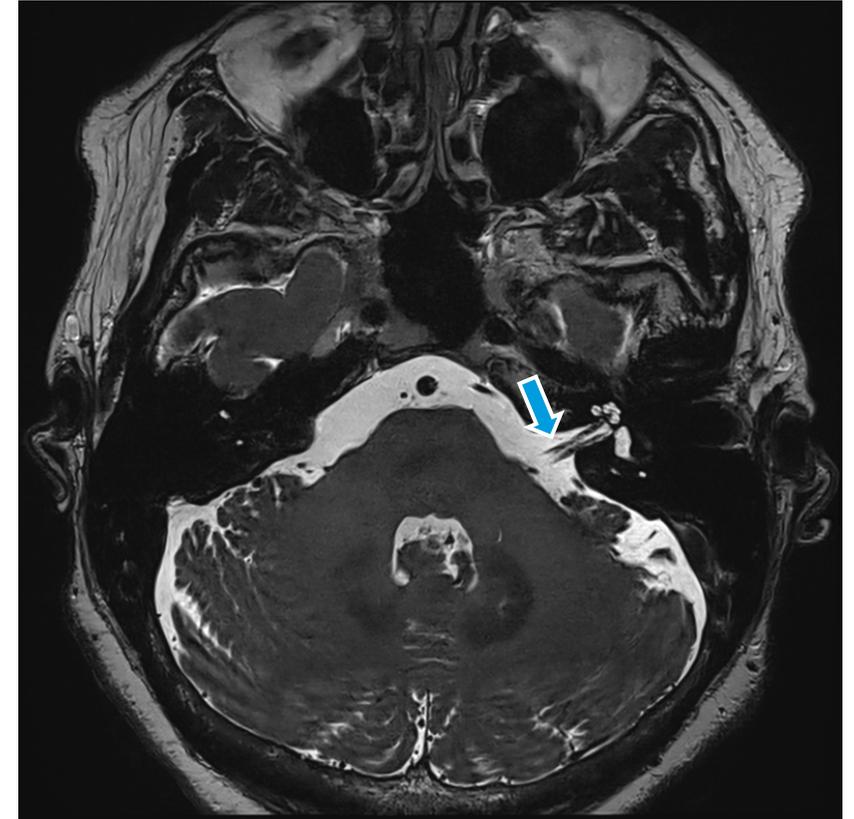
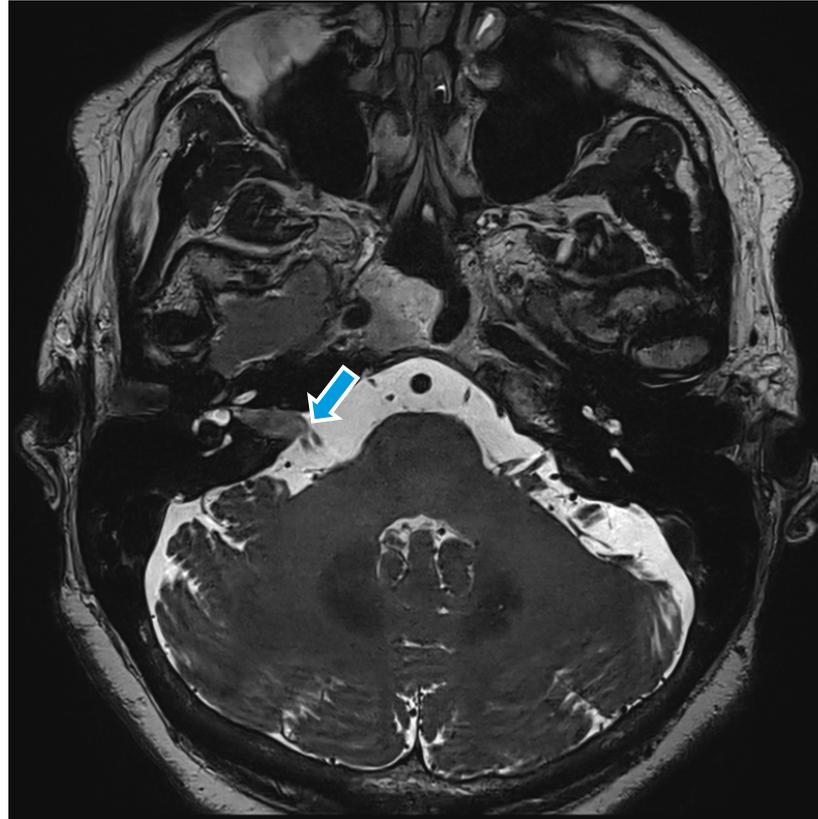
# IMPACT ON BALANCE



- Short term
  - Possible increased vestibular symptoms
  - 3-9 months post SRS
- Long term
  - Stability to improvement with time
  - Low probability of worsening

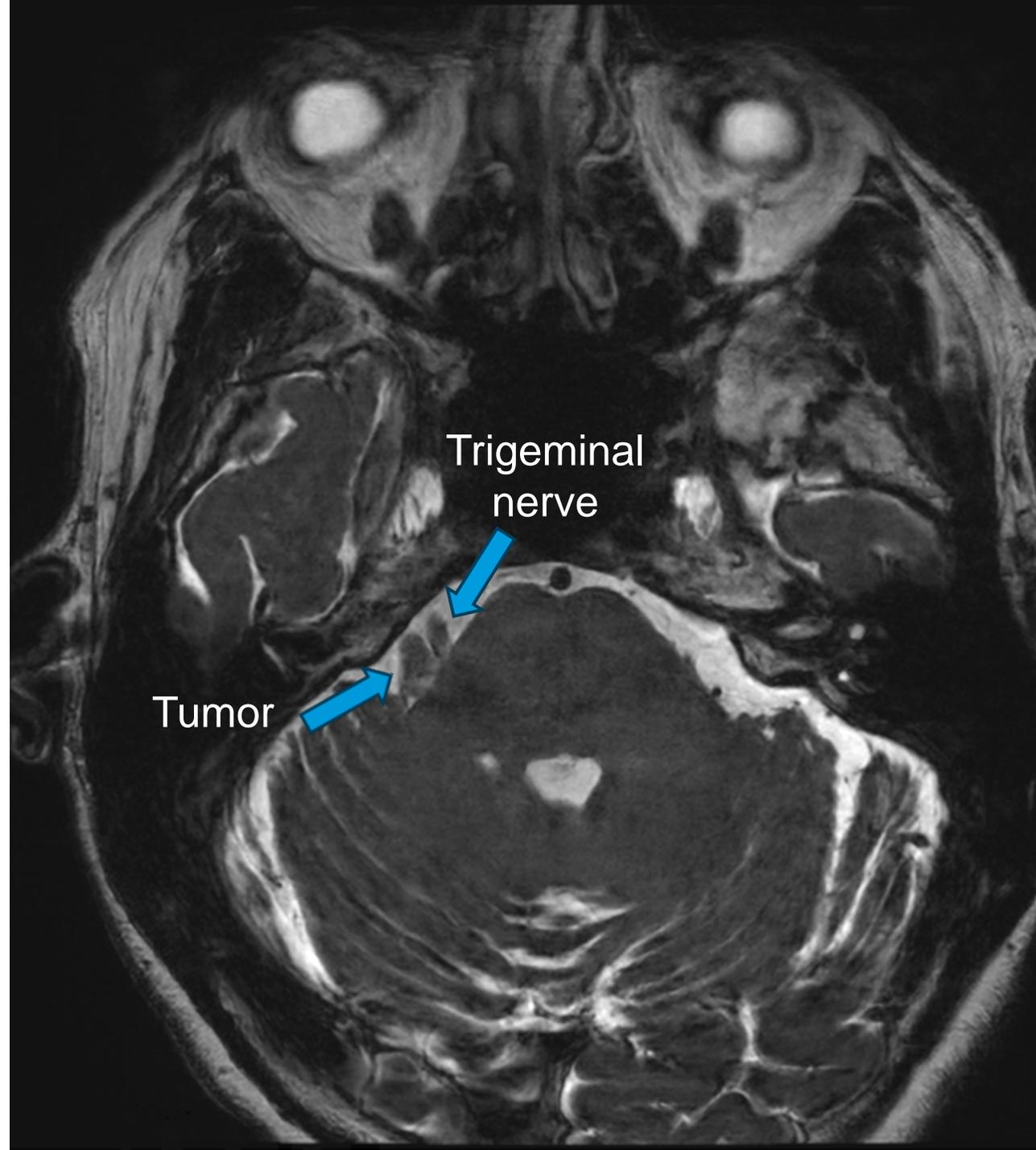
# IMPACT ON FACIAL NERVE

- Runs adjacent to tumor in the internal auditory canal
- 1-2% risk of injury
  - Range from spasm to weakness
  - Typically, within first 6 months
- Associated factors
  - Loss of fundal cap
  - Cochlear dose



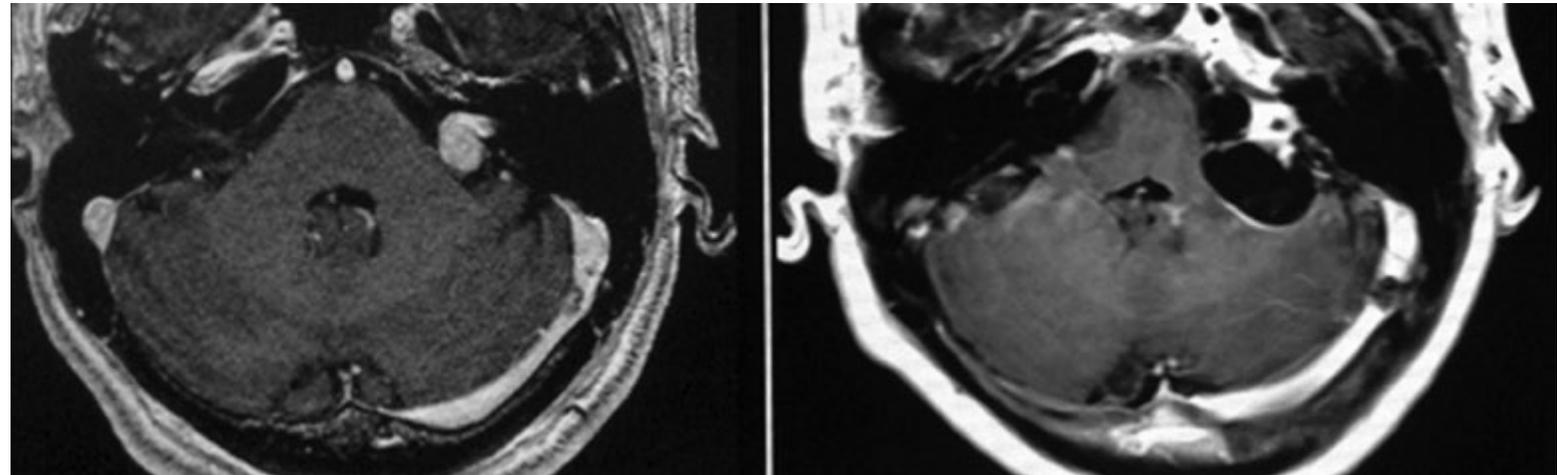
# IMPACT ON TRIGEMINAL NERVE

- 5% risk of injury
  - Moderate size tumors
  - Range from numbness to pain
- Can relieve pre-treatment symptoms



# LATE EFFECTS

- Risk of secondary malignancy or malignant transformation
  - 0.045% over 10 years
  - May be higher in neurofibromatosis type 2 patients
- Delayed cyst formation
  - 2-3%
  - Radiation induced vascular changes



Wolf, et al. Lancet Oncol 2019; 20:159.  
Bin-Alamer, et al. NS 2023; 92(5): 934.  
Shuto, et al. J Clin NS 2016; 33:239.

# HOW IS RADIOSURGERY PERFORMED

- Outpatient procedure
- Typically, 1 treatment
- Minimal recovery time

Immobilization



Imaging



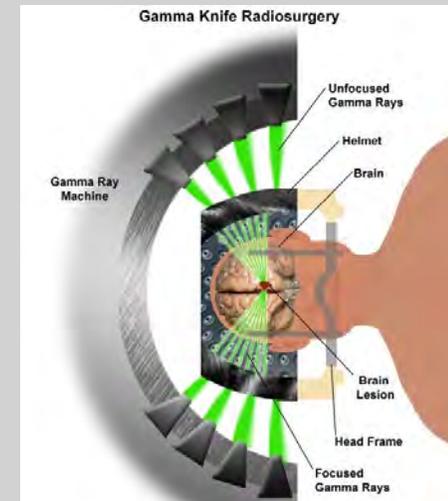
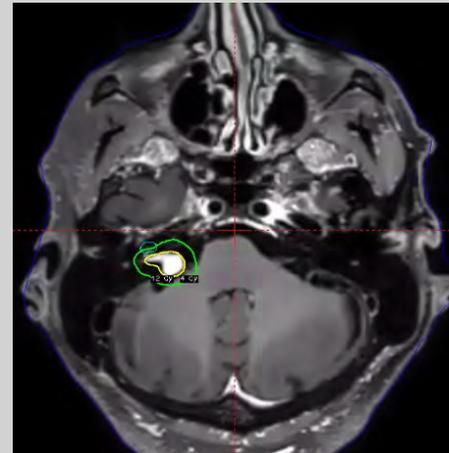
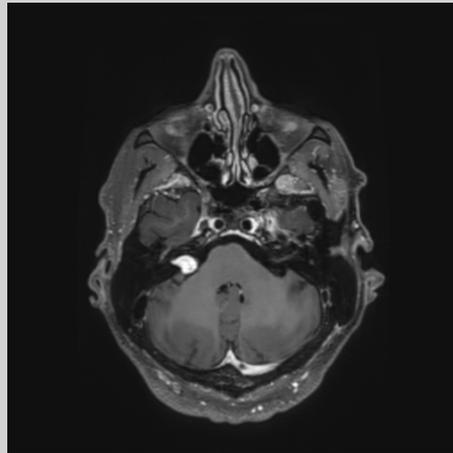
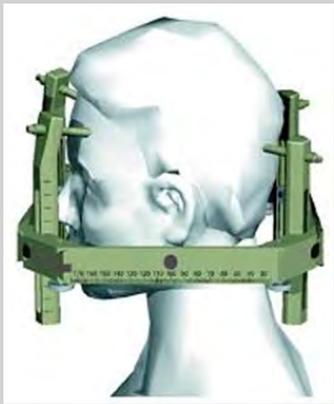
Contouring/  
Plan Development



Quality  
Assurance



Treatment





# 3

# DECISION MAKING

# CONSERVATIVE MANAGEMENT

VS

# RADIOSURGERY

## Conservative Management

---

- Tumor removal: No
  - Requires follow up imaging
- Tumor control:
  - Variable
- Hearing preservation
  - Gradual decline
- Risks
  - Tumor growth
- Ideal candidates
  - Small, stable tumor

## Radiation Therapy

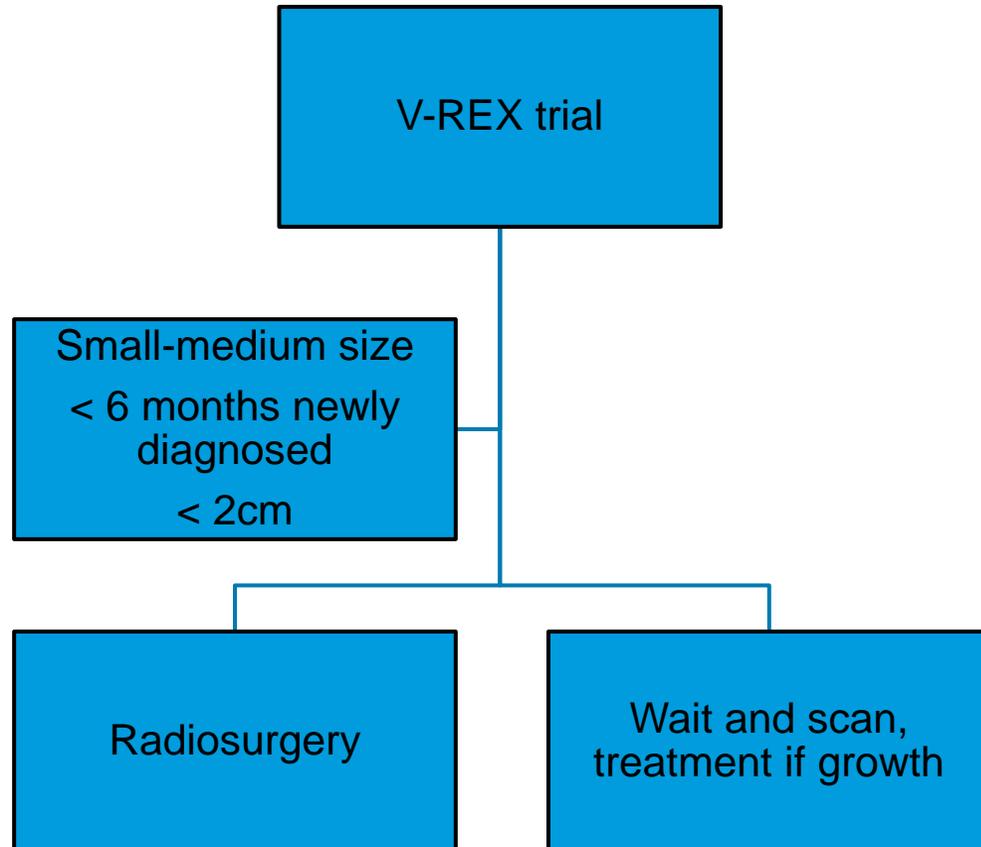
---

- Tumor removal: No
  - Requires follow up imaging
- Tumor control:
  - 90-95%
- Hearing preservation
  - Gradual decline
- Risks
  - Complications
- Ideal candidates
  - Small-medium tumors with growth

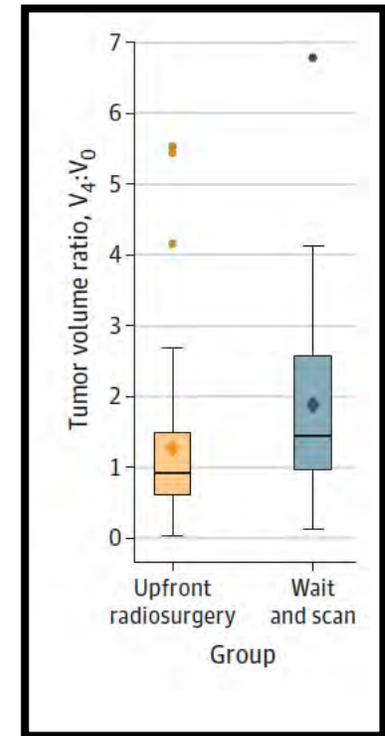
# FACTORS INFLUENCING DECISION

- Tumor size
- Age
- Hearing status
- Symptoms
- Growth rate
- Other medical comorbidities
- Long term follow up needs
- Patient preference

# DOES EARLIER TREATMENT MATTER?

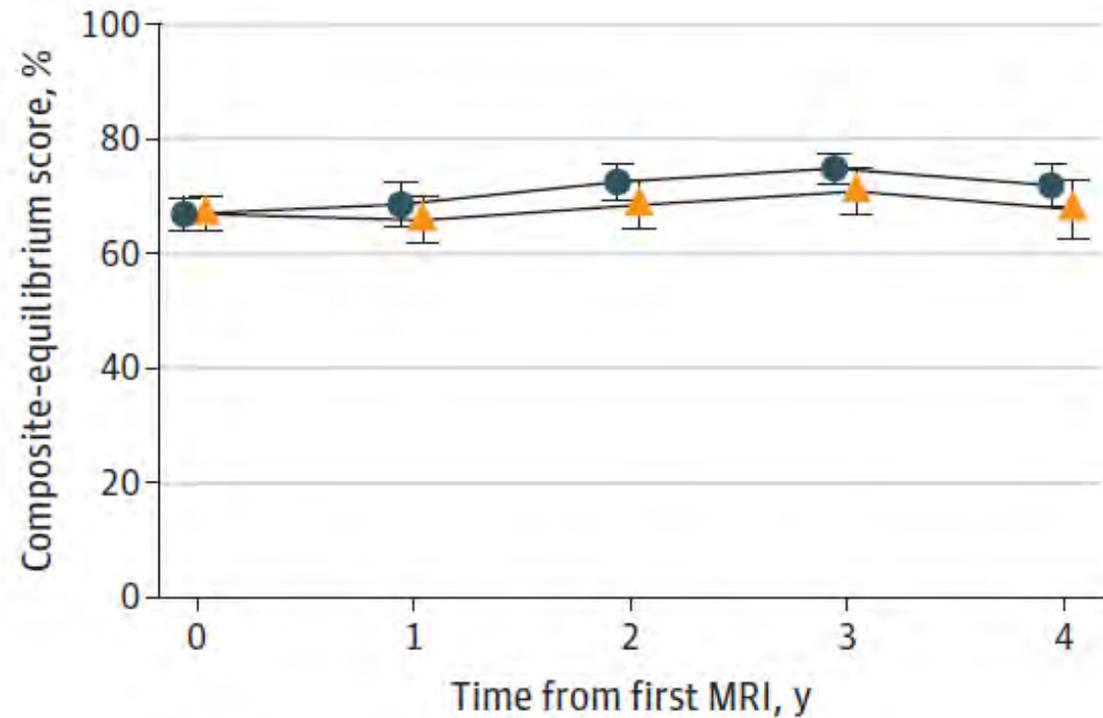


- Median follow up 4 years
- Reduction in tumor size with SRS
- Wait and scan
  - 42% SRS due to growth

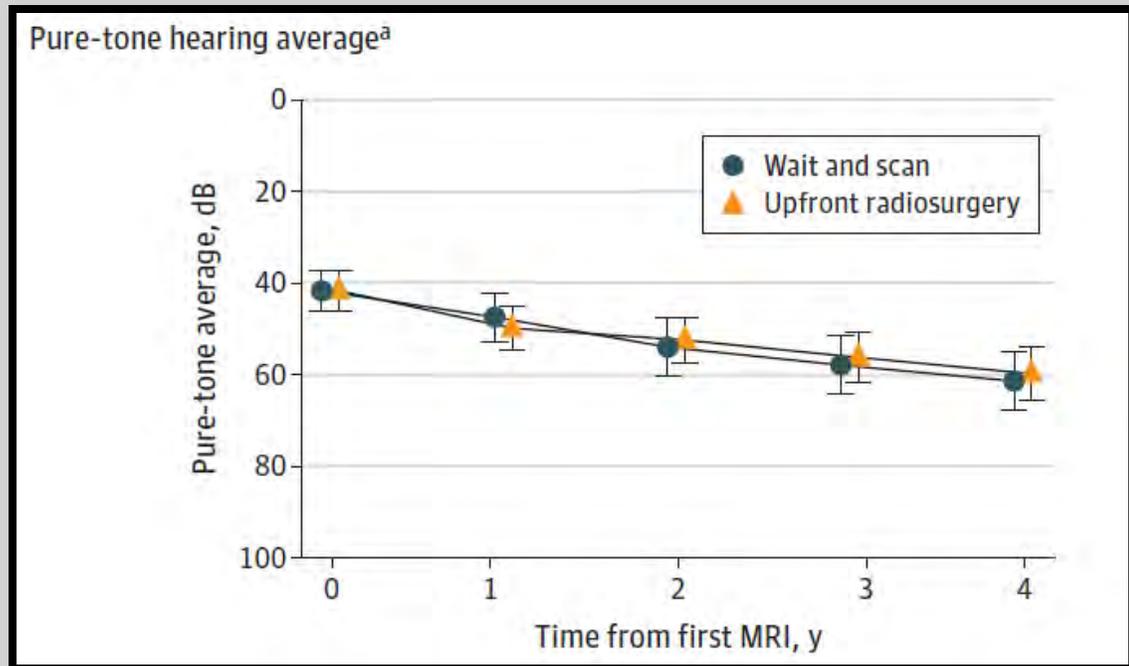
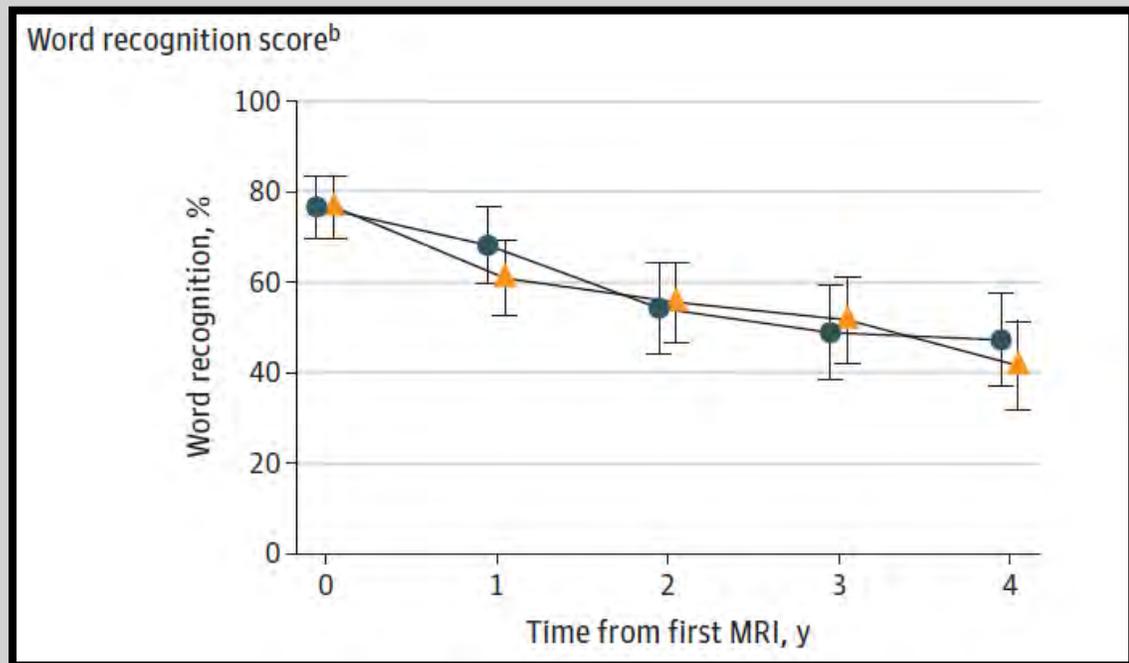


**No difference  
in vestibular  
function**

Composite-equilibrium score<sup>c</sup>



# No difference in hearing preservation





# MULTIDISCIPLINARY MANAGEMENT



**THANK YOU FOR JOINING US!**





# Medical Treatments for Acoustic Neuroma and \*Neurofibromatosis Type 2 (NF2)

Christine Cordova, MD

Mayo Clinic Jacksonville, Neuro-Oncologist

Acoustic Neuroma Patient Education Event

March 7, 2026

---

# NF2- related Schwannomatosis

A diagnosis of NF2-related schwannomatosis can be made when a patient has **one of the following**:

- Bilateral vestibular schwannomas (VS)
- An identical NF2 pathogenic variant\* in at least two anatomically distinct NF2-related tumors (schwannoma, meningioma, and/or ependymoma)
- Either **two Major** OR **one Major and two Minor** criteria are present as follows:

## MAJOR CRITERIA

- Unilateral vestibular schwannoma
- First-degree relative other than a sibling with NF2-related schwannomatosis
- Two or more meningiomas. (Note: single meningioma qualifies as a minor criterion)
- NF2 pathogenic variant\* in an unaffected tissue such as blood

\*When the variant is present at significantly less than 50%, the diagnosis is mosaic NF2-related schwannomatosis

## KEY UPDATES TO FORMER NF2 DIAGNOSTIC CRITERIA:

- Added NF2 pathogenic variant
- Clarified first degree relative with "other than sibling"
- Cataract clarified to juvenile cataract
- Added retinal hamartoma as criterion
- Removed glioma and neurofibroma, and added ependymoma

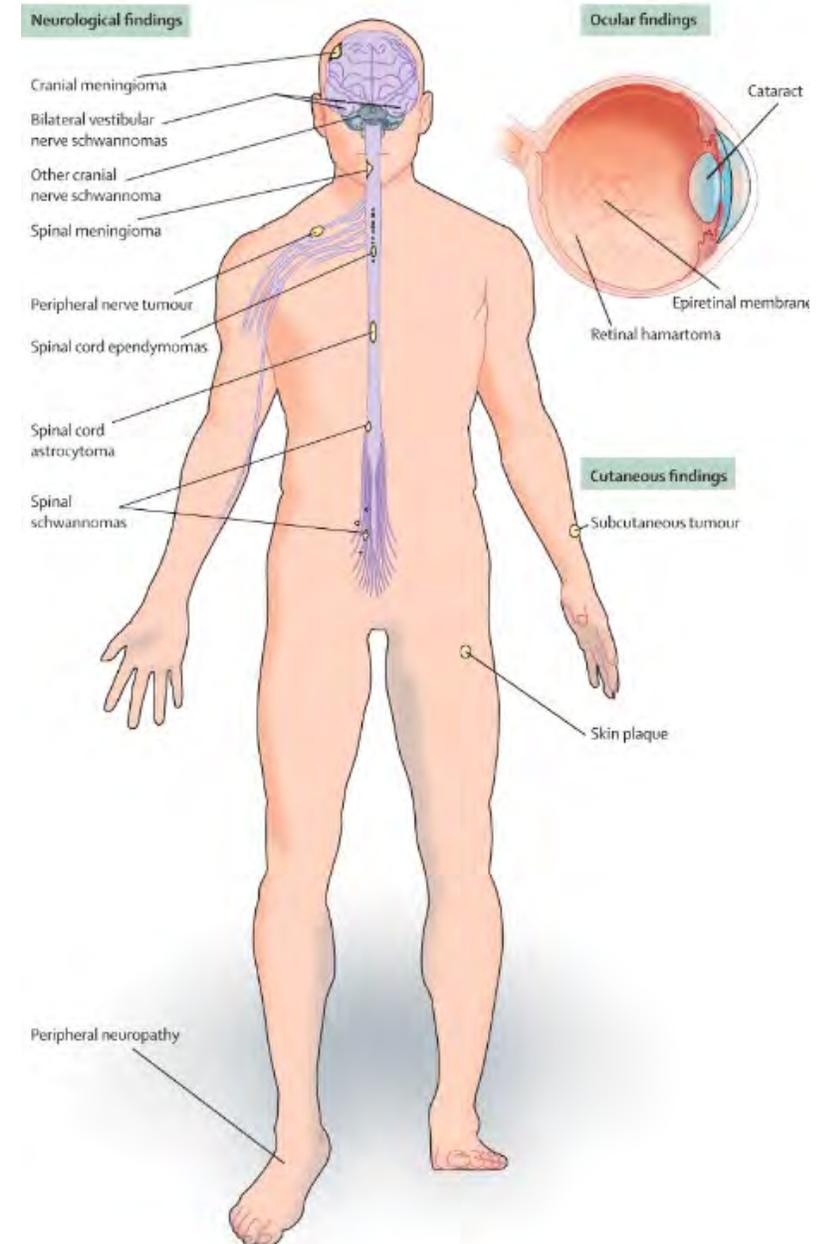
## MINOR CRITERIA

Can count more than one of a type (e.g., two schwannomas = two minor criteria)

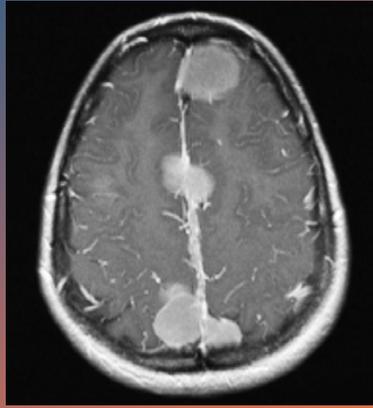
- Ependymoma; schwannoma (Note: if the major criterion is unilateral VS, at least one schwannoma must be dermal in location)

Can count only once

- Juvenile subcapsular or cortical cataract; retinal hamartoma; epiretinal membrane in a person aged less than 40 years; meningioma (Note: multiple meningiomas qualify as a major criterion; meningioma cannot be used as both a major and a minor criteria)



# NF2-related tumors with medical options



+

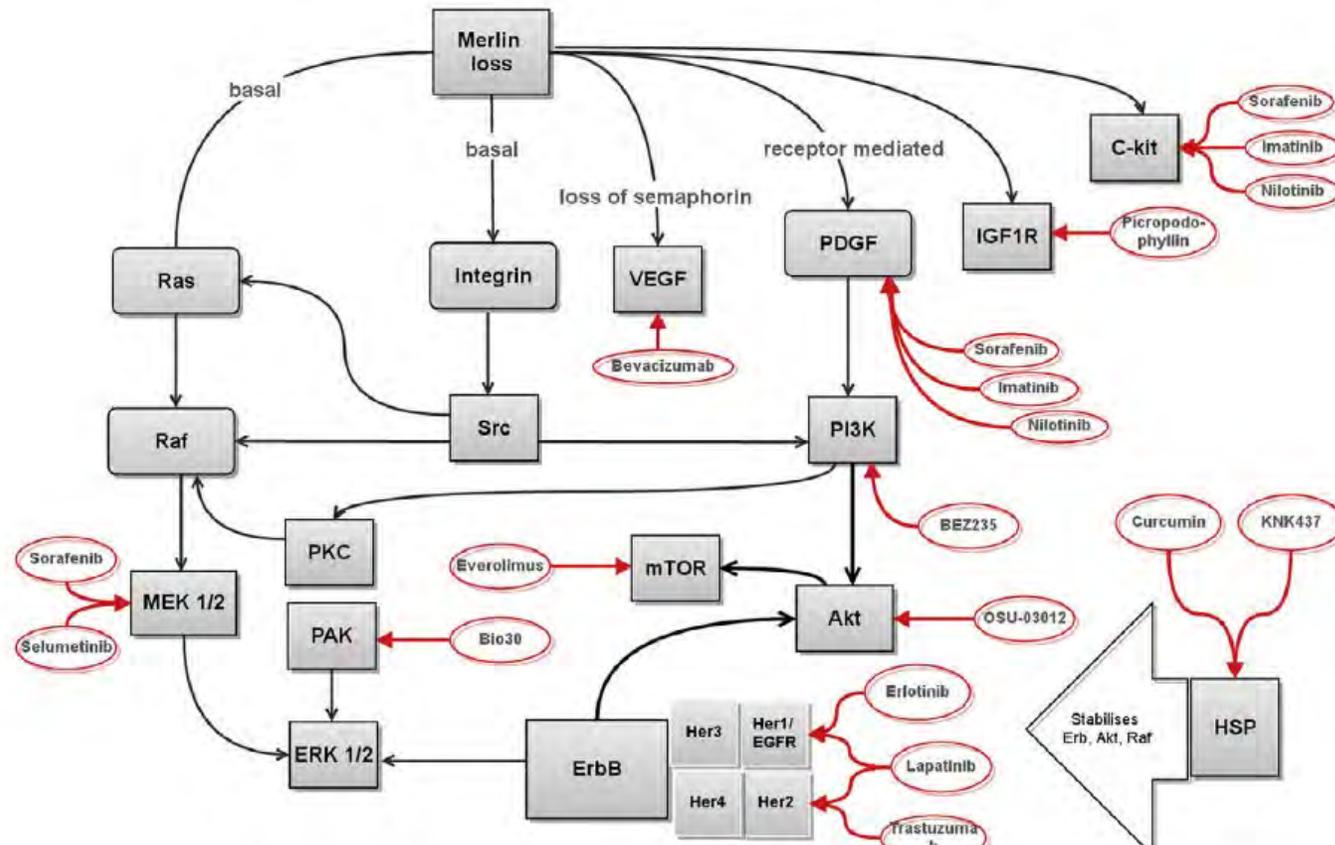


- Vestibular schwannomas 90%
- Non-vestibular schwannomas
  - Facial 27-72%
  - Other cranial nerve 9-36%
- Meningiomas (often multiple) lifetime risk approaching 80%
- Ependymomas 20-35%

# NF2 mutation = loss of Merlin function (lost suppression)



S.H.-S. Lim et al. / Cancer Treatment Reviews 40 (2014) 857–861



## When do you consider medical therapy?

- Multiple tumors are growing
- Hearing declines
- When you aim to preserve hearing/prevent further loss
- In multi-disciplinary discussion with the rest of the patient's team

# Bevacizumab (“Avastin”)

- Antibody against VEGF, a growth factor chemical
- Used in Colon, Lung, Ovarian, Endometrial cancers
- VEGF receptors are expressed in schwannomas
- an IV infusion every 3 weeks
- Growing vestibular schwannomas
  - Meta-analysis of patients receiving this showed:
    - Shrinkage or stability in most patients
    - Hearing improvement in some
- Spinal ependymomas

# Bevacizumab (“Avastin”)

- Effects can fade over time
- Side effects
  - High blood pressure, Abnormal kidney function, Blood clots, Bleeding, Wound healing issues, premature menopause
- Meningiomas did not respond

# Brigatinib

- Inhibits ALK and ROS1
- Oral
- Approved in certain types of lung cancer
- 35% of patients had improvement in hearing
- Greatest activity in meningiomas and schwannomas (non-vestibular nerve)
- Activity was seen in patients with ependymoma (2)
- Side effects: rash, diarrhea, nausea, fatigue

# It's all relative

- The Brigatinib trial, having 40 patients, was the largest NF2 designed trial to date and it was conducted across several centers
- Moving beyond just FDA approval
- Importance of funding and study participation

Phase 1

Phase 2

Phase 3

FDA Review

Phase 4

20-80

100-300

1,000-3,000

1,000+

Participants

Participants

Participants

Participants

Drug Approved for Testing in Humans

Drug Submitted for FDA Approval

Drug Approved

# Lapatinib

- Inhibitor of EGFR
- Approved in certain type of breast cancer, in Ependymoma combined with another type of chemotherapy
- oral
- EGFR is overexpressed in vestibular schwannoma samples
- Modest tumor reduction, very modest hearing preservation
- Meningiomas did not respond
- Side effects: diarrhea, rash, potential cardiac toxicity

# Neratinib

- HER1, HER2, HER4 inhibitor
- Approved for a type of breast cancer
- oral
- A phase 2 trial of 20 patients showed some activity in schwannomas (non-vestibular) and meningiomas. No VS or ependymomas showed response.
- A larger study is in progress
- Side effects: rash, fatigue, diarrhea, potential for cardiac toxicity



# Obtaining medications

- Requests off-label use of these oral medications
- Awaits initial denial
- Requests an appeal
- Will likely get appeal denied
- Go directly to the drug manufacturer for Patient Assistance Programs

Get involved. Be proactive. Communicate.  
You are the most important part of the team.

## Factors which will influence therapy choice(s)

- Your health
- Which tumor(s) are progressing/are being targeted
- Sequence of other treatments like surgery and radiation
- Side effect avoidance
- Insurance and drug manufacturer policies

# On the horizon



**Selumetinib (oral inhibitor of MEK/MAPK, activity in NF1)**



**VEGF receptor vaccine (small study in Japan)**



**CAR-T cells**



**Checkpoint inhibitors (no current trials)**



**Bacteriotherapy (animal data)**

Intratumoral injection of salmonella

# VESTIBULAR REHABILITATION



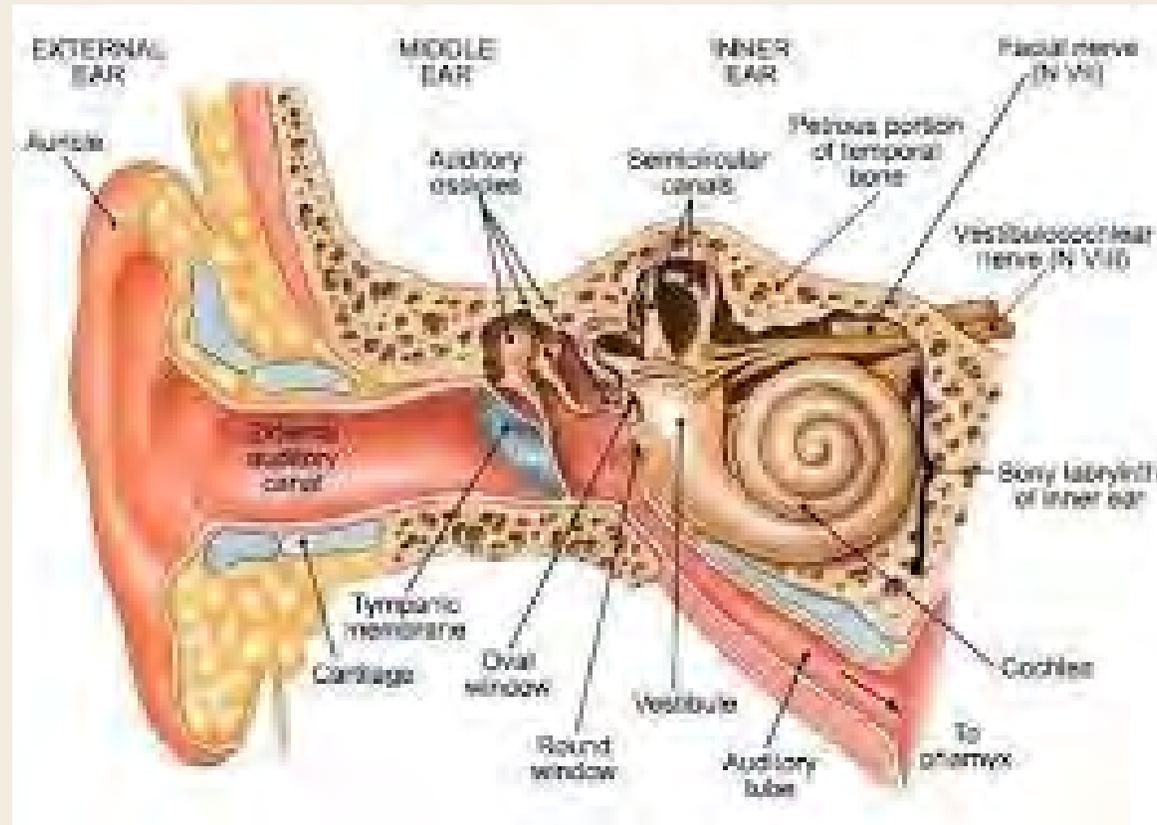
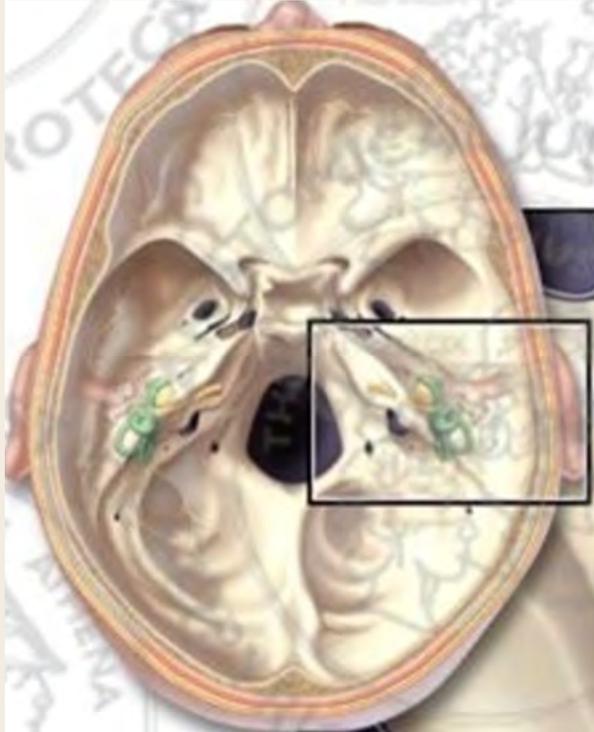
WHAT IS IT AND HOW CAN IT HELP?



# WHAT IS VESTIBULAR REHABILITATION?

- Physical therapy designed to treat balance disorders and symptoms of dizziness or vertigo that result from dysfunction of the vestibular system.
- 

# THE EAR





# HOW DOES VESTIBULAR REHABILITATION HELP?

- Compensation:
    - The brain's ability to be retrained to better process and organize information from the inner ear and minimize dizziness after damage to the inner ear's vestibular system has occurred
- 



# HOW DOES VESTIBULAR REHABILITATION HELP?

Mechanisms for compensation include:

- Adaptation – retraining the brain to process signals that come from the vestibular system correctly
  - Substitution – using the other senses – vision and somatosensation – to make up for the lost vestibular information.
- 



# SYMPTOMS OF UNCOMPENSATED VESTIBULAR FUNCTION



- Dizziness
- Persistent imbalance
- Motion / visual sensitivity



# KEY COMPONENTS AND GOALS OF VESTIBULAR REHABILITATION

## Core goals:

- To decrease dizziness/ motion sensitivity/ visual sensitivity
- Prevent falls
- Enhance ability to perform daily tasks

## Targeted exercises that include:

- Head- eye movements
  - Balance training
  - Habituation exercises (repeatedly provoking symptoms to reduce sensitivity)
- 



# FACTORS THAT CAN IMPACT RECOVERY

- Medications
  - Lack of stimulation to the system
  - Compliance with Home Exercise Program (HEP)
- 



# DOES IT HELP?

## Acoustic Neuroma Patient

- 62 yo male
  - Hx of BPPV and acoustic neuroma
  - Vestibular Testing Results for R ear :
    - 36.5% RVR on VEMP
    - 10% RVR on calorics
- 



# DOES IT HELP?

## Subjective report

Patient reports ongoing symptoms of dizziness and imbalance, sensitivity to motion rich environments, motion sensitivity, sensitivity to light and more open spaces since developing vertiginous symptoms in March. Patient was diagnosed and treated for BPPV. Patient states the vertiginous symptoms have resolved but the dizziness and imbalance persist.



# DOES IT HELP?

## Objective and Subjective Assessments

### Functional Gait Assessment (FGA)

- Cutoff for fall risk  $< 22$  pts
- Age-matched norm for pt = 27.1/30

### Dizziness Handicap Inventory (DHI)

- 100-61 = Severe Perception of Handicap
- 60-31 = Moderate Perception of Handicap
- 30-0 = Low Perception of Handicap

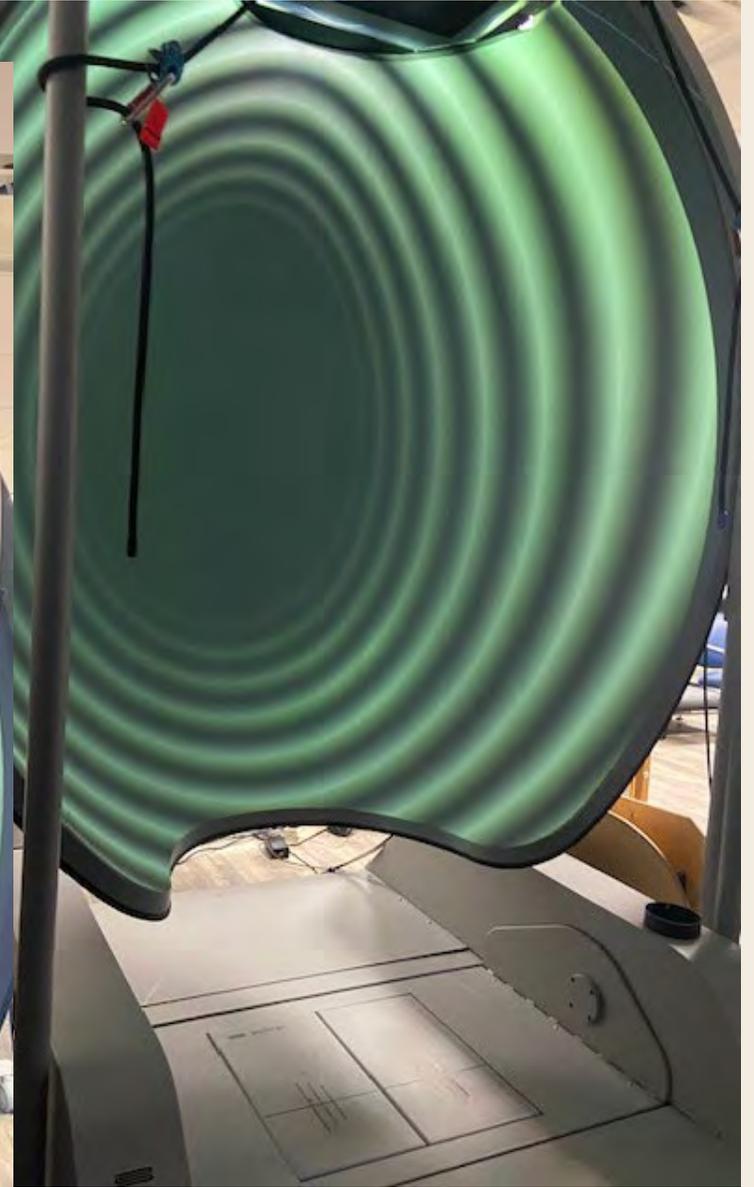
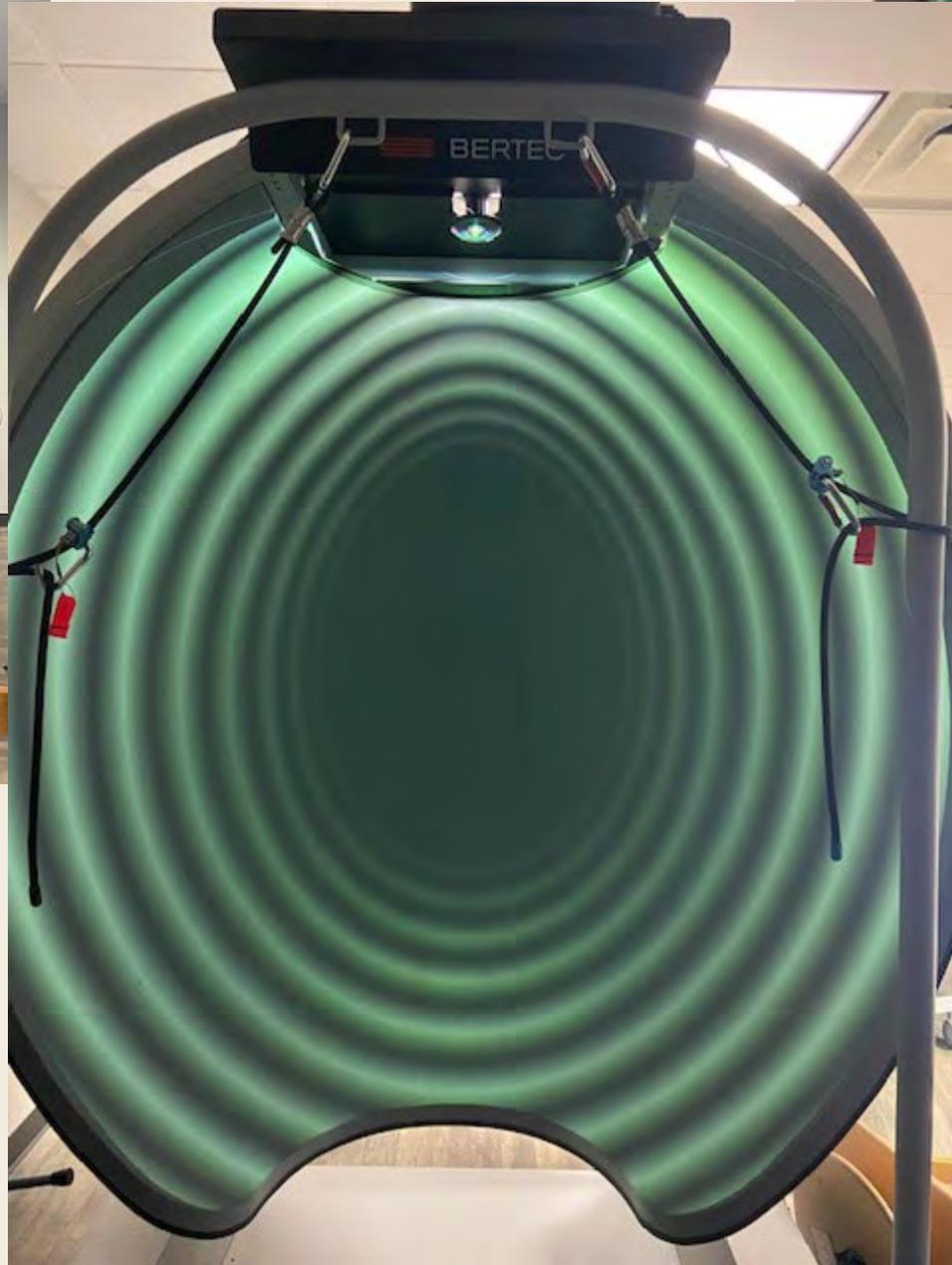
### Activities Specific Balance Confidence Scale (ABC)

- High Fall Risk  $< 67\%$  for community dwelling OA

### Sensory Organization Test (SOT)

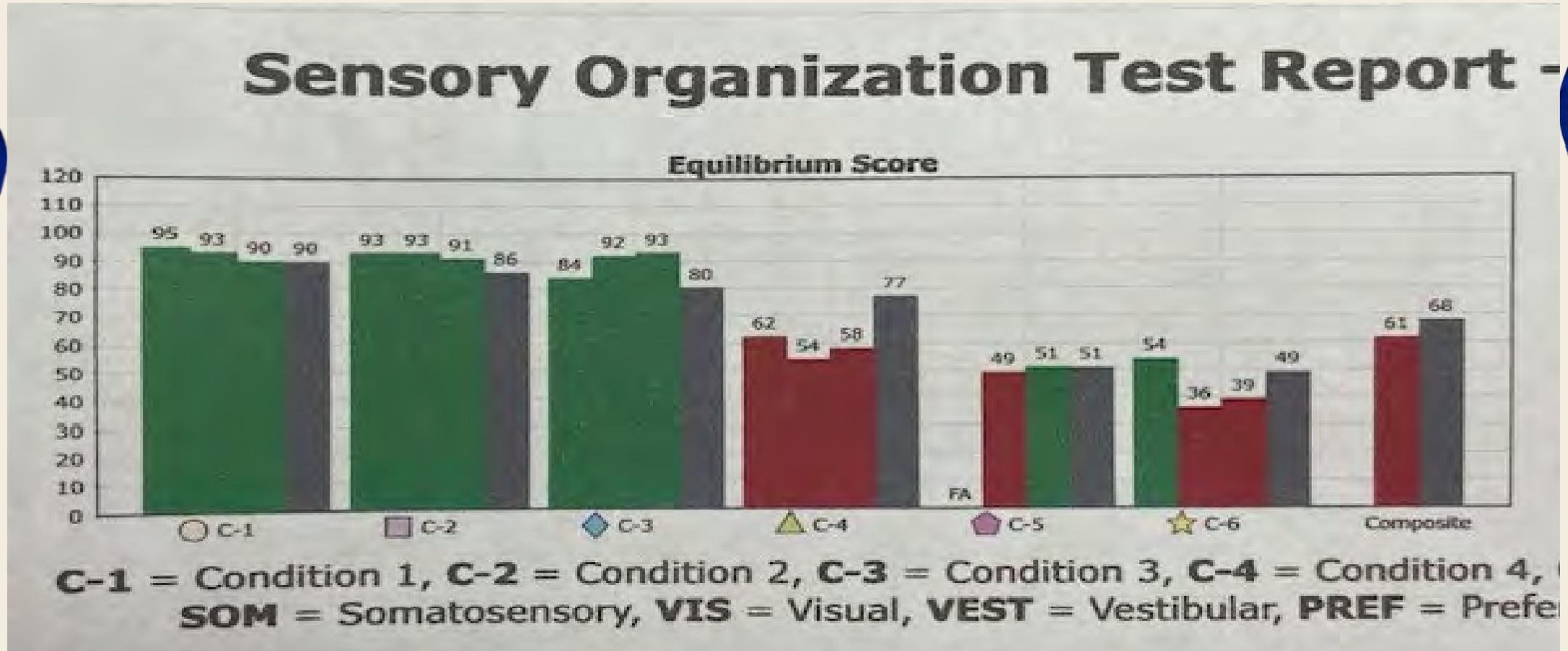
# DOES IT HELP?

Assessment	Evaluation	Discharge
FGA	16	25
DHI	72%	12%
ABC	37.5%	95.62%
SOT	61%	78%



# DOES IT HELP?

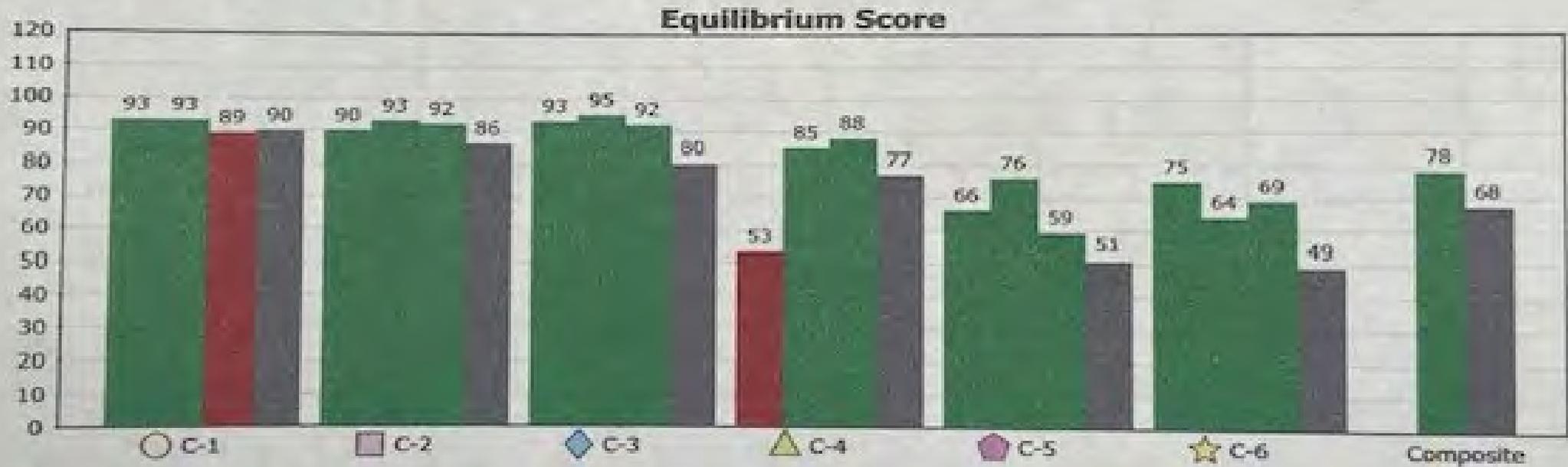
## EVALUATION



# DOES IT HELP?

## DISCHARGE

### Sensory Organization Test Report





DOES IT HELP?

YES!!!



# QUESTIONS



**MAYO  
CLINIC**



# FACIAL NERVE SYNKINESIS

**Deanna C. Menapace, MD**

Facial Plastic & Reconstructive Surgery | Head & Neck Surgery

Dept. Mayo Clinic Otolaryngology Head & Neck Surgery

Mayo Clinic Cosmetic Center

Mayo Clinic | 4500 San Pablo Rd | Jacksonville, FL | [mayoclinic.org](https://www.mayoclinic.org)

Office: 904-953-6674 Cosmetic Center: 904-953-0795

@MenapaceMD

**DISCLOSURES:  
NONE**

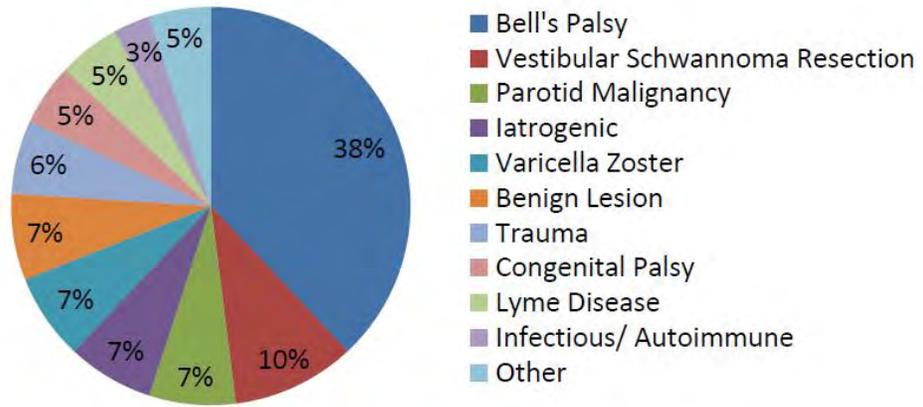
**COI:  
NONE**

# OBJECTIVES: MANAGEMENT OF SYNKINESIS

1. CONTEMPORARY UNDERSTANDING OF FACIAL NERVE BRANCHING PATTERNS

2. NEUROMUSCULAR RETRAINING: PRINCIPLES OF FACIAL NEUROMUSCULAR RE-EDUCATION

3. USE OF NEUROMODULATORS TO CREATE FACIAL SYMMETRY

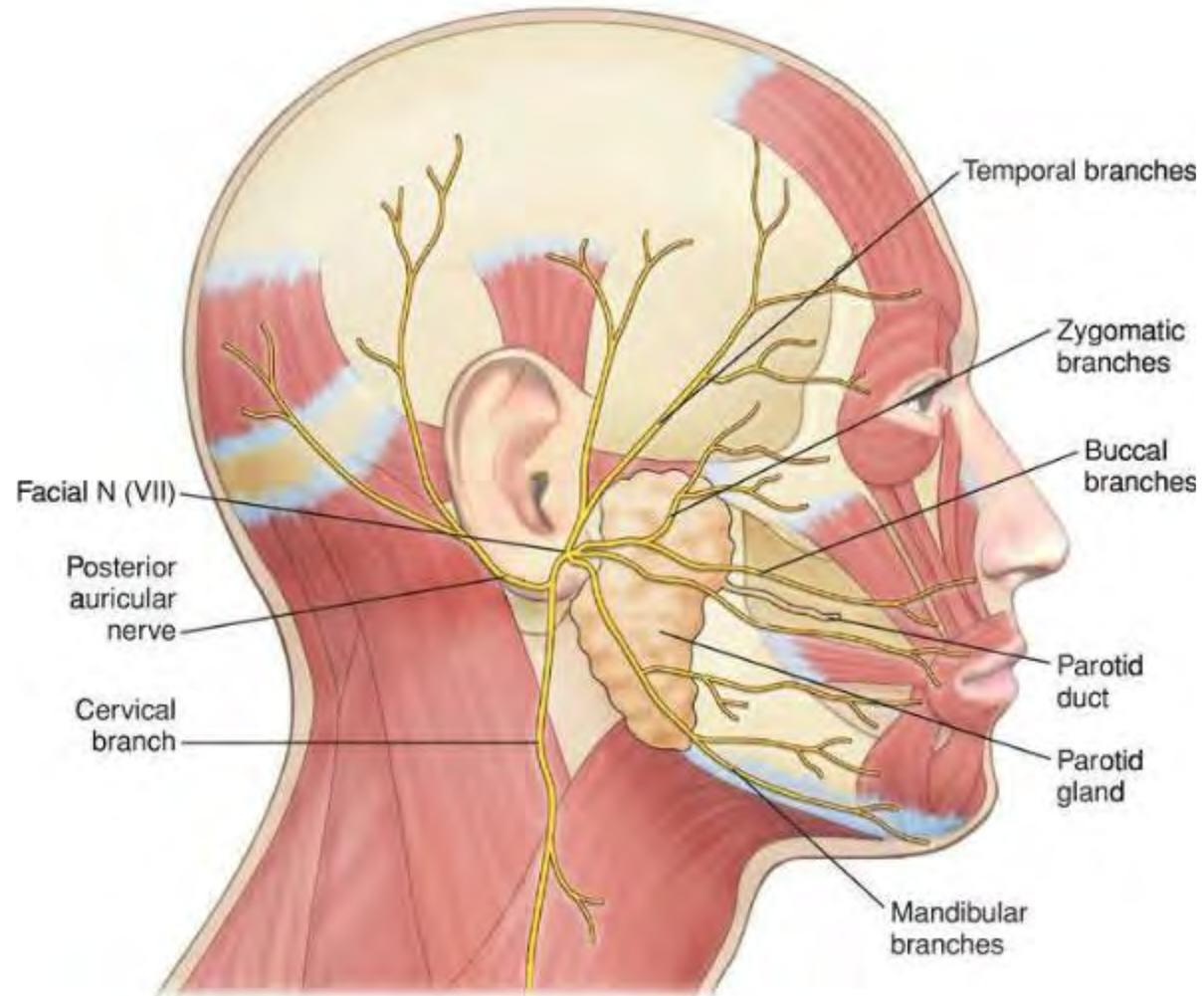


*The Laryngoscope*  
 © 2013 The American Laryngological,  
 Rhinological and Otological Society, Inc.

### Etiology, Diagnosis, and Management of Facial Palsy: 2000 Patients at a Facial Nerve Center

Marc H. Hohman, MD; Tessa A. Hadlock, MD

\* 50% of patients with facial paralysis will seek care or surveillance at tertiary centers



## EXTRATEMPORAL SEGMENT OF THE FACIAL NERVE

## Temporal Branch

1 main segment with up to 6 branches)

### Muscles:

Frontalis

Corrugator Supercilii

Procerus

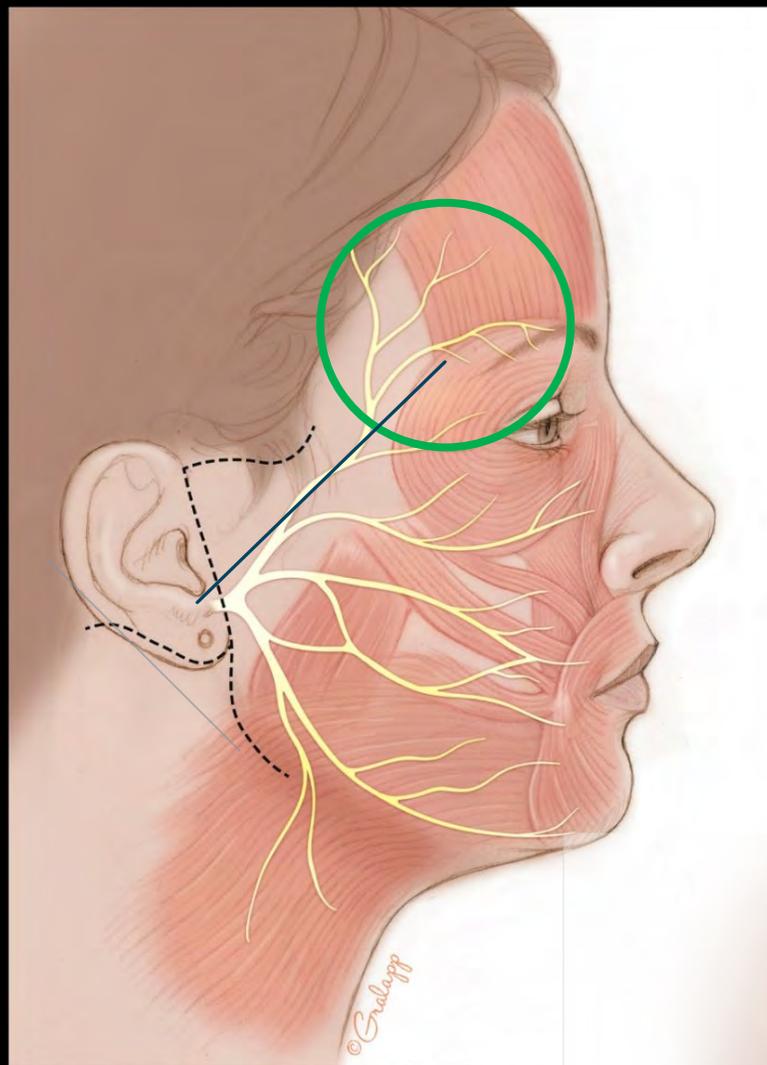
Orbicularis Oculi

### Deficits:

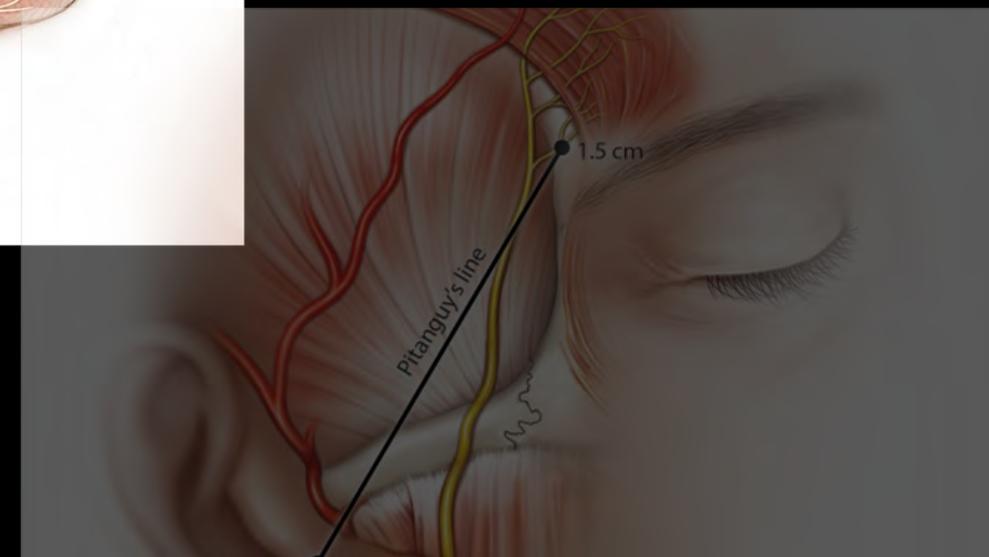
Brow ptosis

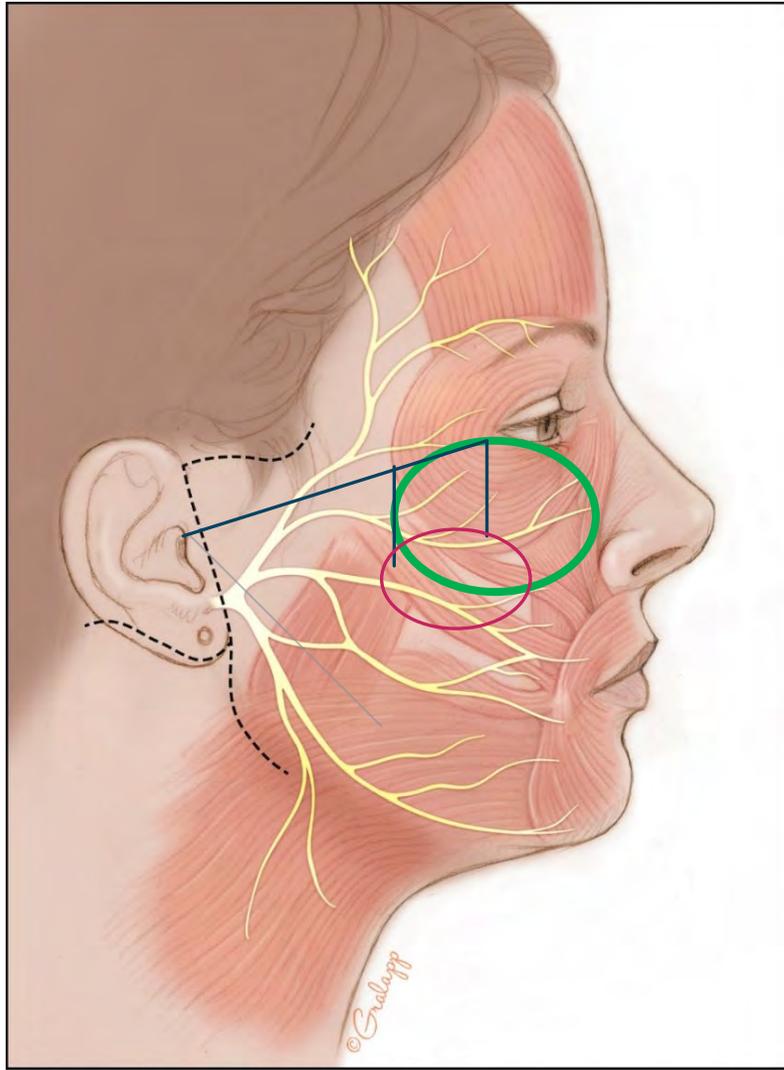
Pseudo-dermatochalasis

Pseudo-lagophthalmos



Pitanguy's Line





## Zygomatic Branch

### Muscle:

Lateral Orbicularis Oculi

\*Anastomosis with buccal branches  
to aid in zygomaticus innervation

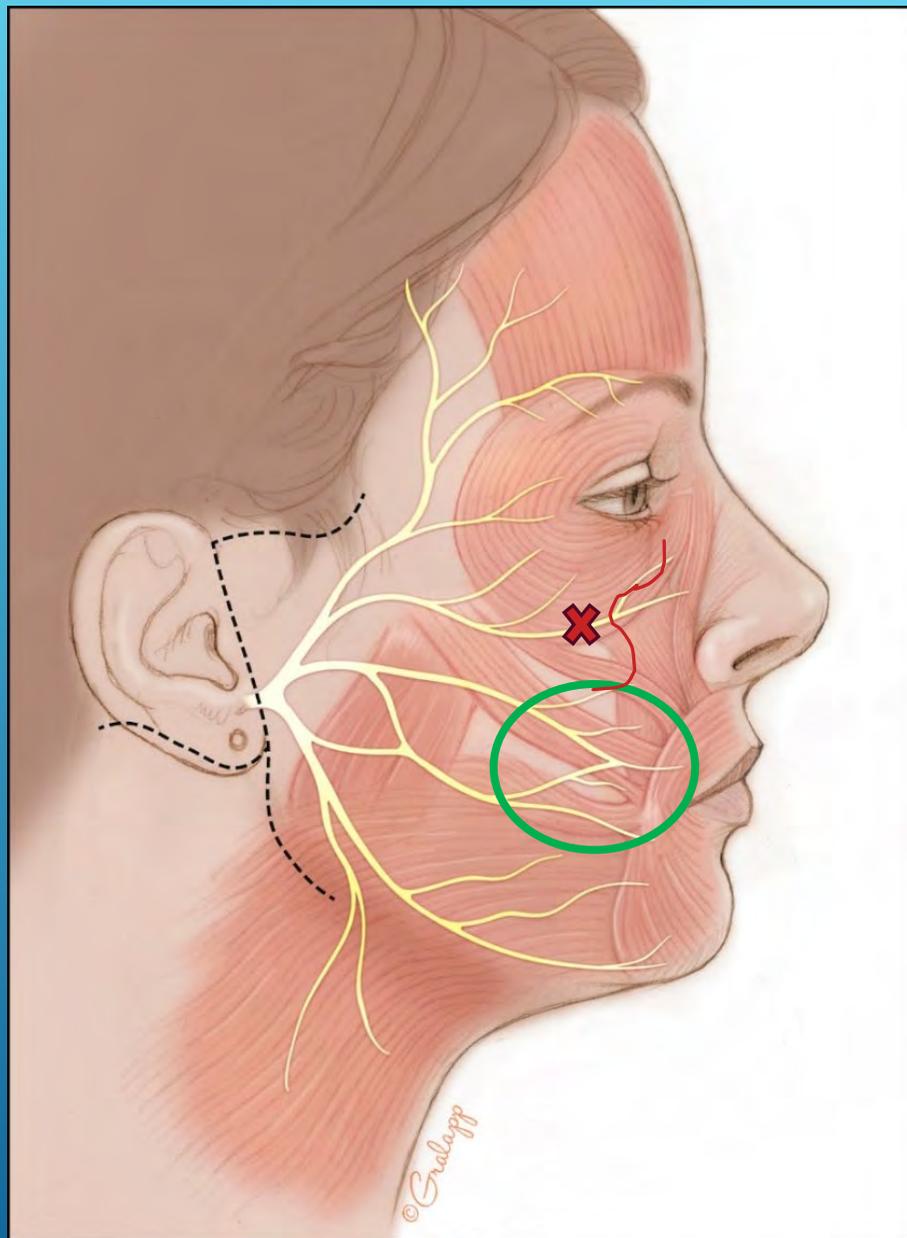
### Deficit:

Lateral Ectropion

Lagophthalmos

Possible asymmetric lip elevation

“Circle of knowledge”



► Buccal Branches

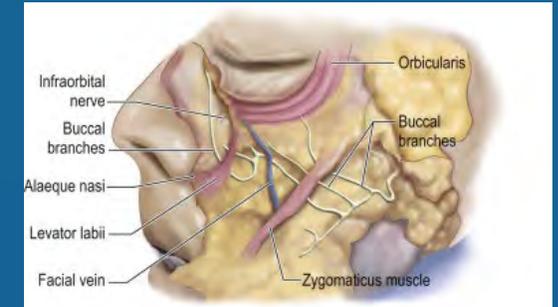
► Muscles:

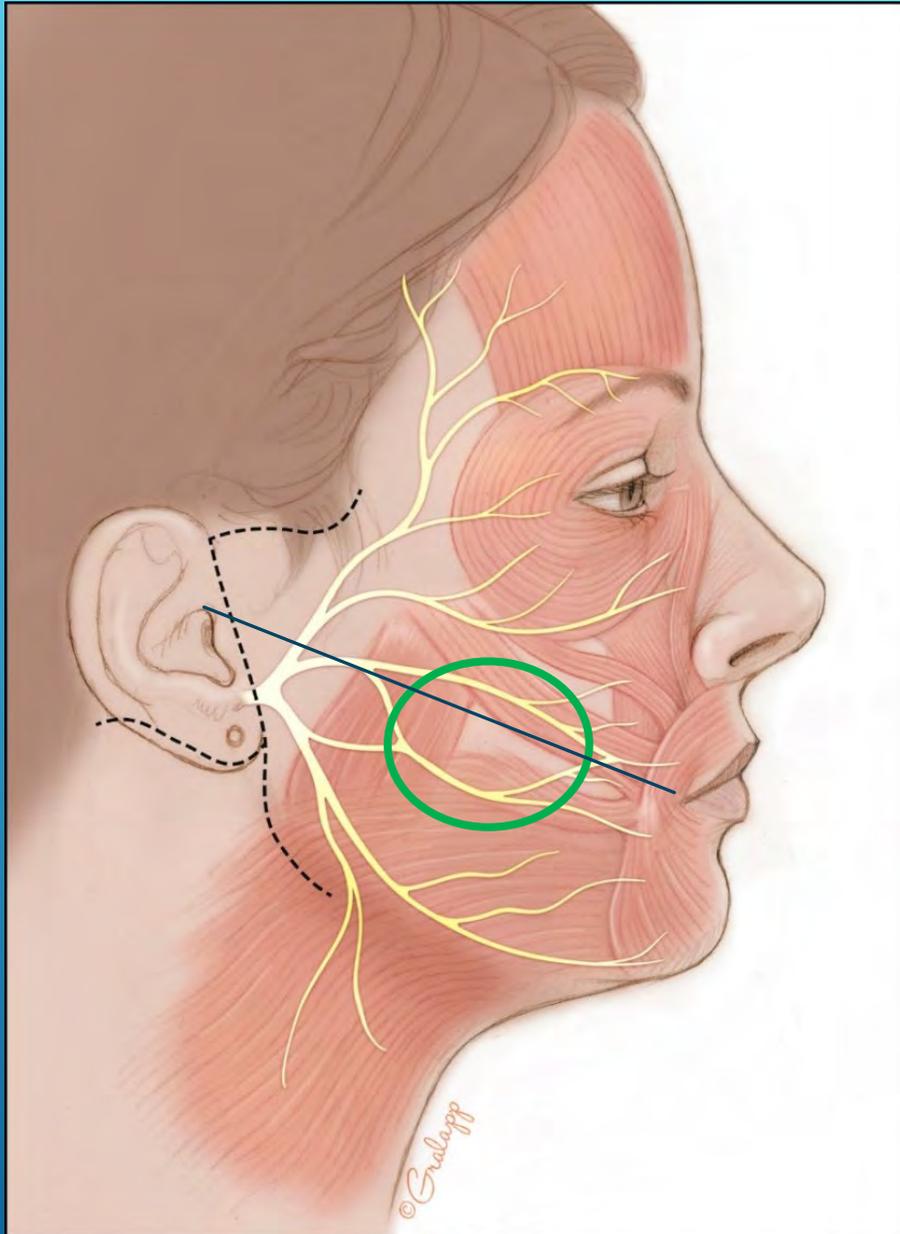
- **Orbicularis Oculi (medial)\***
- Buccinator
- Risorius
- Zygomaticus Major
- Zygomaticus Minor
- Levator Anguli Oris
- Levator Labii Superioris
- Levator Labii Superioris Alaque Nasi
- Nasalis
- Depressor Septi

► Deficits:

- **Medial Ectropion**
- Nasal Obstruction
- Nasal Asymmetry
- Midface Paralysis
- Difficulty elevating the upper lip
- Oral Incompetence
- Dysarthria

\*ANATOMY CLARIFICATION





## Zuker's Point



Plast Reconstr Surg. 2013 Feb;131(2):253-257. doi: 10.1097/PRS.0b013e3182778753.

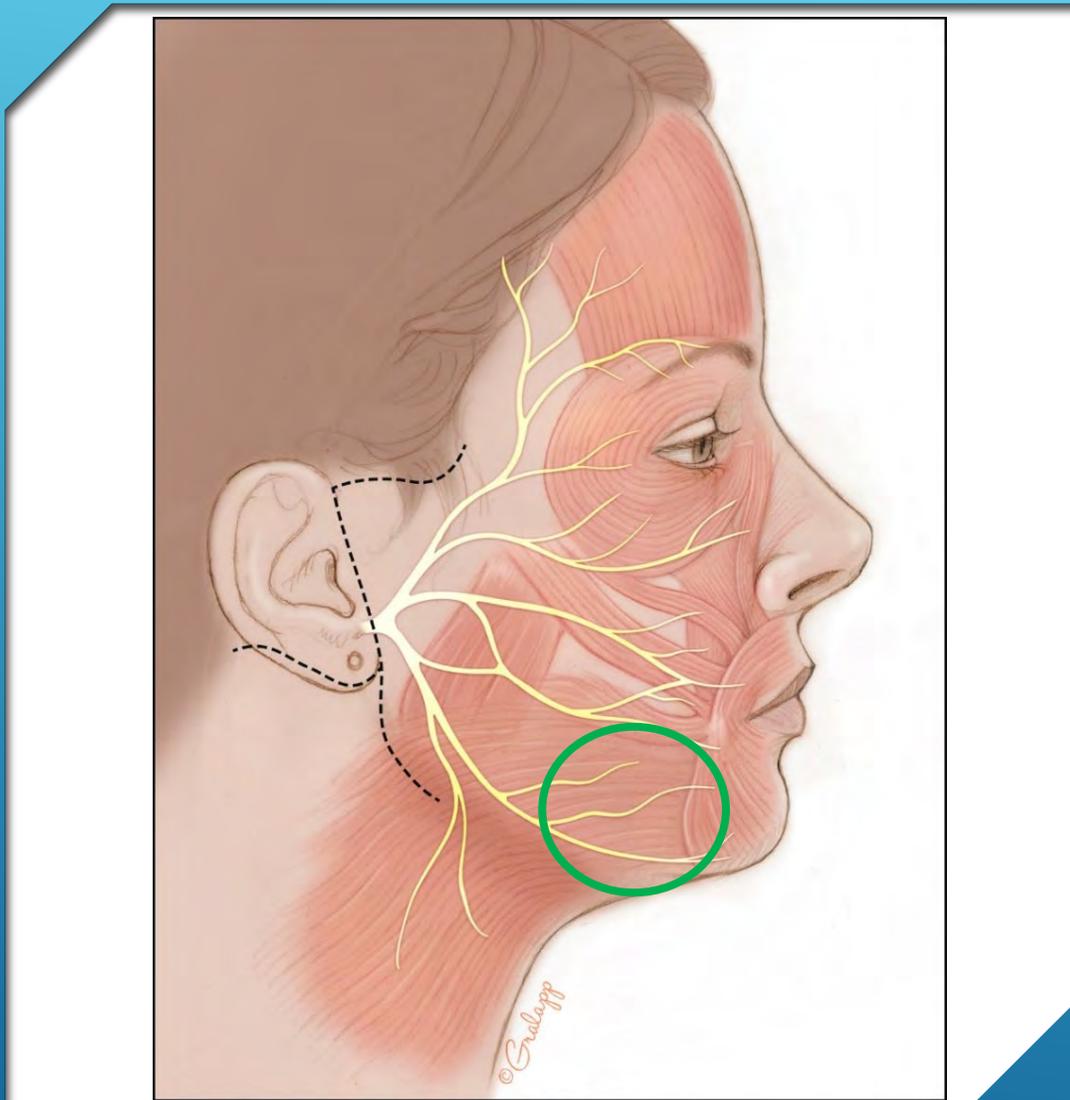
### Surface anatomy of the middle division of the facial nerve: Zuker's point



Amir H Dorafshar<sup>1</sup>, Daniel E Borsuk, Branko Bojovic, Emile N Brown, Ralph T Manktelow, Ronald M Zuker, Eduardo DeJesus Rodriguez, Richard J Redett

Affiliations + expand

PMID: 23357986 DOI: 10.1097/PRS.0b013e3182778753



▶ Marginal Mandibular Branch

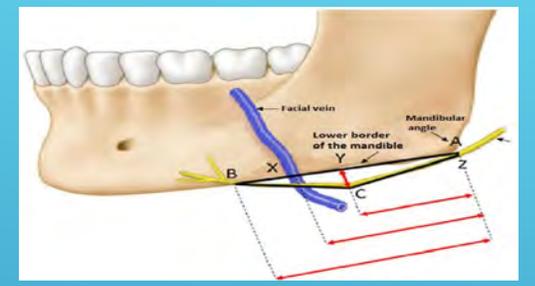
▶ Muscles:

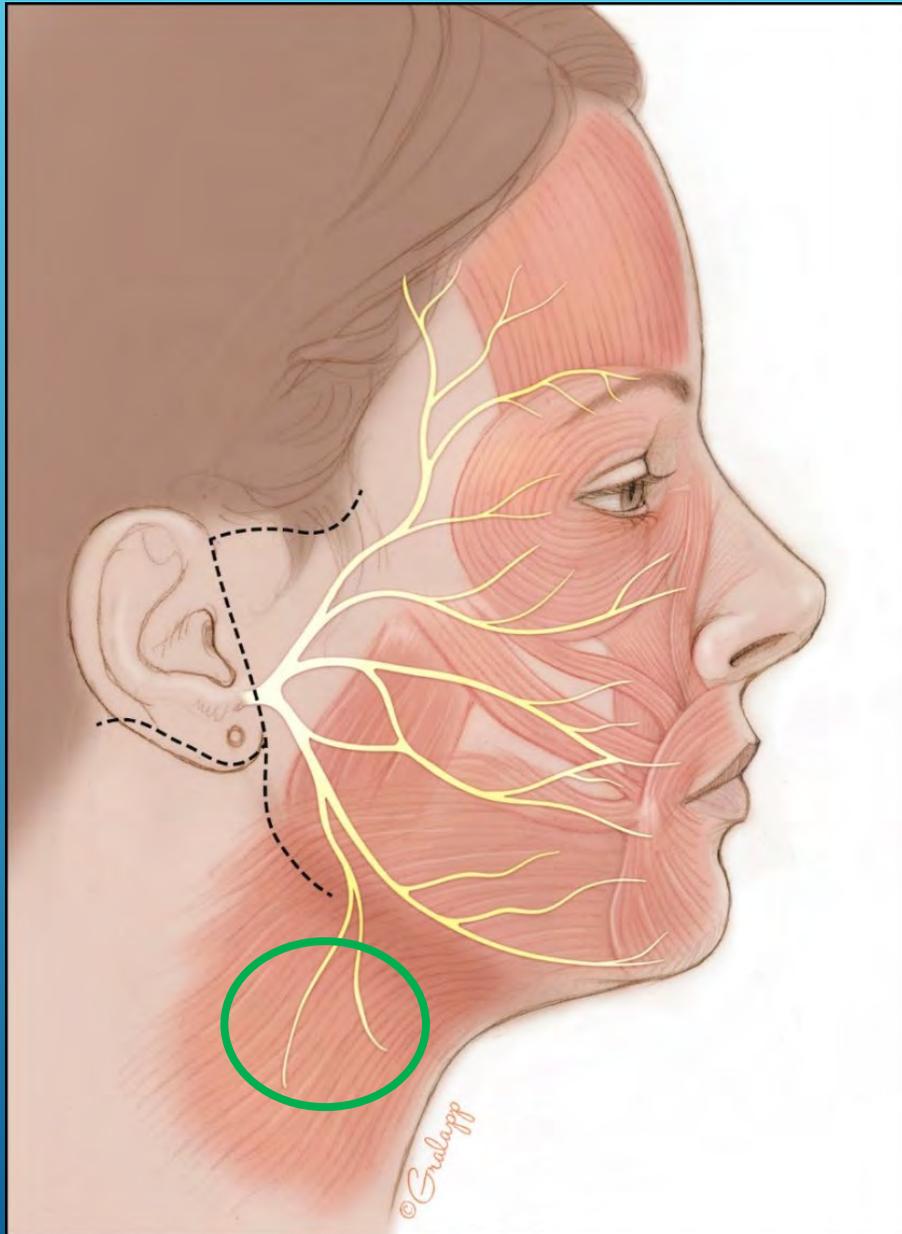
- ▶ Depressor Anguli Oris DAO
- ▶ Depressor Labii Inferioris DLI
- ▶ Mentalis

▶ Deficits:

- ▶ Lower commissure position
- ▶ Difficulty depressing the lower lip
- ▶ Difficulty opening the lower lip to eat

## UNRELIABLE ANATOMY





- ▶ Cervical Branch

- ▶ Muscle:

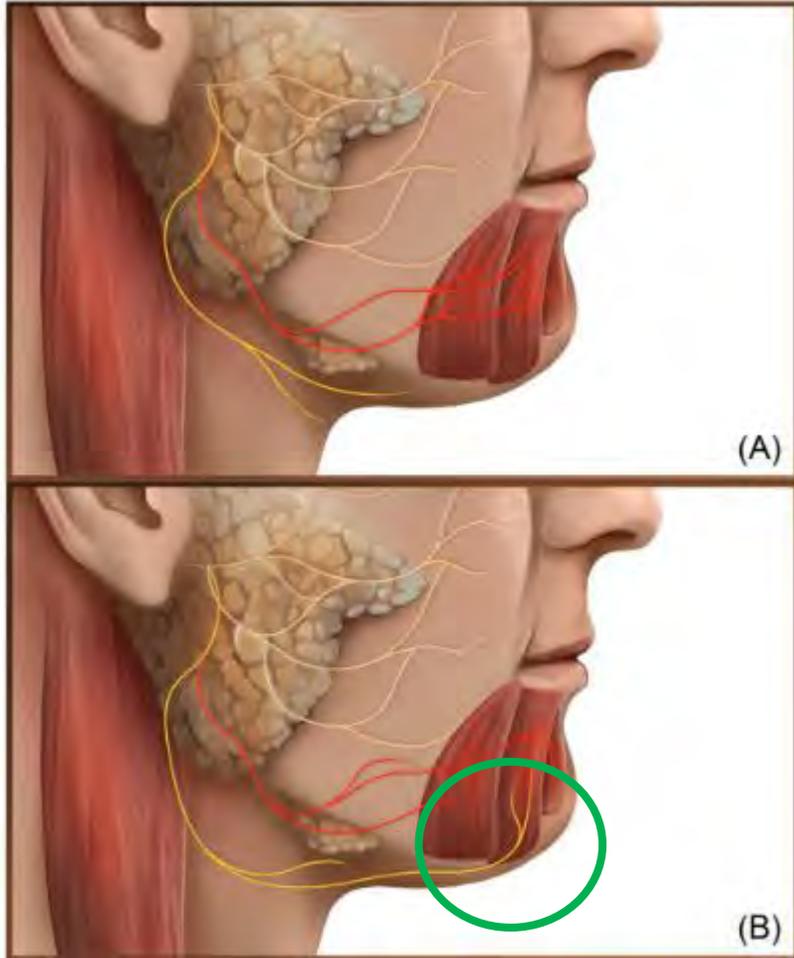
- ▶ Platysma

- ▶ DLI\*

- ▶ Deficit:

- ▶ None to mild lower lip asymmetry during smile ("pseudo-palsy")

# ANATOMY CLARIFICATION: Nerve to DLI



**Figure 2.** Innervation pattern of the lower lip. (A) Traditional teaching: The marginal mandibular branch innervates lower lip musculature and the cervical branch innervates platysma only. (B) Study findings shift: The DLI muscle is innervated by the cervical branch. DLI, depressor labii inferioris.

> Otolaryngol Head Neck Surg. 2023 Oct;169(4):837-842. doi: 10.1002/ohn.337. Epub 2023 Apr 6.

## Lower Facial Nerve Nomenclature Clarification: Cervical Branch Controls Smile-Associated Lower Lip Depression and Dental Display



Tal Kaufman-Goldberg <sup>1</sup>, John P Flynn <sup>1</sup>, Caroline A Banks <sup>1</sup>, Mark A Varvares <sup>1</sup>,  
Tessa A Hadlock <sup>1</sup>

Affiliations + expand

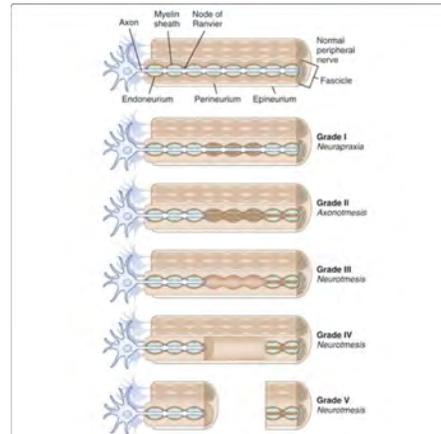
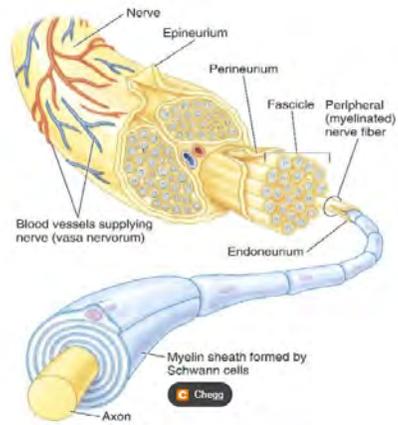
PMID: 37021911 DOI: 10.1002/ohn.337

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## Discerning a smile – The intricacies of analysis of post-neck dissection asymmetry

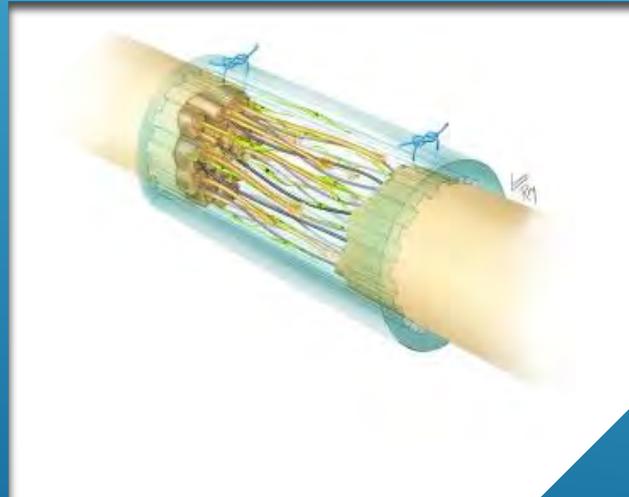
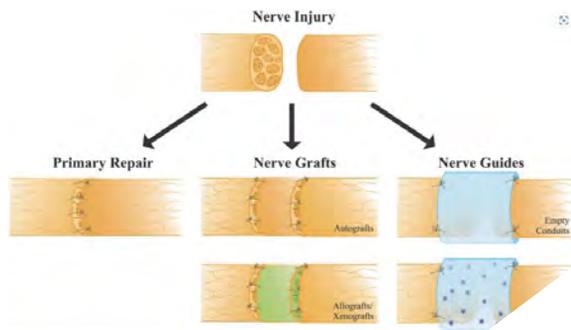
R.I.Thomas <sup>a</sup>, J.Whittaker <sup>b</sup>, J.Pollock <sup>c</sup>

Show more



## FACIAL NERVE INJURY:

- INFLAMMATION
- SWELLING
- ISCHEMIA
- ENERGY TRANSFER
- DESICCATION
- PRESSURE
- EVULSION (RARE)
- NERVE SACRIFICE (PLANNED)



## Post Injury Recovery “Spectrum”

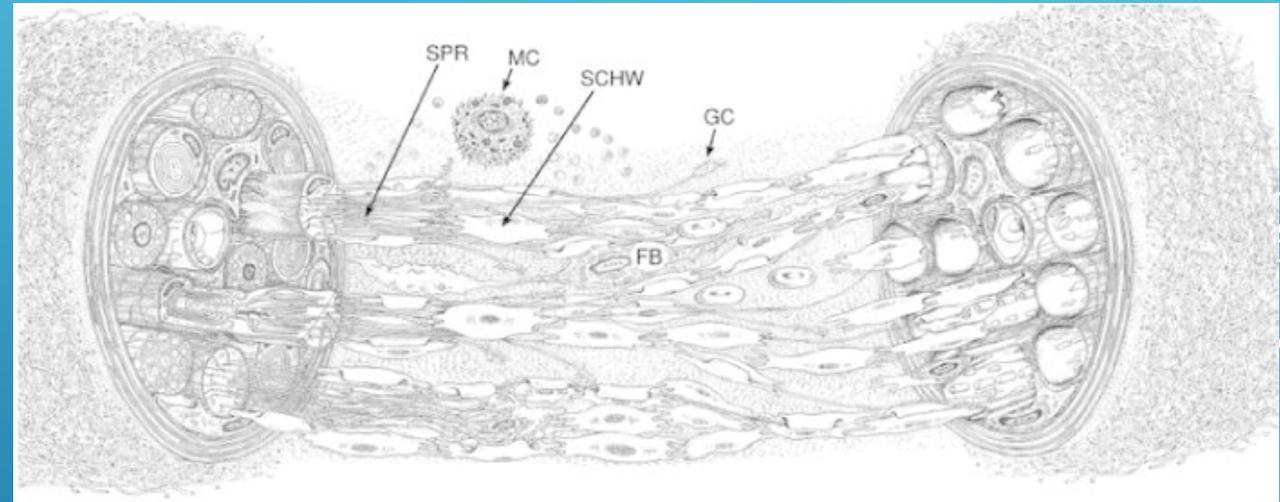
- Complete flaccid paralysis
- Partial recovery with varying degrees hypoactivity
- Normal function
- Partial recovery with varying degrees hyperactivity
- +/- Synkinesis
  - "Aberrant Reinnervation Syndrome"

# Pathophysiology of FARS

- Not completely understood

## Theories:

- o Misdirected axonal regeneration
- o Hyper-sensitization of the facial nucleus
- o Somatotopic reorganization in the cerebral cortex
- o Ineffective re-myelination post nerve injury
- o Altering membrane potentials and thresholds



## Facial Aberrant Reinnervation Syndrome Following Facial Nerve Injury and Recovery



Jacob K Dey<sup>1</sup>, Kofi D O Boahene<sup>2</sup>

Affiliations + expand

PMID: 38949952 DOI: 10.1089/fpsam.2023.0351

## Facial Nerve Synkinesis

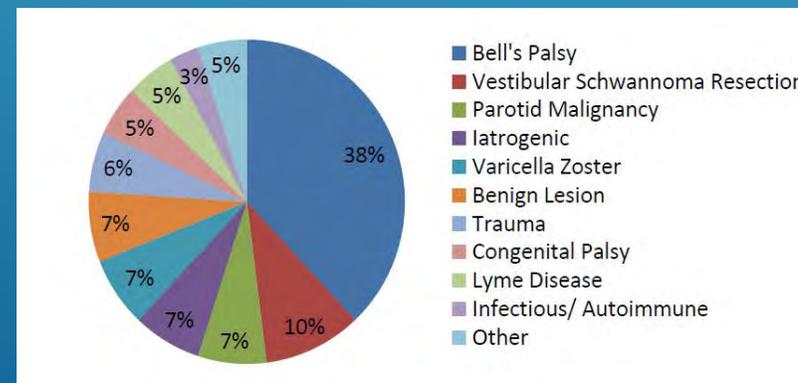
Unintentional motion of one facial area during intentional movement of another facial area after facial nerve injury.

### Causes:

-Primary facial nerve injury

\*Reported in as many as 50% of those patients with longstanding facial paralysis

-Facial nerve reinnervation procedures



## Changing Perception: Facial Reanimation Surgery Improves Attractiveness and Decreases Negative Facial Perception

Jacob K. Dey, BS; Masaru Ishii, MD, PhD; Kofi D. O. Boahene, MD; Patrick J. Byrne, MD;  
Lisa E. Ishii, MD, MHS

### Our patients with facial paralysis have:

- Lower self-reported attractiveness
- Lower mood
- Lower QOL scores
- High rates of depression (42%)

## Patient-perceived severity of synkinesis reduces quality of life in facial palsy: A cross-sectional analysis in 92 patients

Martinus M. van Veen ✉, Olivia Quatela, Joana Tavares-Brito, Mara Robinson, Jennifer H. Baiungo, Paul M. N. Werker, Pieter U. Dijkstra, Tessa A. Hadlock



## Association Among Facial Paralysis, Depression, and Quality of Life in Facial Plastic Surgery Patients

Jason C. Nellis, MD, Masaru Ishii, MD, PhD, Patrick J. Byrne, MD, MBA, Kofi D. O. Boahene, MD, Jacob K. Dey, MD, and Lisa E. Ishii, MD, MHS

Department of Otolaryngology–Head and Neck Surgery, Johns Hopkins University Baltimore Maryland

JAMA Facial Plastic Surgery | Original Investigation

## Comparing Patient, Casual Observer, and Expert Perception of Permanent Unilateral Facial Paralysis

Jacob K. Dey, MD; Lisa E. Ishii, MD, MHS; Jason C. Nellis, MD; Kofi D. O. Boahene, MD; Patrick J. Byrne, MD, MBA; Masaru Ishii, MD, PhD

## Expression of Emotion and Quality of Life After Facial Nerve Paralysis

\*Susan E. Coulson, †Nicholas J. O'Dwyer, \*Roger D. Adams, and ‡Glen R. Crosson

**MAYO  
CLINIC**



▶ **Treatment Options:**

- Non-surgical: Neuromuscular retraining (NMR) +/- Chemodenervation
- Surgical: Select Myectomy and Select Neurectomy



## First-line treatment:

### ○ Neuromuscular Retraining

- ✓ Relies on cortical adaption
- ✓ Improvement seen irrespective of chronicity, age or gender
  - ▶ Refer to Jackie Diels or Laura Wazen currently

#### FACIAL NERVE

## Facial Rehabilitation as Noninvasive Treatment for Chronic Facial Nerve Paralysis

Karp, Emily; Waselchuk, Emily; Landis, Cynthia; Fahnhorst, Jill; Lindgren, Bruce; Lyford-Pike, Sofia

[Author Information](#) ⓘ

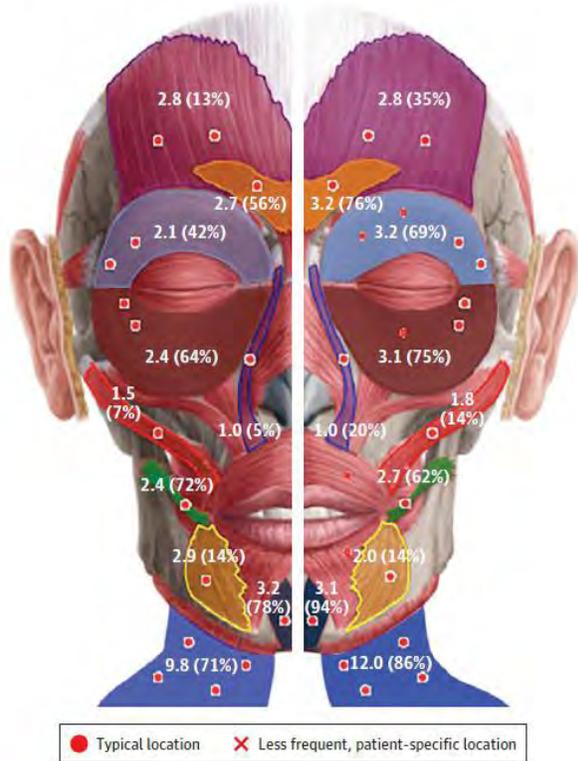
*Otology & Neurotology* 40(2):p 241-245, February 2019. | DOI: 10.1097/MAO.0000000000002107

# Treatment: Chemodenervation

Figure. Initial and Steady-State Treatment Patterns

A Initial injection pattern

B Steady-state injection pattern



Color transparency reflects the frequency a muscle is injected in each new patient (A) and after the botulinum toxin dose is titrated (B). The mean dose in units of botulinum is shown, along with the frequency a muscle is injected (shown in parentheses).

JAMA Facial Plastic Surgery | Original Investigation

## Treatment Patterns and Outcomes in Botulinum Therapy for Patients With Facial Synkinesis

Justin R. Shinn, MD; Nkechi N. Nwabueze, BS; Liping Du, PhD; Priyesh N. Patel, MD; Kevin K. Motamedi, MD; Cathey Norton, PT; William R. Ries, MD; Scott J. Stephan, MD

- Significant improvement in SAQ scores and quality of life

## Botulinum Toxin for Aberrant Facial Nerve Regeneration: Double-Blind, Placebo-Controlled Trial Using Subjective Endpoints

Gary Borodic, M.D., Mary Bartley, R.N., William Slattery, M.D., Michael Glasscock, M.D., Eric Johnson, Ph.D., Carl Malazio, B.S., Michael Goodnough, Ph.D., Martin Acquadro, M.D., and Michael McKenna, M.D.

- Significant improvement in QOL, social interaction, personal appearance, self-esteem.

# Chemodenervation

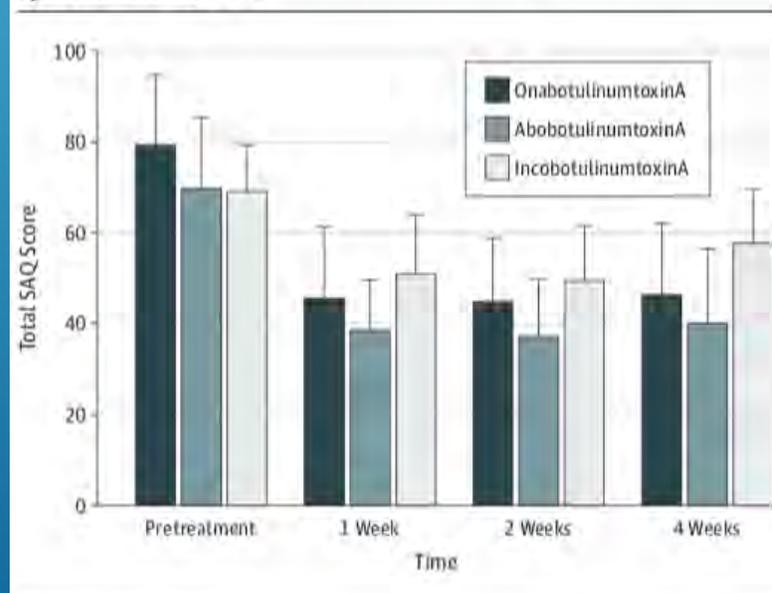
JAMA Facial Plastic Surgery | Original Investigation

## Effect of 3 Commercially Available Botulinum Toxin Neuromodulators on Facial Synkinesis | A Randomized Clinical Trial

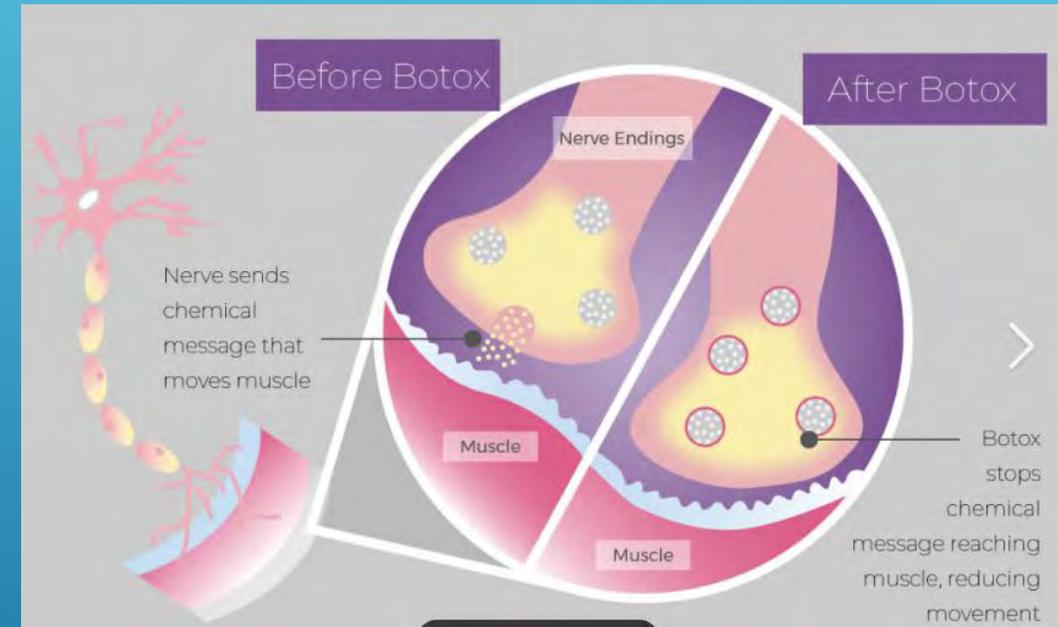
Andrew J. Thomas, MD; Michael O. Larson, BS; Samuel Braden, MD; Richard B. Cannon, MD; P. Daniel Ward, MD, MS



Figure 3. Synkinesis Assessment Questionnaire (SAQ) Scores by Treatment and Time



Error bars indicate SD.



3 common neuromodulators all have similar efficacy

# Chemodenervation: Neuromuscular Balancing

Facial paralysis produces a bilateral motor imbalance, not a unilateral problem.

- The “normal” side often develops:
  - Compensatory hyperactivity
  - Increased tone and dominance
  - Progressive asymmetry over time

## Typical bilateral strategy

Paralyzed side:

- Target synkinetic muscle groups
  - **BASIC:** OO, DAO/DLI, mentalis, platysma, corrugator
  - **ADVANCED:** buccinator, peri-auricular, occipital area, PBD, lacrimal gland
- High precision (+/- ultrasound)

Unaffected side:

- Strategic weakening (e.g., DAO, levator labii, frontalis, corrugator, etc.)



**Table 1. Sample starting doses of botulinum toxin for chemodenervation for various muscle groups**

*Typical starting doses of BT per muscle group*

Muscle group	Location	BT dose (units)
Frontalis	Ipsilateral	2-4
	Contralateral	3-5
Glabella (corrugator supercillii and procerus)	Unilateral	7.5
	Bilateral	15
Periocular (orbicularis oculi)	Lateral canthus	1-7.5
	Lower eyelid	0.5-2.5
	Upper eyelid	0.5-2.5
Perinasal (nasalis, LLS alaque nasi, DS)	Lateral nasal sidewall	0.5-1.25
	Junction ala/distal nasal sidewall	0.5-1.25
	Labiocollumellar junction	0.5-1.25
Buccinator		0.5-1.25
Lip depressors	Mentalis	2.5-7.5
	DAO	2-2.5
	DLI (contralateral only)	2-2.5
Neck (platysma)		25
Periauricular		3-6

BT, botulinum toxin; DAO, depressor anguli oris; DLI, depressor labii inferioris; DS, depressor septi; LLS, levator labii superioris.

# Comprehensive Chemodenervation

ORIGINAL ARTICLE

## Botulinum Toxin and Quality of Life in Patients With Facial Paralysis

Ritvik P. Mehta, MD; Tessa A. Hadlock, MD

- Significant improvement in FaCE scores

**Table. FaCE Scores, by Subdomain Before and After Botulinum Toxin Therapy<sup>a</sup>**

Subdomain	Treatment Score		P Value	Historical Comparison Cohort <sup>b</sup>
	Pretreatment	Posttreatment		
Facial Movement	39.1 (25.7)	49.4 (20.5)	.02	35.1 (29.0)
Facial Comfort	43.5 (34.5)	57.0 (31.1)	.03	65.0 (27.5)
Oral Function	62.3 (29.9)	78.3 (22.3)	<.001	65.4 (29.1)
Eye Comfort	49.4 (34.2)	57.9 (32.0)	.03	57.7 (31.6)
Lacrimal Control	52.9 (33.6)	66.5 (33.0)	.02	61.1 (36.4)
Social Function	63.0 (28.9)	74.4 (24.5)	.001	70.1 (26.3)
Total score	51.7 (20.9)	63.7 (17.8)	<.001	59.3 (19.8)

Abbreviation: FaCE, Facial Clinimetric Evaluation.

<sup>a</sup>A statistically significant improvement ( $P < .05$ ) was noted in all subdomain scores and the total score. Data are given as mean (SD).

<sup>b</sup>Scores from the original FaCE questionnaire validation study.<sup>14</sup>

# Select Chemodenerivation: DAO

JAMA Facial Plastic Surgery | **Original Investigation**

## Effect of Weakening of Ipsilateral Depressor Anguli Oris on Smile Symmetry in Postparalysis Facial Palsy

Nate Jowett, MD; Ronit Malka, BS; Tessa A. Hadlock, MD

Figure 1. Preweakening and Postweakening of the Depressor Anguli Oris (DAO) in Postparalysis Facial Palsy

**A** Before injection

**B** After injection



# Concomitant Treatment: NMR+ Chemodenervation

## Clinical protocol

- Offered after or together with NMR at first signs of nerve recovery
- Neuromodulator Treatments every 3 months with titration plan
  - Product dilution 2.5U/0.1mL

## Medication necessity:

Blepharospasm

Clonic hemifacial spasm

Other disorders of facial nerve

Other muscle spasm

CPT: 64612-50

H.J. Diels, D. Combs

**Neuromuscular retraining for facial paralysis**

Otolaryngol Clin N Am, 30 (1997), pp. 727-743

[View in Scopus ↗](#)

[Google Scholar ↗](#)

# Surgical Myectomy

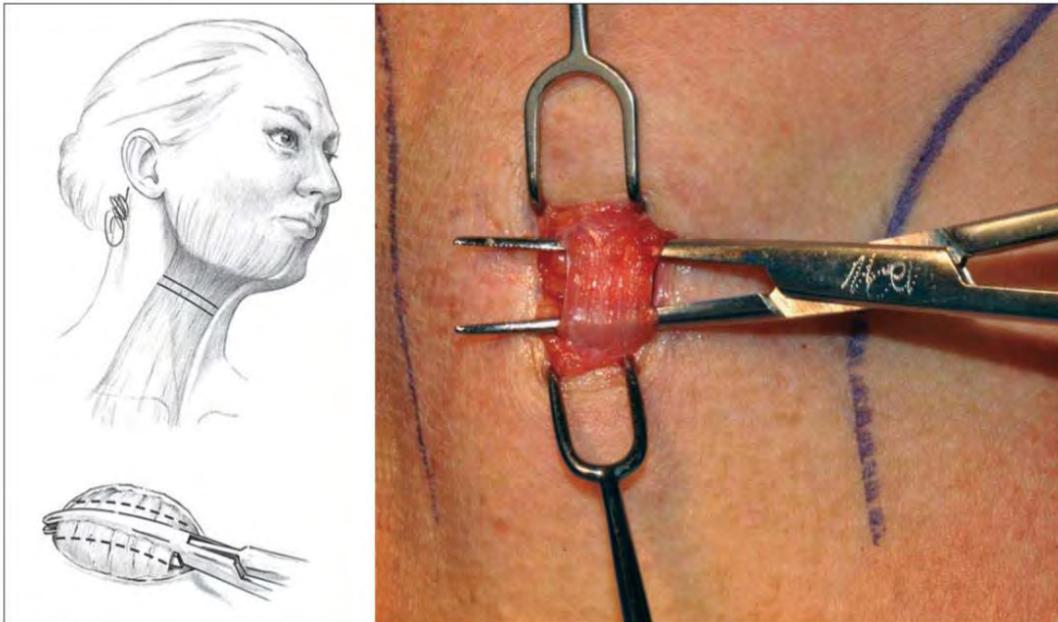
Surgical lysis of muscles  
to treat synkinesis and hypertonicity

# Surgical Myectomy: Platysma

## Platysmectomy

*An Effective Intervention for Facial Synkinesis and Hypertonicity*

Douglas K. Henstrom, MD; Juan S. Malo, MD; Mack L. Cheney, MD; Tessa A. Hadlock, MD



**Figure 3.** Delivery of the posterior section of the hypertrophied platysma muscle through the surgical incision before division. The inset shows the planned resection of the section of the platysma muscle.



**Figure 6.** Platysmectomy results. A, Smile before platysmectomy. Note the significant hypertrophy and banding of the left platysma. B, Smile after platysmectomy. Note the absence of hypertrophy or banding of the left platysma.

# Surgical Myectomy: Long Term outcomes

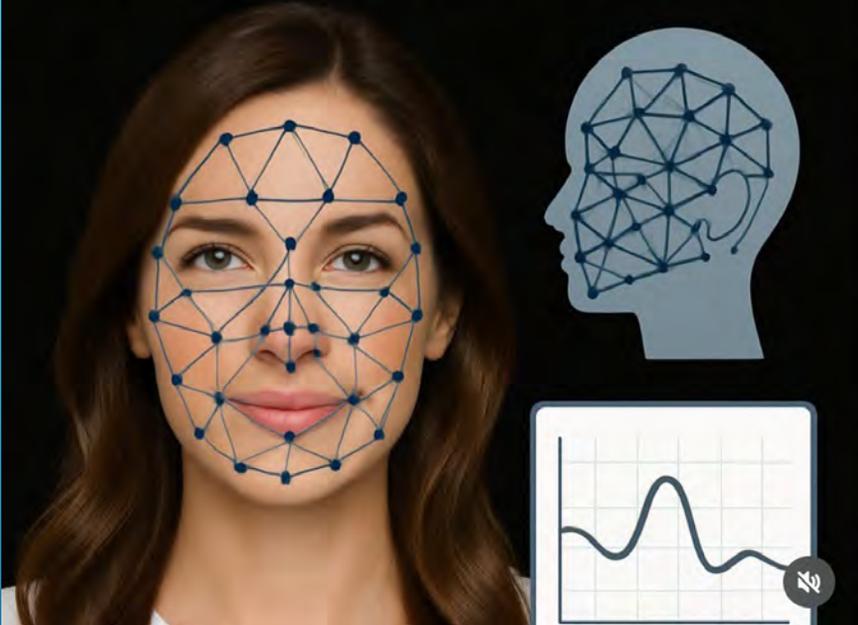
Miller et al: DAO myectomy shows sustained smile symmetry and quality of life improvements at ~2 years post-op

- **Median follow-up:** ~21.6 months (range 12–37 months).
- **Significant improvements in:**
- **Smile symmetry**
- **Patient-reported quality of life**
- **Objective facial excursion and dental show**
- **Emotions conveyed with smile** (measured objectively)  
(all statistically significant)

## Surgical Neurectomy

Surgical lysis of redundant/culprit distal nerve branches to treat synkinesis and hypertonicity

# USING FACIAL MAPPING TO TRACK FACIAL PARALYSIS OUTCOMES



Liked by [aestheticsxmaylon](#) and others

**menapacemd** Using advanced 3D facial mapping, our team is developing precise, quantifiable tools to track facial paralysis recovery over time. This technology captures subtle changes in movement and symmetry that the human eye can miss, bringing objective data to patient care and research. Please share with someone who may be interested in enrolling in our pilot.

## CLINICAL TRIALS/RESEARCH:

- FACIAL ANALYSIS AND COMPUTER-ASSISTED EVALUATION SYSTEM ("FACES TRIAL")
  - Developing AI algorithm for MONITORING OF facial paralysis OUTCOMES OVER TIME
    - PI: MENAPACE
      - MESSAGE ME, LIZ MARTIN, OR DR. W. FREEMAN FOR ENROLLMENT

# ASED: HEALING TEARS FROM YOU

Made from your own blood, Autologous Serum Eye Drops (ASED) deliver natural growth factors and nutrients to help repair and hydrate the eye's surface.



Liked by [aestheticsxmaylon](#) and others

**menapacemd** Made from your own blood, autologous serum eye drops (ASED) deliver growth factors and nutrients to help hydrate and repair your eye's surface. At Mayo Clinic Florida, we are looking at how this may help relieve symptoms in patients with facial paralysis. Please reach out or share with someone who may benefit.

## CLINICAL TRIALS/RESEARCH:

- AUTOLOGOUS SERUM EYE DROPS: FOR MODERATE-TO-SEVERE DRY EYE FOLLOWING FACIAL PARALYSIS
  - PI: MENAPACE
- EXOSOME TEST FOR ASEDD PROPOSED MECHANISM OF ACTION FOR IMPROVING EPITHELIAL DEFECTS
  - PI: MENAPACE
    - STUDY COORDINATOR:
      - MESSAGE ME OR JENN ARTHURS PA-C FOR ENROLLMENT; CENTER OF REGEN. MED. BIOTHERAPEUTICS

# SUMMARY:

## ○ ANATOMY UPDATES:

- Both the zygomatic and buccal branches contribute to lower lid tone
- There is a dominant branch to the DLI from the cervical branch

## ○ ABERRANT REINNVERATION SYNDROME (NEW TERM)

- Common in patients that have experienced facial nerve injury
- Includes FACIAL SYNKINESIS, FACIAL MUSCLE HYPERTONICITY, FACIAL MUSCLE SPASM/TWITCHING
- Facial retraining helps with cortical adaptation
- Bilateral chemodeneration helps with neuromuscular balancing
  - TREATMENT MAY HELP WITH SELF-PERCEIVED ATTRACTIVENESS, DEPRESSION AND QOL

## ○ MYECTOMY & NEURECTOMY PROCEDURES

- SURGICAL OPTIONS FOR MANAGEMENT OF SYKINESIS

# Thank you



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Cosmetic Center  
P: 904-953-0795

# Surgical Neurectomy

## Two-Step Highly Selective Neurectomy for Refractory Periocular Synkinesis

Marc H. Hohman, MD; Linda N. Lee, MD; Tessa A. Hadlock, MD

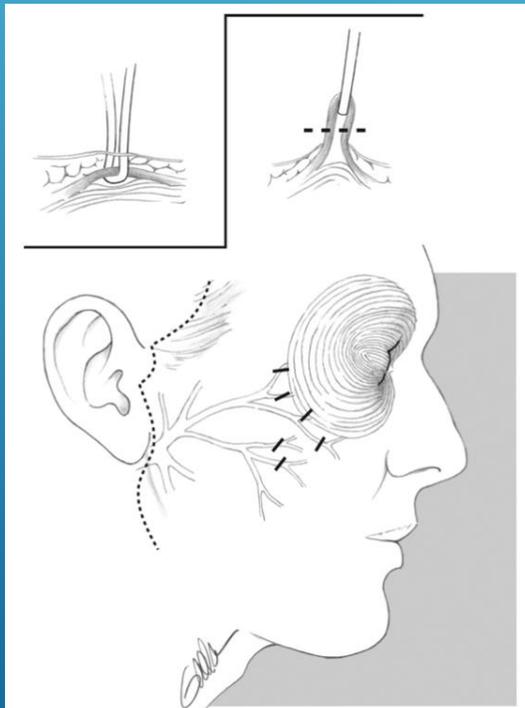


Fig. 4. A schematic of procedure showing preauricular incision, stab incisions overlying nerve branches to orbicularis oculi, retraction and resection of a nerve branch.



Fig. 2. Patient photographs of palpebral fissure width with maximal smile effort. All three patients presented with right-sided synkinesis. [Color figure can be viewed in the online issue, which is available at [www.laryngoscope.com](http://www.laryngoscope.com).]

# DISCLOSURE OF RELEVANT FINANCIAL RELATIONSHIP(S) WITH INELIGIBLE COMPANIES

- ▶ Nothing to disclose

# REFERENCES TO OFF-LABEL USAGE(S) OF PHARMACEUTICALS OR INSTRUMENTS

- Nothing to disclose

*All relevant financial relationships have been mitigated.*

ELECTROSTIMULATION ?



# Chemodenervation

## Risks:

- Ptosis
- Lagophthalmos
- Lip droop
- Smile asymmetry
- Poor oral competence
- Dysarthria

## Contraindications:

- Hypersensitivity to any type of botulinum toxin
- Patients who are pregnant or lactating
- Neuromuscular Junction Disorders
- Active skin infections at injection site(s)

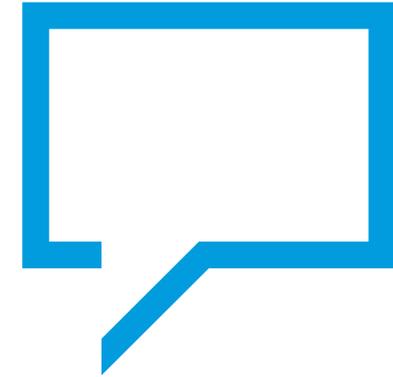


# AUDITORY REHABILITATION

HOW TO MAXIMIZE HEARING FUNCTION

Greta Stamper, AuD, PhD  
Audiology Division Chair

Acoustic Neuroma Association and Mayo Clinic Florida Patient Education Event  
March 7, 2026



# WHAT IS AUDITORY REHABILITATION?

“The reduction of hearing-loss induced deficits of function, activity, participation and quality of life through a combination of sensory management, instruction, perceptual training, and counseling.”

- Arthur Boothroyd

How do you hear ***your*** best?



# AURAL REHABILITATION CARE PATHWAY



Audiology evaluation



Auditory needs  
assessment



Hearing device  
options



Communication  
strategy tips / Assistive  
listening devices



Ongoing re-evaluation

# AUDIOLOGICAL EVALUATION

- Hearing thresholds at specific frequencies
- Speech understanding ability
- Measure of auditory nerve pathways
  - Auditory brainstem response
  - Acoustic reflex testing

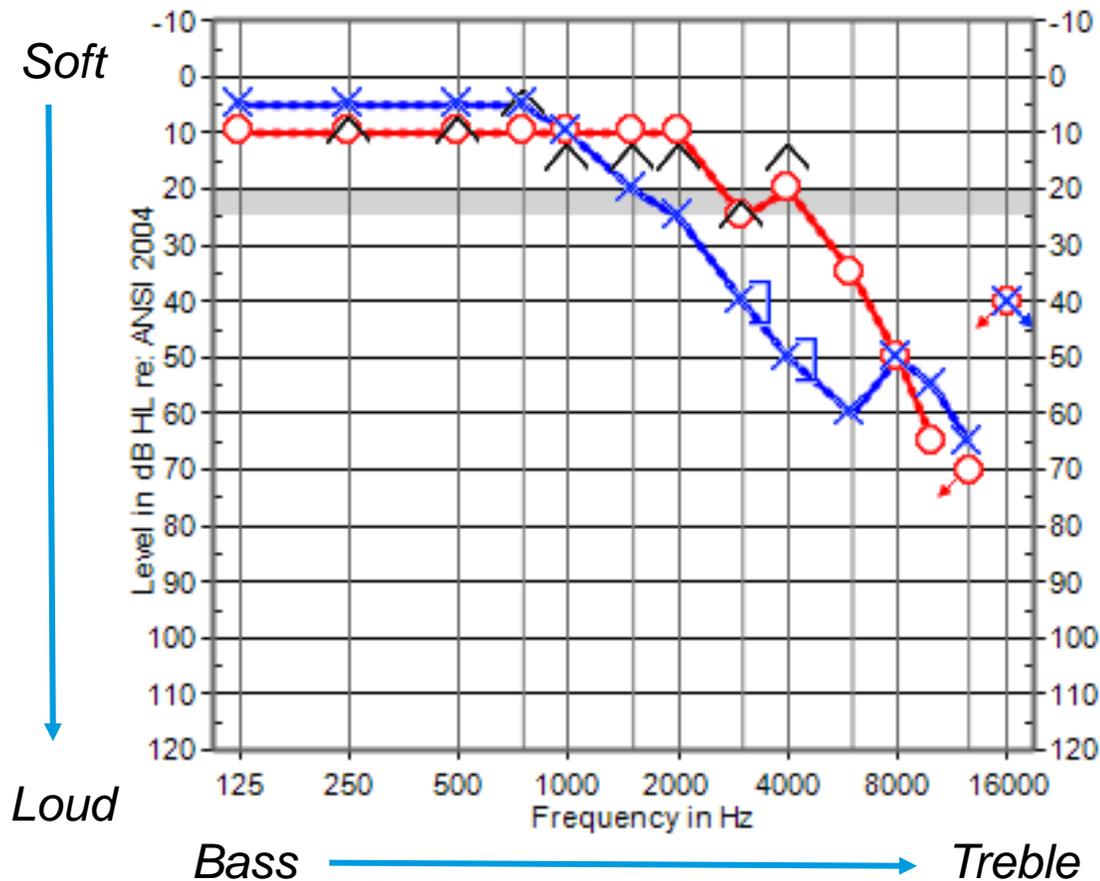


# HEARING SYMPTOMS WITH ACOUSTIC NEUROMA

- Hearing loss / loss of volume
  - Difficulty understanding speech
  - Trouble hearing in background noise
- Tinnitus (sounds in your ears)
- Localizing sound
- Increased concentration needed when listening



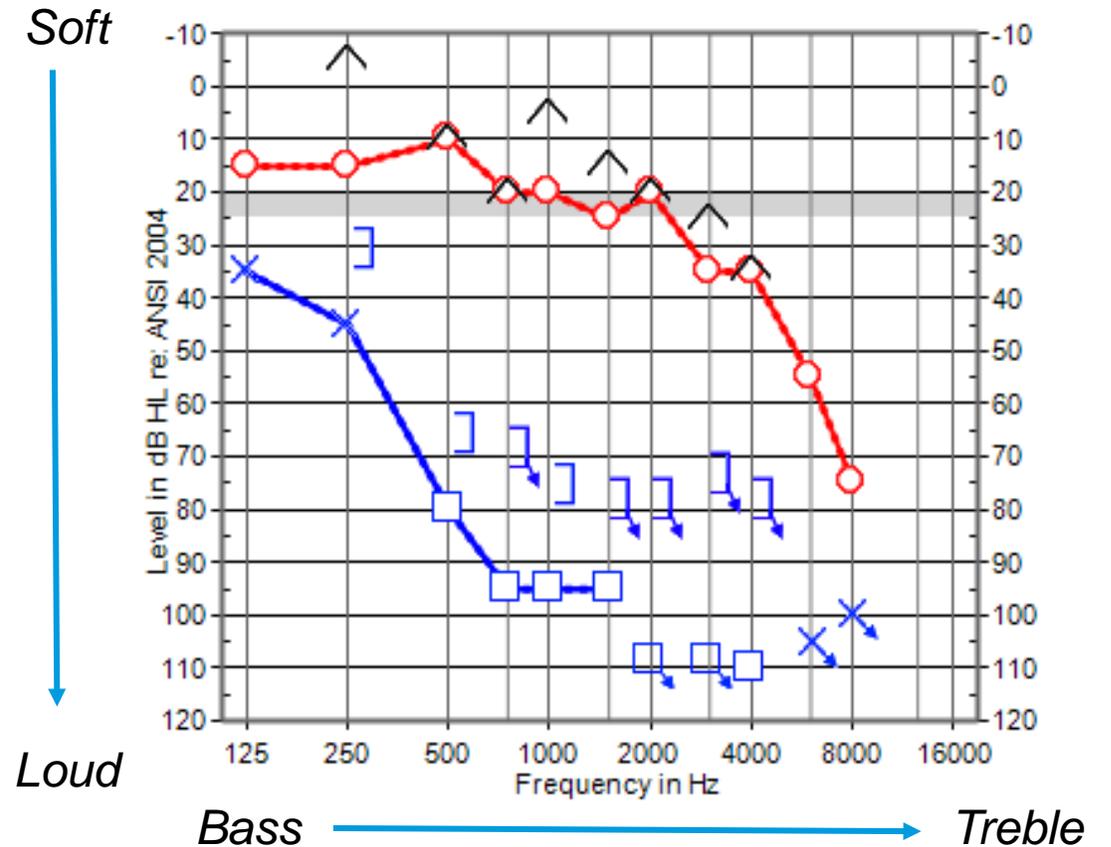
# AUDIOGRAM RESULTS: EARLY STAGE



- Hearing loss asymmetry in high frequencies
- Reduced word understanding
- Unilateral tinnitus
  
- Prescription hearing aid(s) can be effective

# AUDIOGRAM RESULTS: LATER STAGE

- Increased hearing asymmetry
- Poor word understanding
- Importance of monitoring over time
  
- Prescription hearing aid(s) provide limited benefit





1:1 Conversations



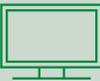
Group Settings



Telephone



Work / Meetings



TV / Movies



Community Conversations

# AUDITORY NEEDS ASSESSMENT

## HOW IS YOUR HEARING LOSS IMPACTING YOU?

# HEARING DEVICE OPTIONS



No  
Treatment

Hearing  
Aid(s)

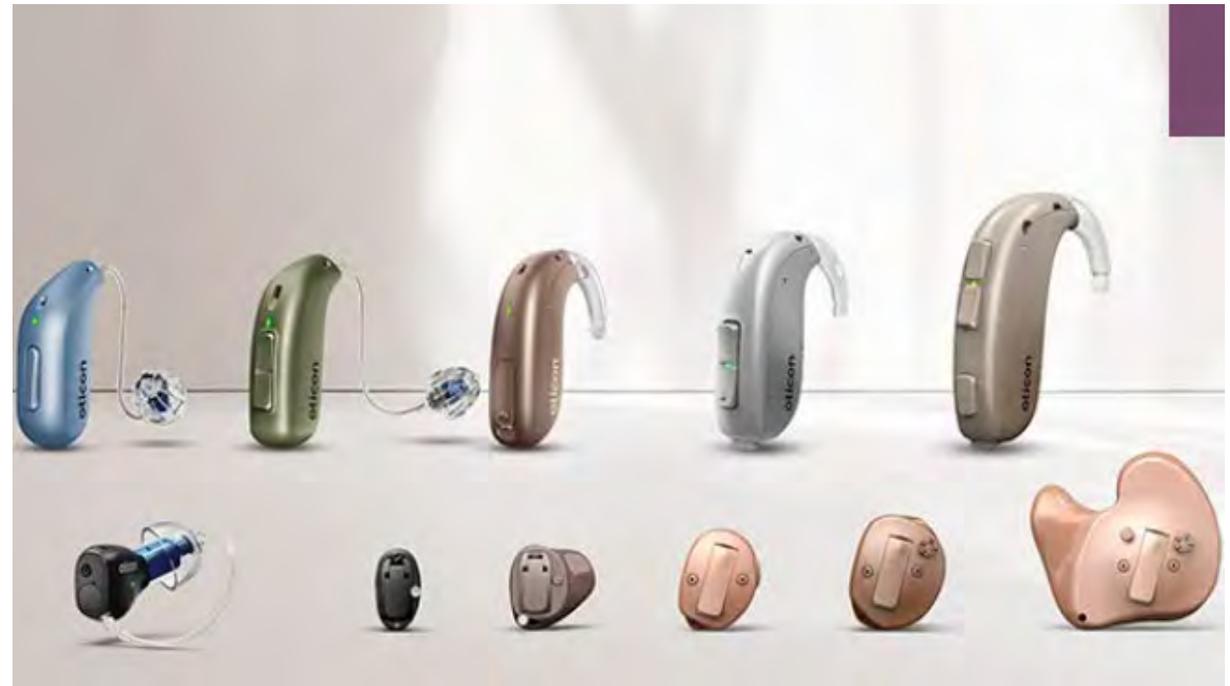
CROS /  
BiCROS

Bone  
Anchored  
Implant

Cochlear  
Implant

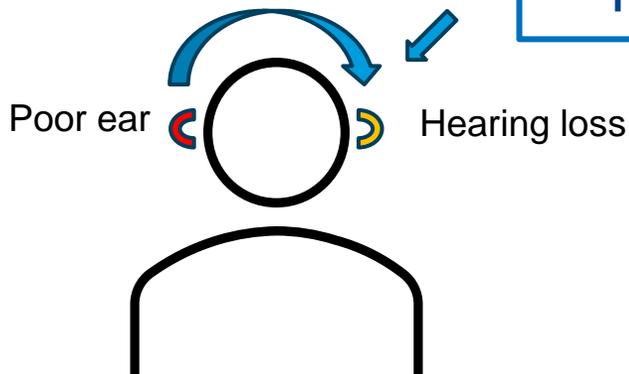
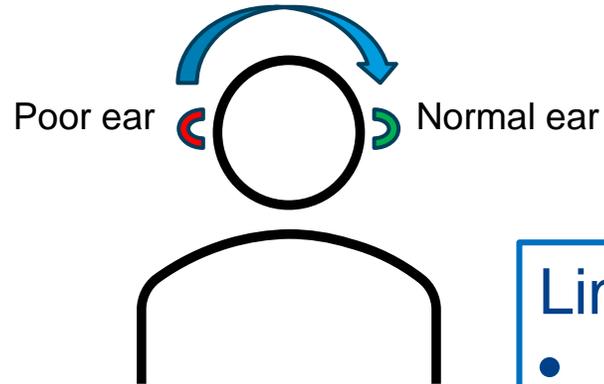
# PRESCRIPTION HEARING AIDS

- Digitally programmable and customized to individual hearing loss
  - User controls
  - Bluetooth connectivity
- Tinnitus management options
- Improved localization



# CROS / BICROS HEARING AIDS

- **Contralateral Routing of Signal**
  - Transmits sound from unaidable ear to normal ear
  - No amplification in hearing aid
- **Bilateral Contralateral Routing of Signal**
  - CROS function and hearing aid



## Limitations:

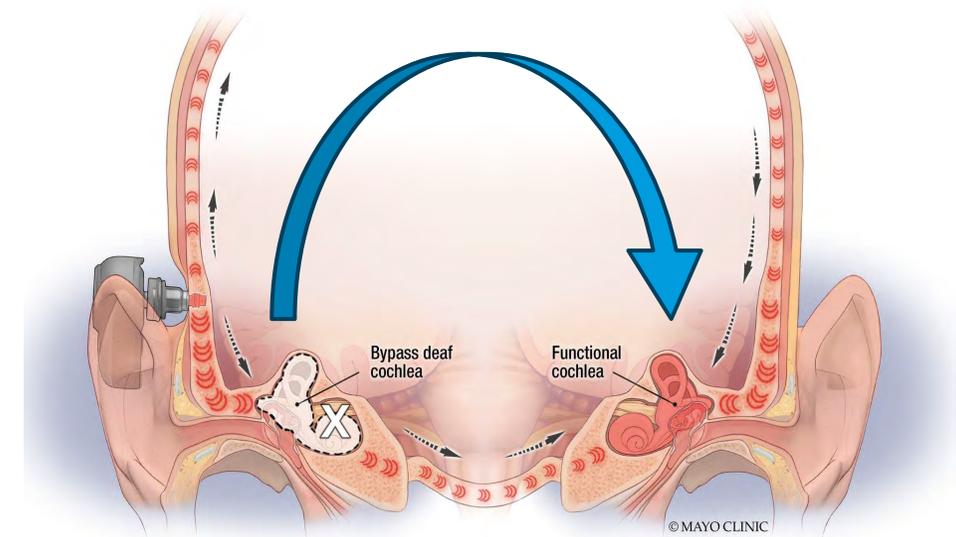
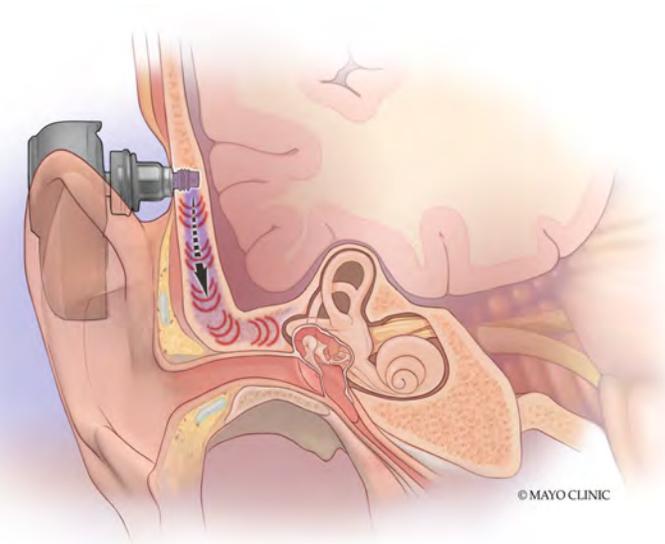
- No hearing in poor ear
- No tinnitus management
- No localization

# BONE ANCHORED IMPLANT

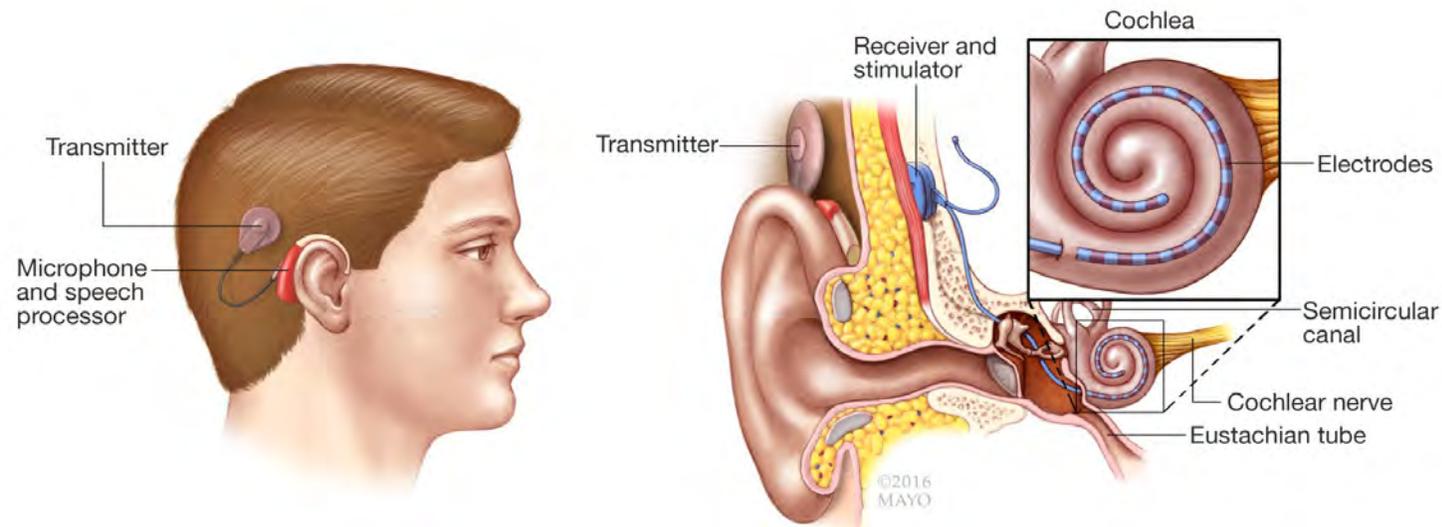
- Bone anchored implant surgically placed on AN ear
  - Transfers sound to opposite ear through the skull
  - 4-12 weeks before device can be used
- Requires good hearing in the opposite ear

## Limitations:

- No hearing in poor ear
- No tinnitus management
- No localization
- Future imaging



# COCHLEAR IMPLANTATION



- Electrical impulses sent directly to auditory nerve
  - Brain must re-learn sound and how to use it
  - Can take time for speech understanding (3-12 months)
- Provides sound to affected ear and binaural hearing
  - Sound detection, localization, speech understanding, tinnitus relief
- Potential concerns:
  - Insurance coverage and future imaging

# COMMUNICATION STRATEGIES AND ASSISTIVE LISTENING DEVICES



# COMMUNICATION STRATEGIES: TALKER



1

Get the person's attention before talking

2

Face the person

3

Stay within a few feet of the person

4

Limit background noise

# COMMUNICATION STRATEGIES: LISTENER



1

Use lip  
reading cues

2

Choose a  
quieter area

3

Sit close to  
the speaker

4

Ask for  
repetition –  
don't pretend

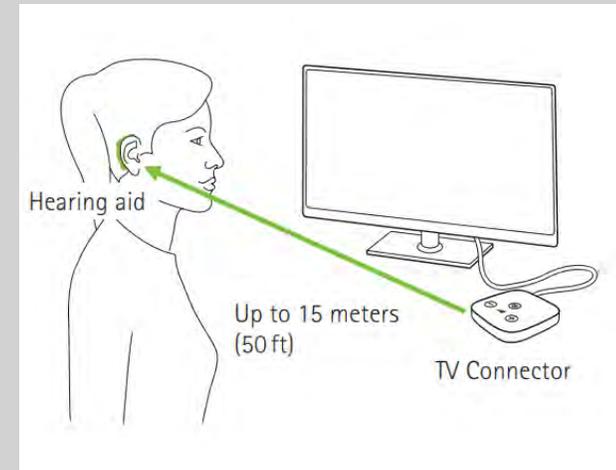
# ASSISTIVE LISTENING WITH HEARING DEVICES



Remote  
Microphones



Listening programs  
on hearing devices



TV streaming

# ASSISTIVE LISTENING DEVICES

- Alerting devices

- Vibration watch alarm
- Loud alarm clock with lights
- Fire alarm or doorbell light alert



- Assistive technology

- Captions for phone and TV
- Live transcription apps
- TV streaming headphones



# LISTENING IN PUBLIC AREAS

- Public amplification systems

- Telecoil loop systems



- Auracast broadcast audio

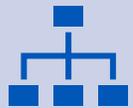


# ONGOING RE-EVALUATION



Hearing difficulties not stable

Monitoring and re-evaluation to maximize your hearing abilities



No single one size fits all

Best solution can change over time



Importance of a multidisciplinary team

**THANK YOU FOR  
LISTENING!**

