38TH ICRO TEACHING COURSE

BENIGN BRAIN TUMORS

Dr. Kausik Bhattacharya
Director & HOD
AIG Institute of Oncology, Hyderabad

SCOPE OF STUDY

- Meningioma
- Pituitary adenoma
- Vestibular schwannoma
- craniopharyngioma

- Epidemiology
- Radiology
- Treatment
  - Radiosurgery
- Outcomes
- Outline of radiosurgery technique

MENINGIOMA

MENINGIOMA

- Extra axial
- Meningocytes or arachnoid cap cells of meninges
- Location
  - Supratentorial → 85 – 90%
  - Infratentorial → 5 – 10%
  - Miscellineous intradural → 5%
    - Intraventricular
    - Parafalcine
    - Sphenoid wing
    - Intraosseous
    - Optic N
    - Olfactory groove

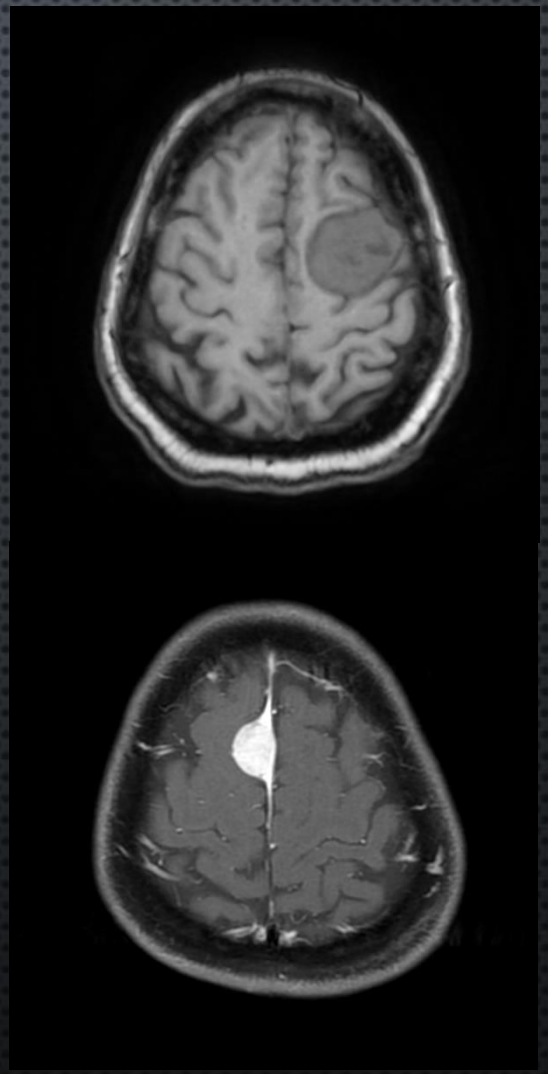
- Women : men = 2:1
- Inrtacranial : spinal = 4:1
- Elderly age group > 40 yrs
- Younger age in NF2

MENINGIOMA : HISTOLOGY (WHO)

- Grade 1 (benign) → 70%
  - transitional
  - meningothelial
  - Fibrous
  - Microcystic
  - Psammomatous
  - Angiomatous
  - Secretory
  - Metaplastic
  - Lymphoplasmacytic rich
- Grade 2 (atypical) → 30%
  - Clear cell
  - Choroid meningioma
  - Atypical by histologic criteria
    - infiltration into brain parenchyma
    - 4 – 9 mitosis per 10 HPF
    - Necrosis
    - Sheet like growth
    - Small cell changes
    - Increased cellularity
    - Prominent nucleoli
- Grade 3 (anaplastic) < 1%
  - rhabdoid
  - papillary
  - anaplastic by histologic criteria
    - > 20 mitosis per 10 HPF
    - obvious malignant features

MENINGIOMA : RADIOLOGY(MRI)

- Extra axial mass with broad dural base
- T1 P
  - Isointense (60-90%)
  - Hypointense in psammommatous/ fibrous type
- T1 c
  - Intense homogenous enhancement
- T2
  - Iso to hyperintense
  - Hypointense in fibrous/ calcified type
- DWI
  - Atypical and malignant type may show restricted diffusion
- MR perfusion is helpful to predict histological grade

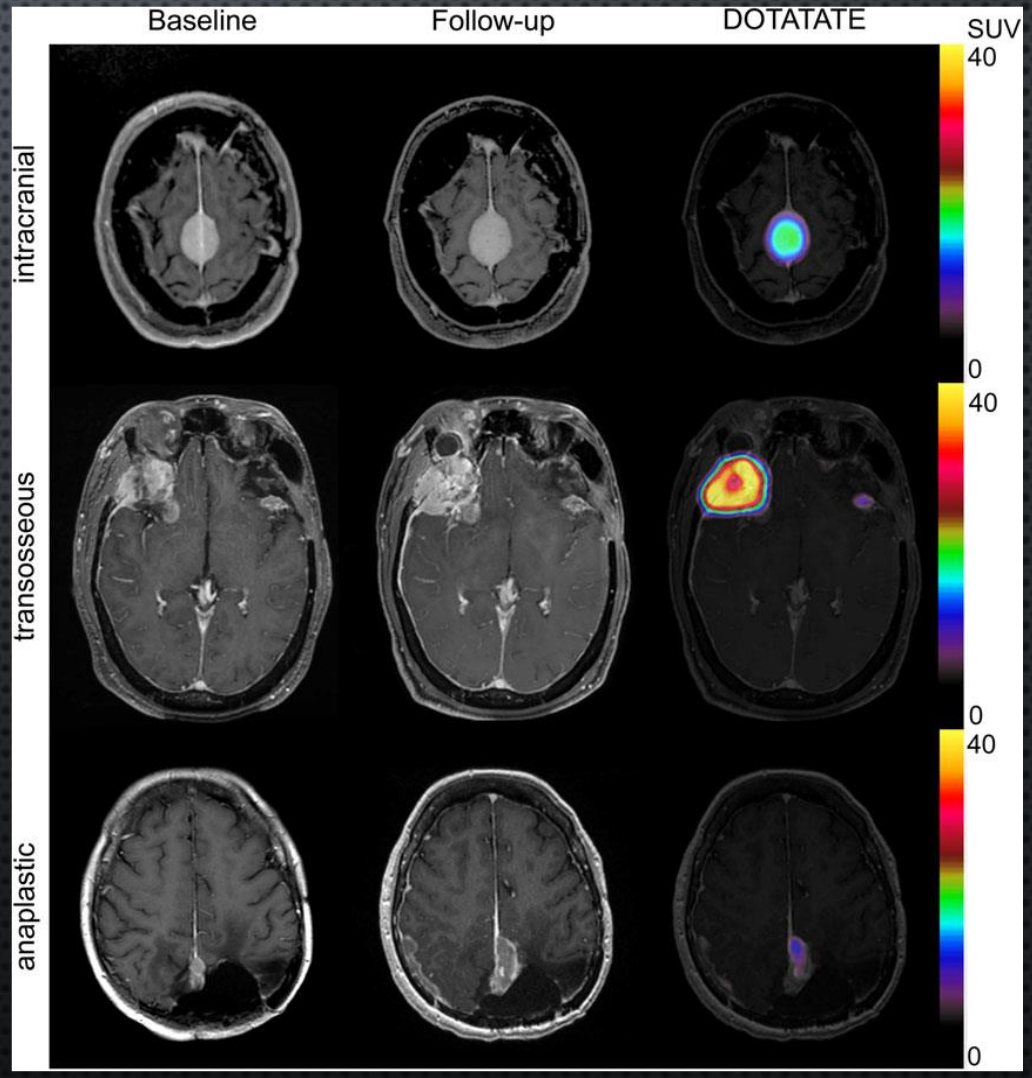


MENINGIOMA : RADIOLOGY(CT)

- PLAIN CT
  - HYPERDENSE (60%) OR ISODENSE
  - CALCIFICATION SEEN (20%)
  - HYPEROSTOSTOSIS IN SKULL BASE LESIONS
- CONTRAST CT
  - INTENSELY ENHANCING (72%)
  - LESS ENHANCEMENT/ CYSTIC CHANGES IN HIGH GRADE

MENINGIOMA : RADIOLOGY(DOTA)

- AVID IN GALLIUM DOTATATE SCAN
- HELPFUL IN INOPERABLE SITES
- MAY PREDICT
  - GRADE
  - RESPONSE



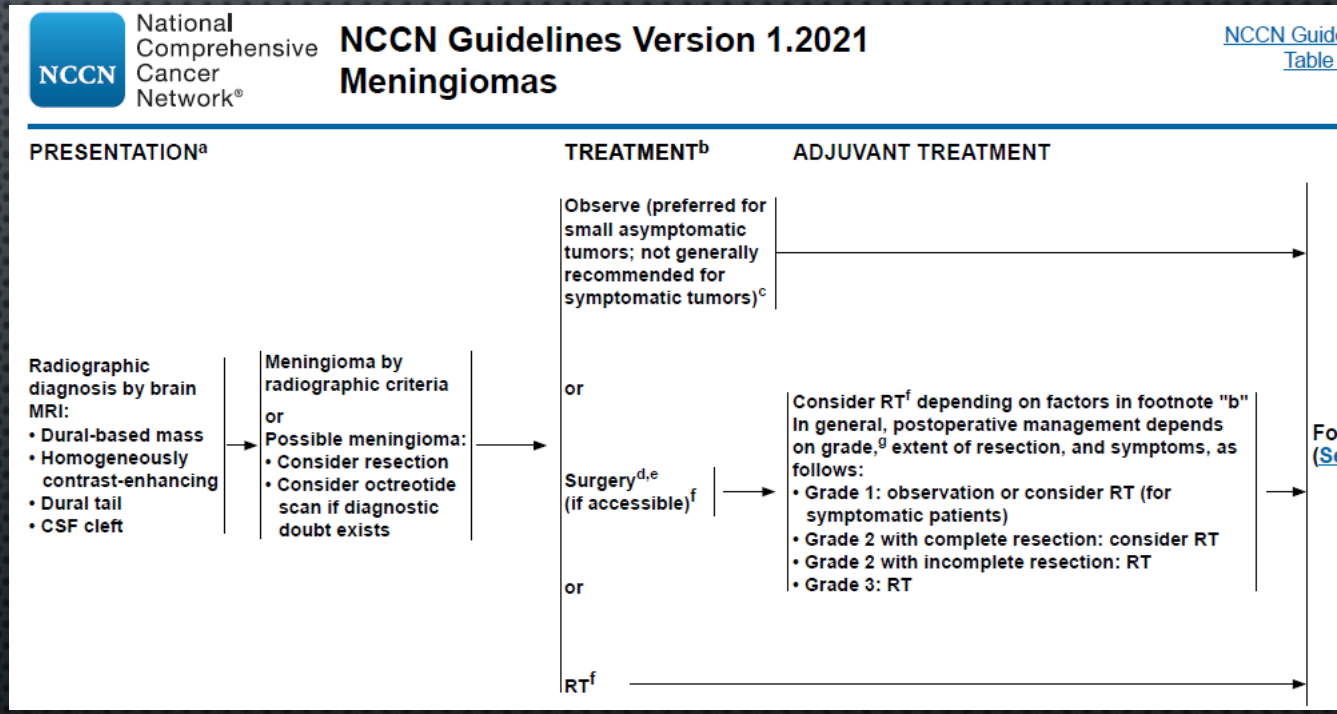
MENINGIOMA : TREATMENT OPTIONS

- Observation
  - Small, asymptomatic tumours
  - Serial MRI
- Surgery:
  - More than 3 cm, symptomatic
  - Radiologically aggressive

Simpson's grade	10 yrs recurrence
• Grade 1 • Complete resection with dura and bone	9%
• Grade 2 • Complete resection with dura	19%
• Grade 3 • Complete resection without dura	29%
• Grade 4 • Subtotal resection	44%
• Grade 5 • Simple decompression/biopsy	100%

MENINGIOMA : TREATMENT OPTIONS

- ROLE OF RADIOTHERAPY
  - OBSERVATION FOR COMPLETELY RESECTED GR1 TUMORS
  - COMPLETELY RESECTED GR2
    - CONSIDER DEPENDING ON
      - POSSIBILITY OF RE-RESECTION
      - RATE OF GROWTH
      - MITOTIC INDEX
      - NEUROLOGICAL STATUS
  - INCOMPLETELY RESECTED GR 2
  - GR 3
  - INOPERABLE / SKULL BASE ETC



MENINGIOMA : TREATMENT OPTIONS

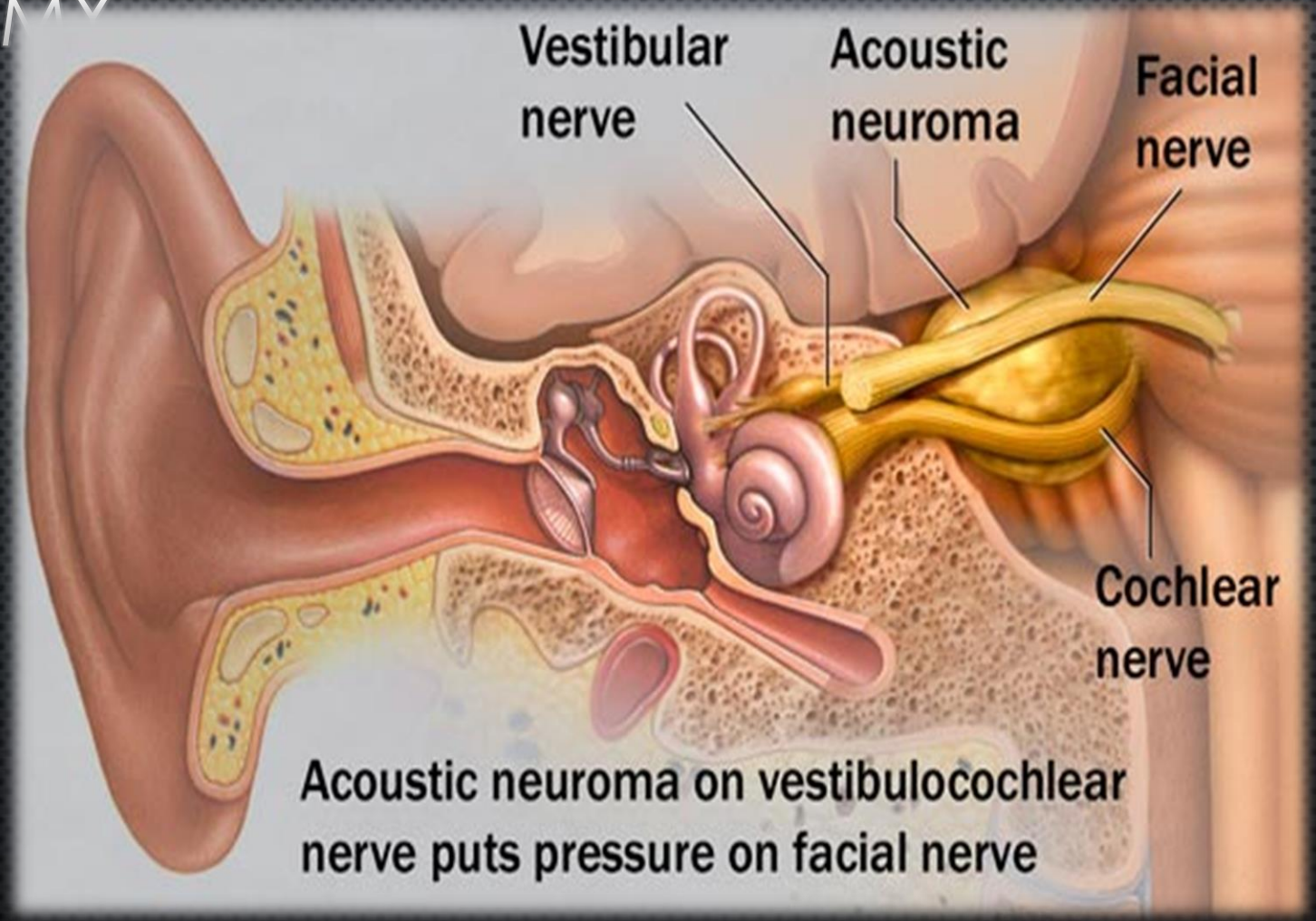
- HIGHLY CONFORMAL TECHNIQUES
- CONVENTIONAL DOSE 45- 54 GY
- SRS DOSE 14 – 16 GY

Overview of the recent clinical literature on SRS and SRT for meningiomas

Author	Institution	Year	# of Lesions	% Prior Surgery	Mean Volume (cm^3)	Mean Dose (Gy)	# of Fractions	% IDL covering PTV	% Local Control	% Tumor Response	% Late Toxicity
Villavicencio[11]	Brigham and Women's Hospital, Boston	2001	56	64	0.06	15	1	100	95 at 26 months	41	9
Spiegelmann[5]	The Chaim Sheba Medical Center, Tel Hashomer	2002	42	26	8.20	14	1	72	98 at 36 months	60	7
Torres[12]	UCLA School of Medicine, Los Angeles	2003	63	66	12.7	16	1	67	92 at 41 months	35	5
Torres[12]	UCLA School of Medicine, Los Angeles	2003	72	66	16.1	48	26	89	97 at 24 months	34	5
Selch[13]	David Geffen School of Medicine, Los Angeles	2004	45	64	14.5	50	28	90	97 at 36 months	18	0
Candish[14]	BC Cancer Agency, Vancouver	2006	36	28	8.90	50	28	90	100 at 26 months	NA	6
Hamm[15]	Helios Klinikum, Erfurt	2006	65	69	18.9	54	30	90	100 at 45 months	54	3
Yenice[16]	Memorial Sloan-Kettering Cancer Center, New York	2006	7	57	7.80	54	30	100	100 at 17 months	71	0

VESTIBULAR SCHWANNOMA

ANATOMY


Vestibular nerve
Acoustic neuroma
Facial nerve
Cochlear nerve
Acoustic neuroma on vestibulocochlear nerve puts pressure on facial nerve

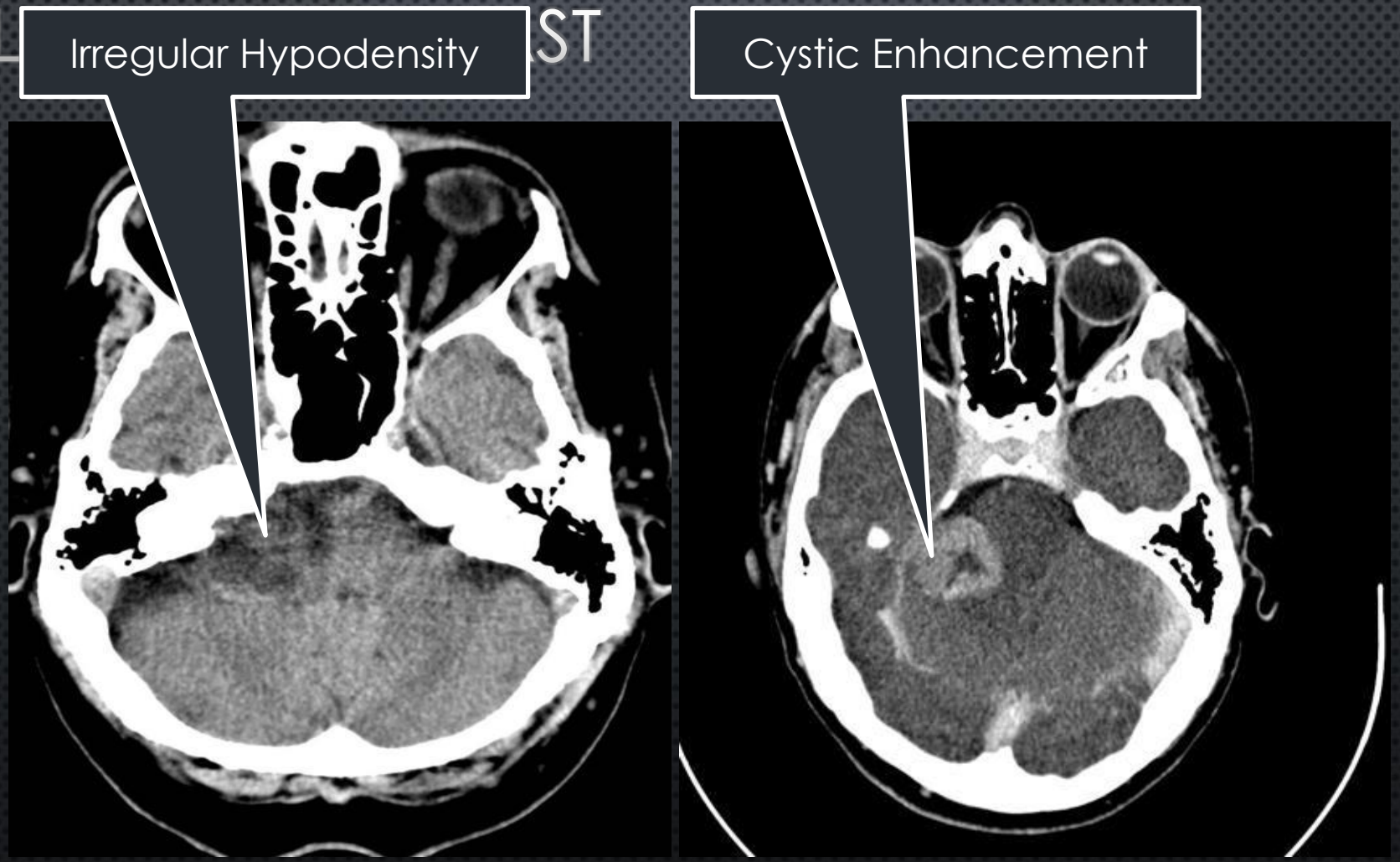
RADIOLOGICAL APPEARANCE

- CT Plain & Contrast
- MRI T1 (Plain & Contrast)
- MRI T2
- MRI T2 Contrast (BTFE / CISS)

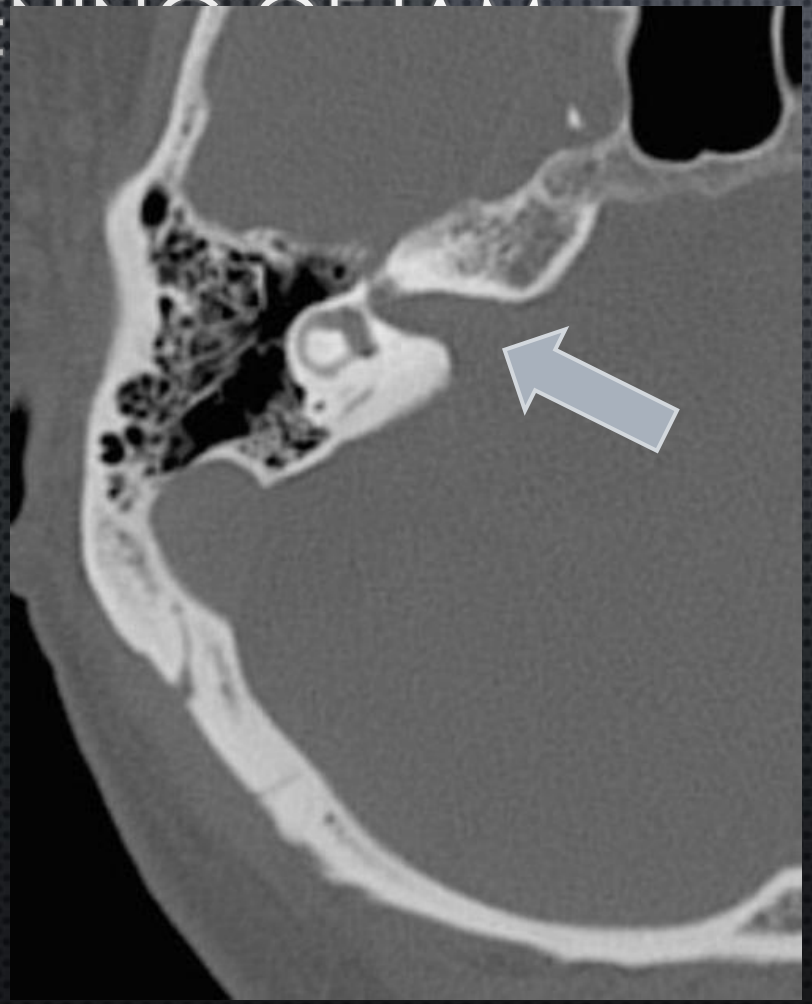
CT PLAIN & CONTRAST

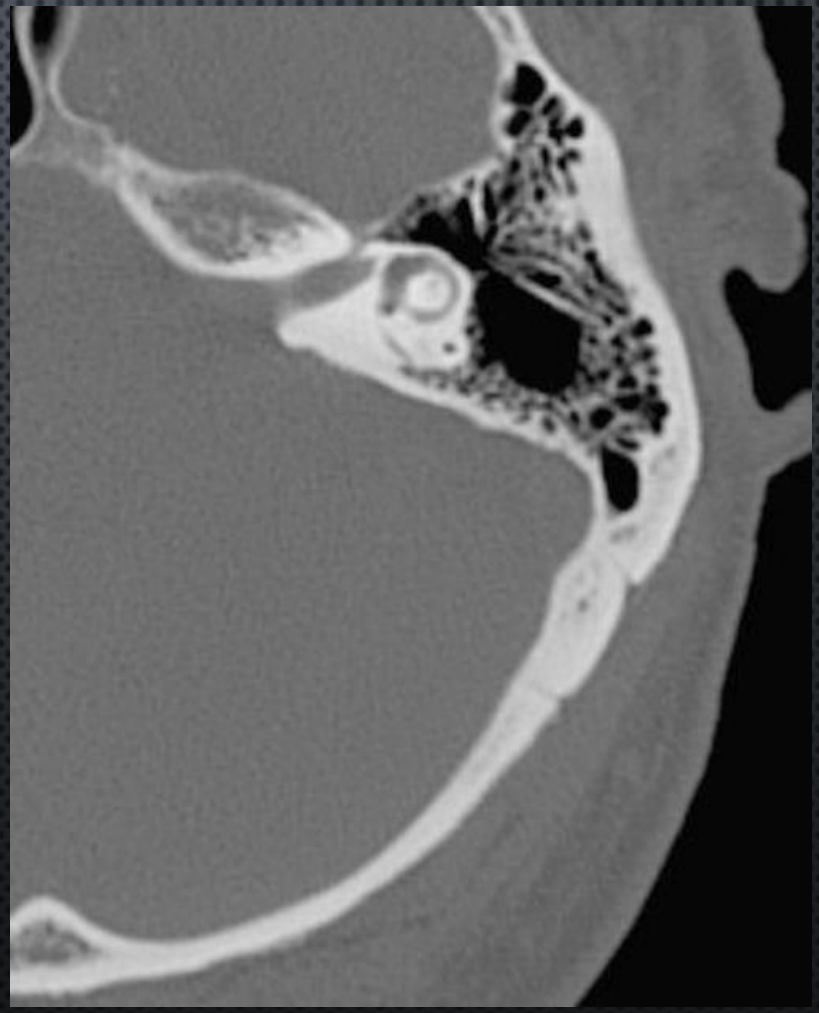
- EROSION & WIDENING OF IAM
- PLAIN CT :
  - VARIABLE INTENSITY
  - POOR VISIBILITY DUE TO ARTIFACTS FROM PETROUS BONE
- CONTRAST CT:
  - IRREGULAR ENHANCEMENT
  - CYSTIC COMPONENTS

CT PL ST



WIDE





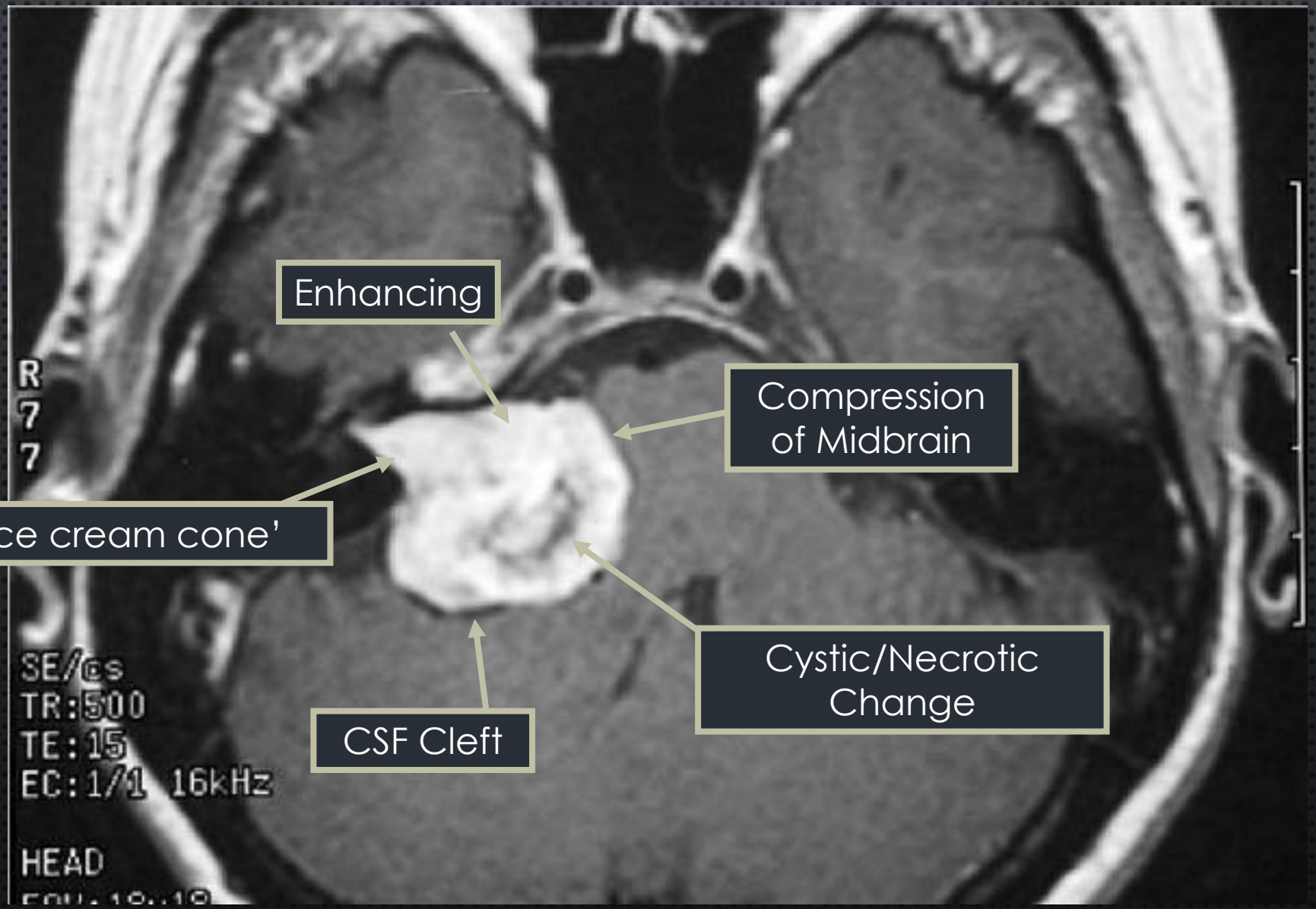
MRI T1 (P&C), T2

- T1 Plain
  - Slightly hypo-intense - 63%
  - Iso intense - 37%
  - May contain hypo intense cystic areas
- T1 Contrast (Gd)
  - Contrast enhancement is vivid
  - Heterogeneous in larger tumors
- T2
  - Heterogeneously hyper intense
  - Cystic areas fluid intensity
  - May have associated peri-tumoural arachnoid cysts

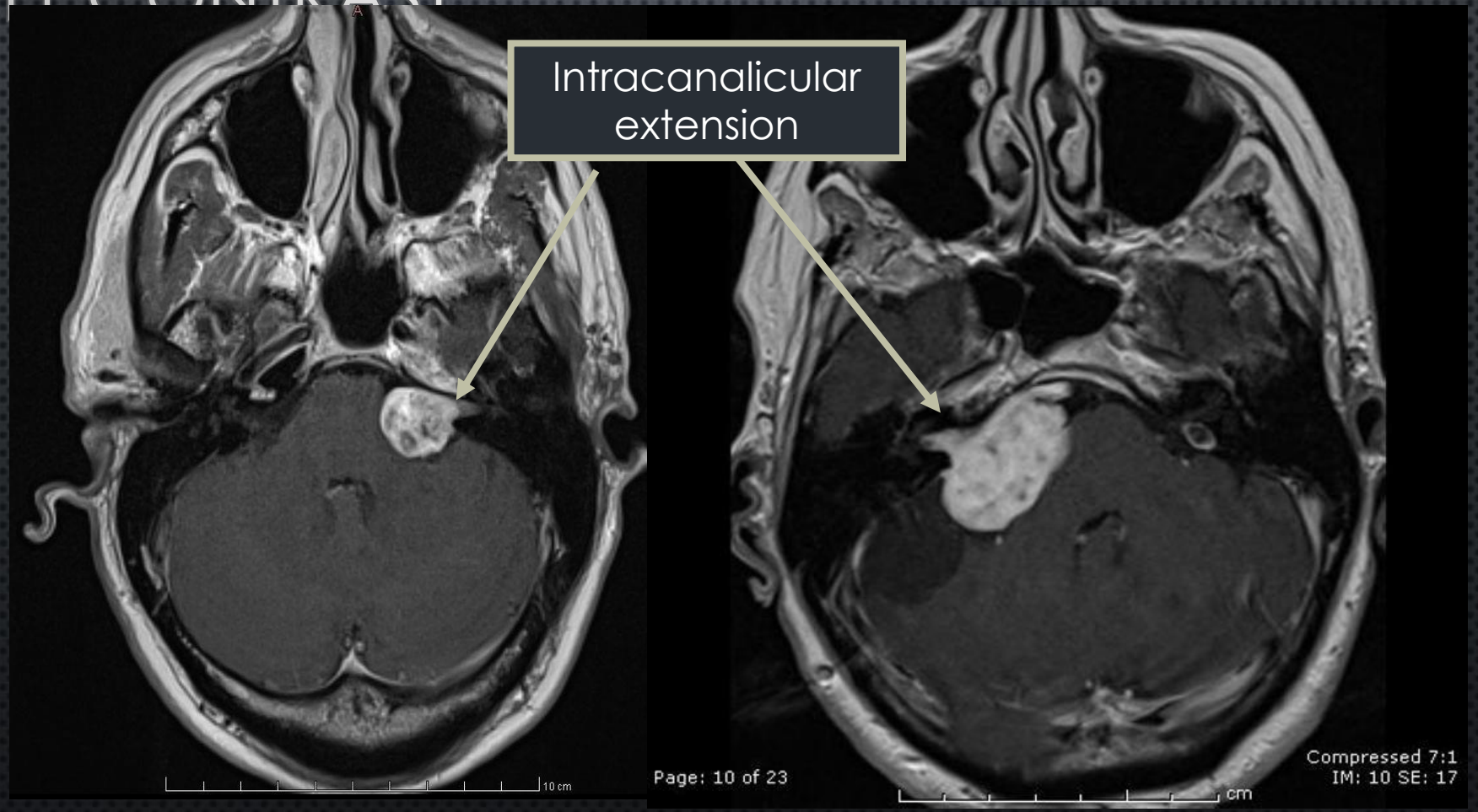
MRI T1 (P&C), T2

- T2 & Fast Spin Echo : Cochlea
- T2 CISS Contrast : Nerves within IAC

RADIOLOGICAL ANATOMY



MRI T1 CONTRAST



KOOS STAGING FOR VESTIBULAR SCHWANNOMA

stage I	Small intracanalicular tumor
Stage II	Small intracanalicular tumor with extension into cerebellopontine angle
Stage III	Large tumor occupying cerebellopontine cistern without brain stem displacement
Stage IV	Extremely large tumor with marked displacement of brainstem and cranial nerves

Koos et al. Neurotopographic considerations in the microsurgical treatment of small acoustic neuromas. J.Neurosurg 88(3):506-512,1998.

SERVICEABLE HEARING: GARDENER-ROBERSON CLASSIFICATION

GR class	Description	Speech Discrimination	Maximal PTA
I	Good	70-100%	0-30 dB
II	Serviceable	50-69%	31-50 dB
III	Nonserviceable	5-49%	51-90 dB
IV	Poor	1-4%	91 dB to max
V	None	0%	Not testable

TREATMENT OPTIONS

- OBSERVATION
- SURGERY
- STEREOTACTIC RADIOSURGERY/RADIOTHERAPY

WHICH MODALITY TO CHOOSE?

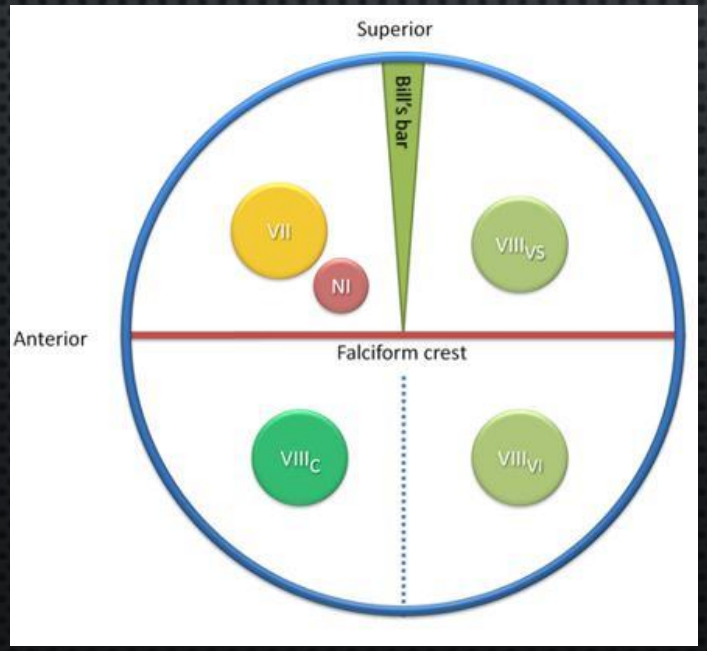
- No Randomized Trial or Level I evidence
- Patient preference
- Available expertise (neuro – oncology team)

- AGE
- SIZE
- SERVICEABLE HEARING
- RECURRENCE

SRS → 1 Fraction
FSRT → 3 or 5 Fractions
SRT → more than 5 fractions, upto 27 fractions

Intracanalicular components

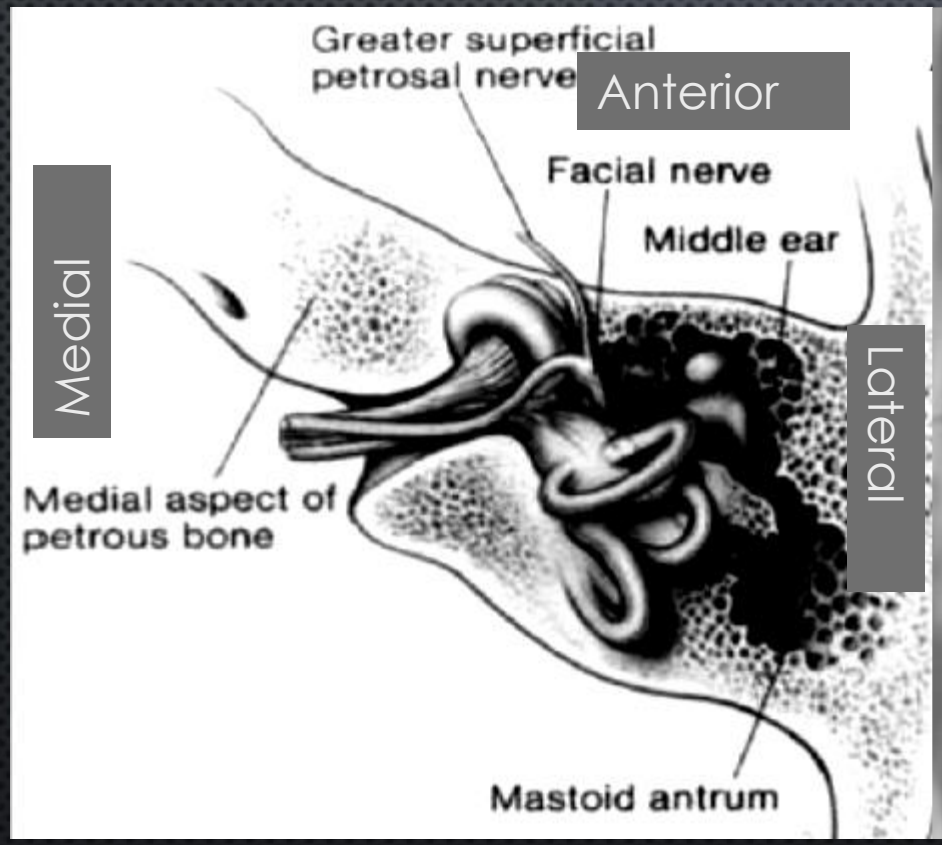
- Motor branch of Facial N (CN VII)
- Cochlear N (CN VIII)
- Inferior Vestibular N (CN VIII)
- Superior Vestibular N (CN VIII)

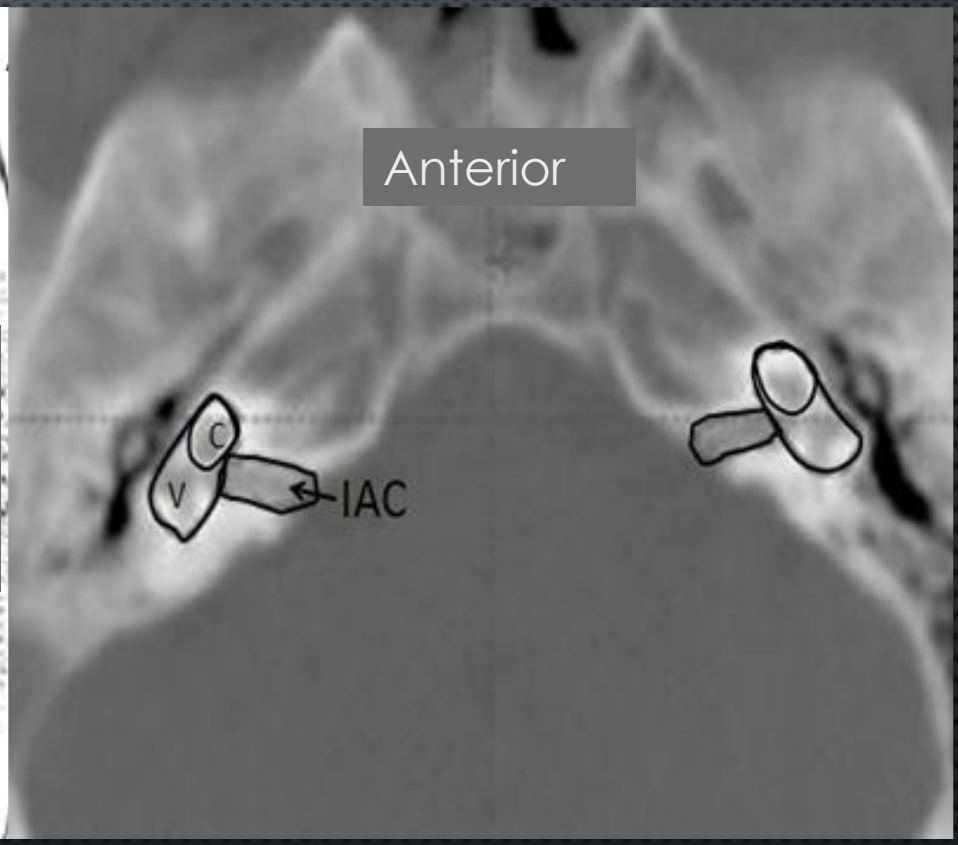


PRE TREATMENT PREPARATION

- AUDIOLOGICAL TESTS
  - PURE TONE AUDIOMETRY (PTA)
  - SPEECH DISCRIMINATION SCORE (SDS)
- GRADED USING GARDNER ROBERTSON GRADING SYSTEM
  - SERVICEABLE HEARING: PTA<50DB/SDS>50%
- VII TH N FUNCTION: HOUSE –BRACKMAN SCORE
- PRE TREATMENT STEROID: CONTROVERSIAL
  - 40 MG MPS IV

IDENTIFYING COCHLEA





DOSE / CONSTRAINTS

- **PRESCRIPTION:12 TO 13 GY AT PERIPHERY OF TUMOR**
    - **45 GY TO 54 GY IN SRT**
- HIGHER DOSES (~16 GY) USED IN THE PAST ASSOCIATED WITH MORE NEUROTOXICITY AND HEARING LOSS
- VCN < 9 GY
- V TH, VIII TH CN > 16GY
- COCHLEA
    - 12 GY FOR SINGLE FR
    - 20 GY FOR 3FR X 6.67 GY
    - 27.5 GY FOR 5FR X 5.5 GY

      (ROBERT TIMMERMAN, SEM RAD ONC, 2008)
    - **35-45 GY FOR SRT**

WHEN TO CONSIDER SRT/FSRT?

- Very large tumors, more than 20cc
- Intracanalicular extensions
- Midbrain compression
- Re treatment

SRS VS. FSRT

Series	Year	number	Hearing	CN VII	CN V
Combs et al	2009	SRS (30) FSRT 172	NR	17% 2%	7% 3%
Andrews et al	2001	SRS (69) SRT (56)	33% 65.4%	2% 2%	5% 7%
Meijer Et al	2003	SRS (49) HFSRT (80)	75% 61%	7% 3%	8% 2%
Anderson Et al	2007	SRS (49) SRT (20) HFSRT (32)	33.3% 65.4%	2% 2%	10.2% 0%

Authors &Year	N	Dose	Local Control	Useful Hearing	VII Injury	V Injury
Varlotto, et al., 1996	12	54	100	100	-	8
Lederman, et al., 1997	38	20	100	-	0	0
Kalapurakal, et al., 1999	19	30-36	100	-	0	0
Fuss, et al., 2000	42	57.6	95	100	0	4
Shirato, et al., 2000	50	36-44	86	-	5	12
Andrews, et al., 2001	56	50	97	81	2	7
Szumacher, et al., 2002	39	50	95	68	5	5
Williams, 2002	111	25	100	70	0	1
Meijer, et al., 2003	80	20-25	94	61	3	2
Sawamura, et al., 2003	101	40-50	91	71.7	4.9	18
Seltch, et al., 2004	48	54	100	92.5	2.2	2.1

VESTIBULAR SCHWANNOMA GUIDELINES

2017

Congress of Neurological Surgeons Systematic Review and Evidence-Based Guidelines on the Role of Radiosurgery and Radiation Therapy in the Management of Patients With Vestibular Schwannomas

Isabelle M. Germano, MD*
Jason Sheehan, MD, PhD‡
Johnathan Parish, MD§
Tyler Atkins, MD§
Anthony Asher, MD¶
Constantinos G. Hadjipanayis, MD, Ph.D*
Stua
Sher
Jeffr

RADIOSURGERY TECHNIQUE

Question: Is there a difference in outcome based on the dose delivered?

Recommendation: Level 3: As there is no difference in radiographic control using different doses, it is recommended that for single fraction SRS doses, <13 Gy be used to facilitate hearing preservation and minimize new onset or worsening of preexisting cranial nerve deficits.

Question: Is there a difference in outcome based on the number of fractions?

Recommendation: As there is no difference in radiographic control and clinical outcome using single or multiple fractions, no recommendations can be given.

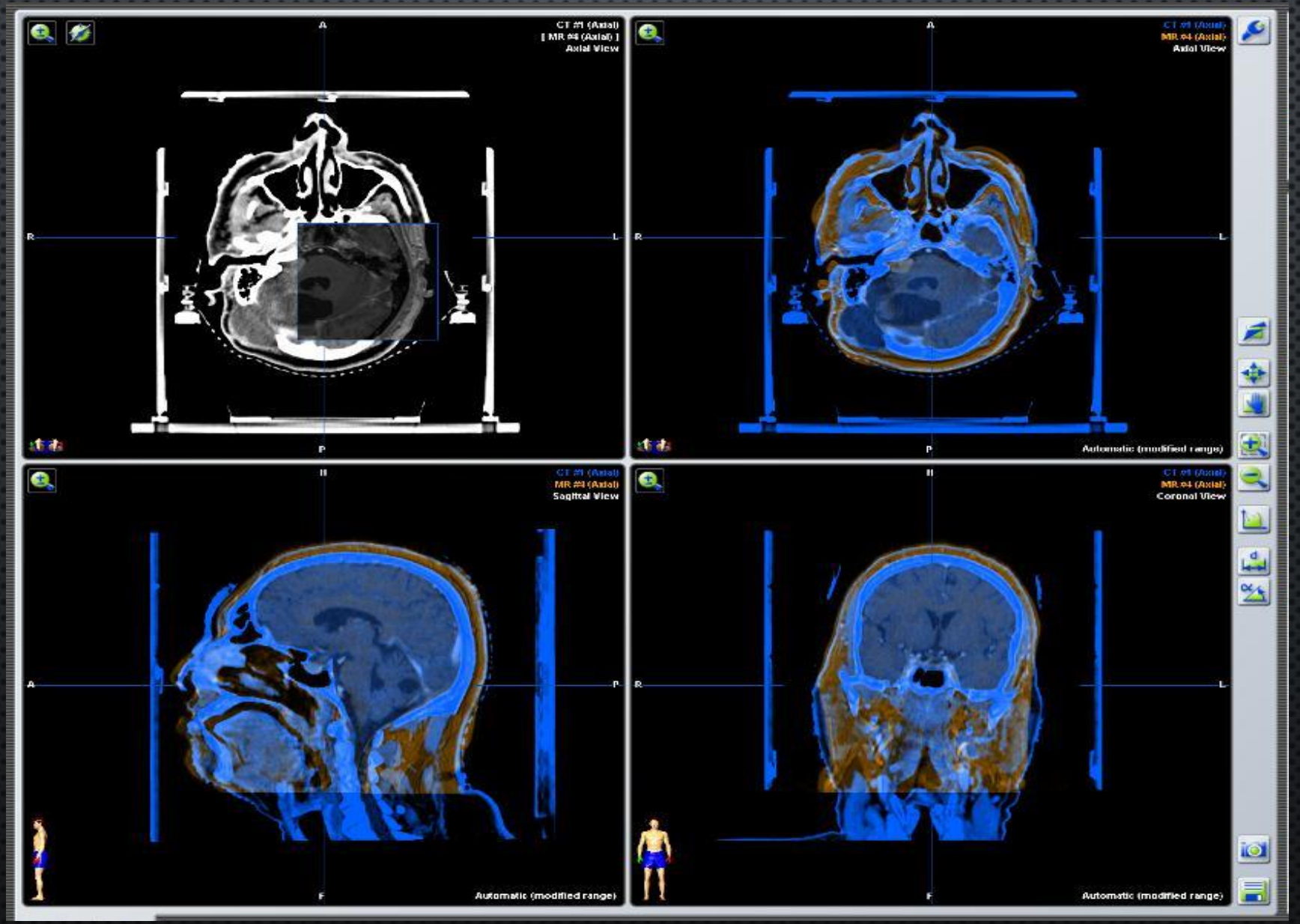
GENERAL CONSIDERATIONS FOR SRS/ SRT

STEPS OF TREATMENT

- Immobilization (Mask / Frame)
- MRI & CT Fusion
- Contouring of Target and OAR
- Planning :
  - Static Conformal
  - IMRS
  - Dynamic Arc
  - Hybrid

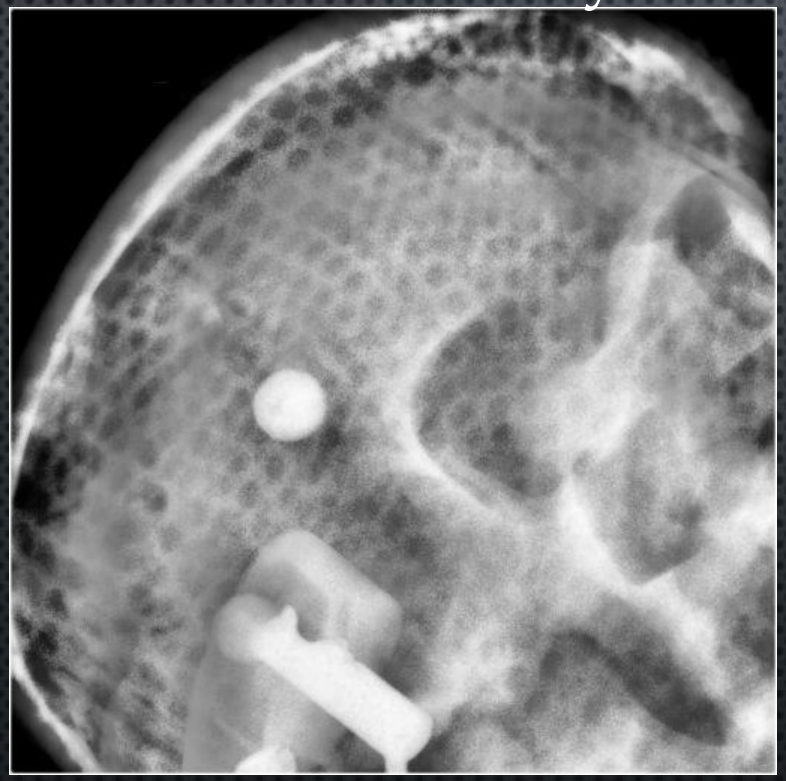
Frame/Mask Preparation

Image Fusion

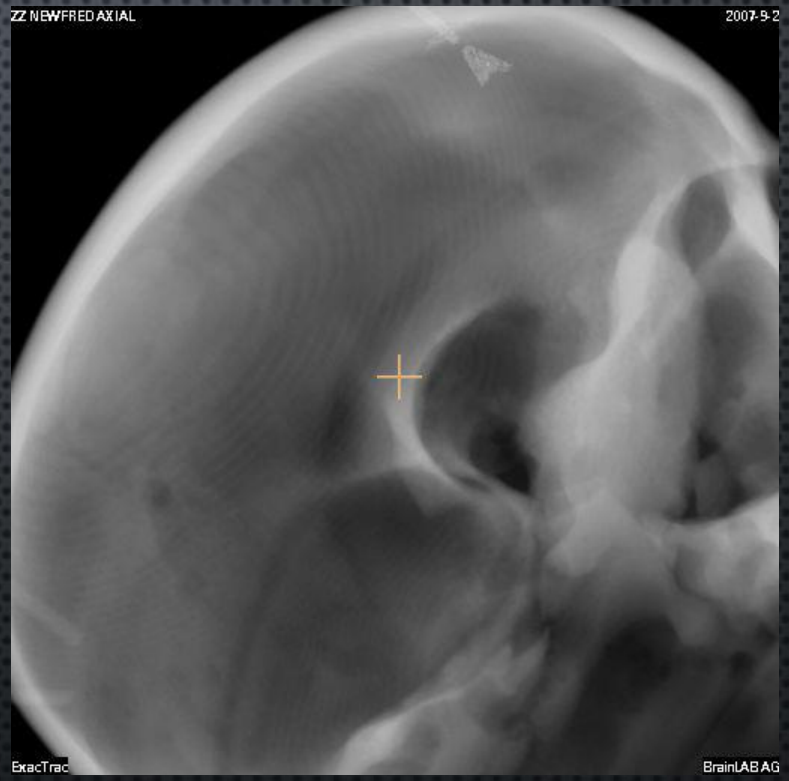


Fusion of 2 sets of oblique images

Exactrac X Ray



DRR



ExacTrac images are fused to the digitally reconstructed radiograph from the treatment planning CT scan.

- Benign tumours of brain have long latency and indolent history
- Surgery, whenever feasible should be considered
- Post operative radiotherapy is considered for incompletely resected, high grade, recurrent and inoperable lesions
- Conformal techniques like SRT is encouraged
- SRS is having excellent outcomes
- Technical and clinical learning curve of SRS is to be considered.


ASSOCIATION OF RADIATION ONCOLOGISTS OF INDIA
तमसो मा ज्योतिर्गमय


AIG
HOSPITALS

THANKS