



Radiosurgery for Benign Brain Tumors

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Accuray Disclaimers and Disclosure

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The Stanford stereotactic radiosurgery experience on 7000 patients over 2 decades (1999–2018): looking far beyond the scalpel

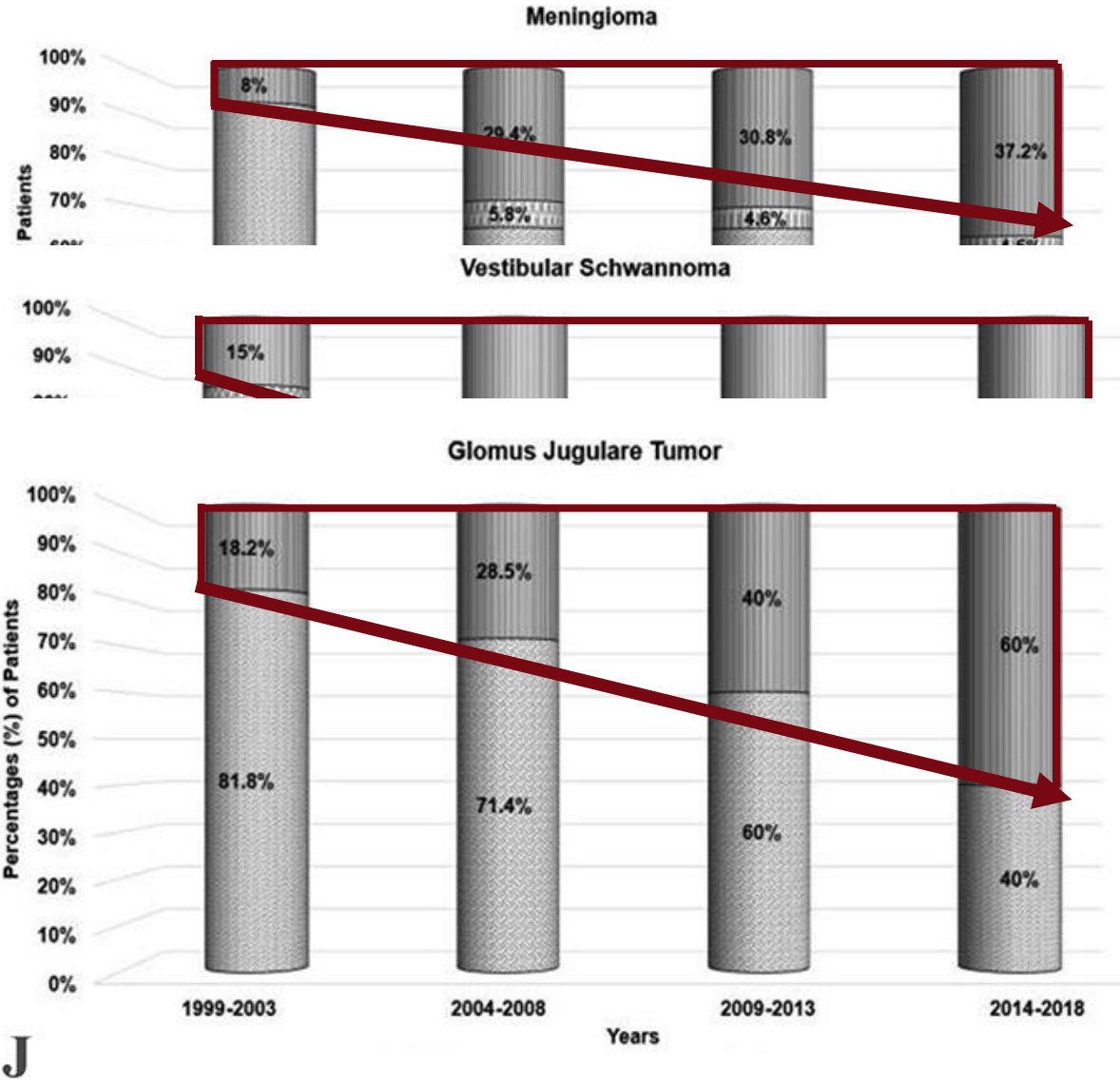
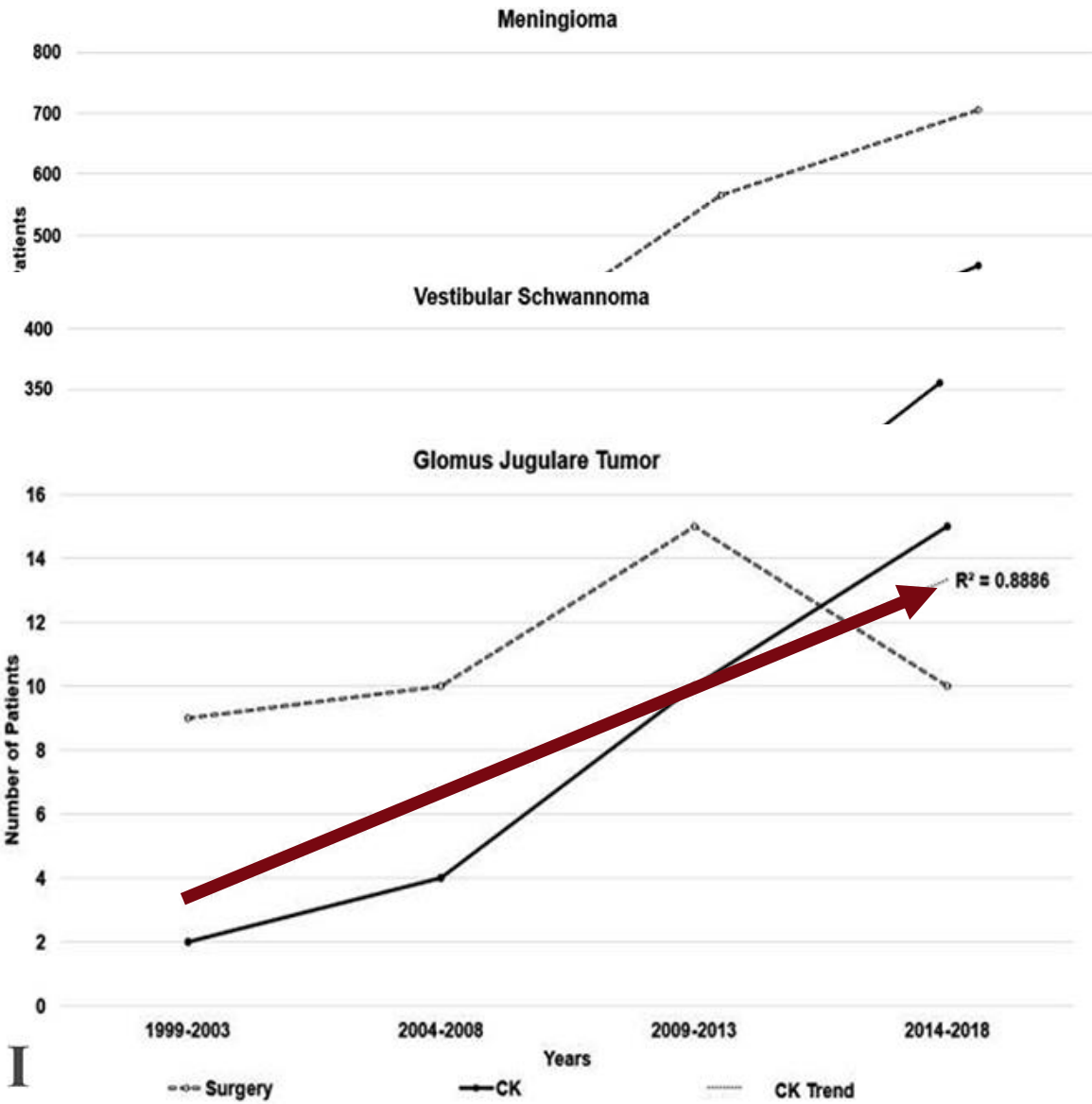
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- Stanford Data, Jan 1999 – Dec 2018 (2 decades)
- Over 7000 patients treated with CyberKnife®
- **Benign brain tumors** (meningiomas, vestibular schwannomas, glomus jugulare tumors, non-vestibular schwannomas, chordomas, hemangioblastomas, ependymomas)
- AVMs (intracranial and spinal cord AVMs)
- Malignant tumors (brain and spine metastases, chondrosarcomas, and glioblastomas)
- Resection cavities of brain metastases
- Trigeminal neuralgia

+ Literature review
: 31 articles for quantitative review
: 40 articles for qualitative review

Benign tumors



Benign tumors

TABLE 3. Characteristics of all included study cohorts with benign intracranial tumors

Authors & Year	No. of Pts	Indication	Target Vol in cm ³ (range)	Median Prescribed Dose in Gy (range)	Conformity Index (range)	Isodose Line in % (range)	No. of Fx (range)	Median FU in Mos (range)	Tumor Size at Last FU (no., %)	Local Tumor Control (%)	Symptomatic Control (no., %)	Complication (no., %)	OS	PFS
Glomus jugulare tumor														
Lim et al., 2003 ²⁷	9	Glomus jugulare tumor	2.4 (1.2–3.6)	(16–25)	NA	80	(1–3)	26	TD: 1 (25), TS: 3 (75), TI: 0 (0)	100	CI: 2/2* (100), CS: 0 (0), CD: 0 (0)	None	NA	NA
Lim et al., 2004 ²⁸	13	Glomus jugulare tumor	3 (1.2–6.2)	(14–27)	NA	80	(1–3)	41 (4–172)	TD/TS: 16 (100)	100	CI/CS: 12 (92.3), CD: 1 (7.6)	Transient ipsilateral tongue weakness & hearing loss: 1 (7.7)	NA	NA
Lim et al., 2007 ⁴⁷	21	Glomus jugulare tumor	3.04 (1.2–6.2)	(14–27)	NA	79 (72–90)	(1–3)	66	TD: 6 (37.5), TS: 10 (62.5)	100	CS: 19 (90.4), CD: 2 (9.5)	Transient worsening: 3 (14.2)	NA	NA
Meningioma														
Pham et al., 2004 ¹⁹	34	Periopic tumors: meningiomas (n = 20) & pituitary adenomas (n = 14)	9.6	20 (15–30)	NA	71 (67–95)	(2–5)	29 (15–62)	TD/TS: 32 (94.1), TI: 2 (5.8)	100	CI: 10* (29.4), CS: 20* (58.8), CD: 3* (8.8)	Transient nausea: 5 (14.7), transient emesis: 3 (8.8), transient blurred vision & diplopia: 1 (2.9), visual deterioration: 2 (5.8)	NA	91%
Adler et al., 2006 ²⁰	49	Periopic tumors: meningioma (n = 27), pituitary adenoma (n = 19), craniopharyngioma (n = 2), mixed germ cell tumor (n = 1)	7.7 (1.2–42)	20.3 (15–30)	1.20 (0.66–1.67)	80 (70–95)	(2–5)	49 (6–96)	TD: 31 (63.2), TS: 15 (30.6), TI: 3 (6.1)	94	CI: 8 (16.3), CS: 38 (77.5), CD: 3 (6.1)	Transient diplopia or headache	90%	NA
Cheshier et al., 2007 ²¹	35	Foramen magnum tumors: 25 benign (9 meningiomas, 5 schwannomas, 4 neurofibromas, 3 hemangioblastomas, 2 ependymomas, 1 chordoma, & 1 pilocytic astrocytoma) & 10 malignant (9 mets & 1 chondrosarcoma)	15.2 (5.48–30.2)	20.3	NA	77 (65–90)	(1–5)	15.4 (2–48)	TD: 10/23 (43.4), TS: 9/23 (39.1), TI: 4/23 (17.4)	82.6	CI: 7/23* (30.4), CS: 11/23* (47.8), CD: 6/23* (26)	Temporary emesis: 1 (2.8), cystic enlargement: 1 (2.8), radiation necrosis: 2 (5.7)	69%	NA

Benign tumors

TABLE 3. Characteristics of all included study cohorts with benign intracranial tumors

Authors & Year	No. of Pts	Indication	Target Vol in cm ³ (range)	Median Prescribed Dose in Gy (range)	Conformity Index (range)	Isodose Line in % (range)	No. of Fx (range)	Median FU in Mos (range)	Tumor Size at Last FU (no., %)	Local Tumor Control (%)	Symptomatic Control (no., %)	Complication (no., %)	OS	PFS
Meningioma (continued)														
Patil et al., 2008 ²²	102	Supratentorial meningiomas	NA	18.0 (11.3–25.0)	NA	NA	(1–5)	20.9 (6–77)	NA	NA	Symptomatic edema: 15 (14.7)	NA	NA	NA
Tuniz et al., 2009 ²³	34	Benign large (>15 cm ³) cranial base tumors: meningioma (n = 21), schwannoma (n = 9), glomus jugulare (n = 4)	19.3 (15.8–69.3)	24 (18–25)	1.24 (1.04–1.90)	78 (67–83)	(2–5)	31 (12–77)	TD: 15 (44.1), TS: 19 (55.8), TI: 0 (0)	100	CI: 7 (21), CS: 23 (67.6), CD: 2 (5.8)	Transient neurological deficit: 4 (11.7); no permanent toxicity	94%	NA
Choi et al., 2010 ²⁴	25	Atypical (WHO grade II) cranial meningioma w/ prior resection	5.3 (0.3–26.0)	21 (16–30)	NA	80 (62–91)	(1–4)	28 (3–67)	TD/TS: 13	54	CI/CS: 23 (92)	Radiation toxicity: 2 (8.0)	90%	NA
Fatima et al., 2020 ²⁵	74	Large intracranial benign tumor (≥14.2 cm ³ or ≥3 cm in max dimension)	16.0 (10.1–65.5)	14.8 (11.3–18.0)	1.25	77 (60–84.9)	(1–5)	32.8 (0.6–125.9)	TD/TS: 71 (95.9), TI: 3 (4.1)	91.7	CI/CS: 71 (95.9), CD: 3 (4.1)	Radiation toxicity: 6 (8.2)	93.2%	NA
Vestibular schwannoma														
Chang et al., 2005 ⁴⁸	61	Unilat acoustic neuroma	1.85 mm (0.5–3.2)	NA	NA	NA	NA	48	TD: 29 (47.5), TS: 31 (50.8), TI: 1 (1.6)	98	CI: 2/46* (4.3), CS: 46/48* (95.8), CD: 0 (0)	Transient facial nerve twitching: 2 (3.3)	NA	NA
Dodd et al., 2006 ⁴⁹	51	Benign intradural extramedullary spinal tumors: schwannoma (n = 30), meningioma (n = 16), neurofibroma (n = 9)	2.18 (0.13–24.6)	(16–30)	NA	80	(1–5)	36	TD: 21 (38.1), TS: 33 (60), TI: 1 (1.8)	98.1	CI/CS: 51 (100)	None	61%	NA
Hansa-suta et al., 2011 ²⁶	383	Vestibular schwannoma	1.1 (0.02–19.8)	16 (12–24)	NA	80 (65–95)	(1–5)	43.2 (12–120)	TD/TS: 373 (97), TI: 10 (3)	96	CS: 151/200 (76)	Complications: 19 (5)	NA	NA
Teo et al., 2016 ⁵⁰	30	Large vestibular schwannomas (Koos grade IV & max diameter >3 cm)	3.4 (3.0–5.2)	18 (18–25)	1.13 (1.04–1.29)	80 (71–90)	3 (3–5)	97	TD/TS: 24 (80), TI: 6 (20)	80	CI/CS: 25 (83.3), CD: 5 (16.7)	None	NA	At 1, 3, 5, & 10 yrs: 100%, 85%, 81%, & 80%



Stereotactic Radiosurgery for Large Benign Intracranial Tumors

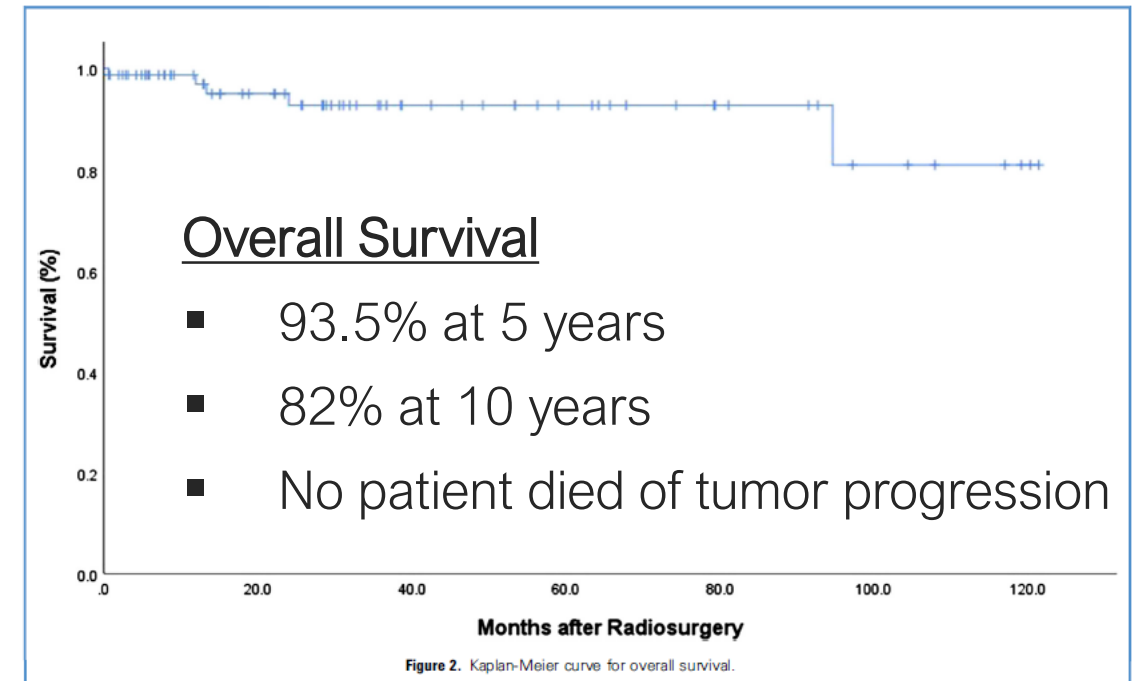
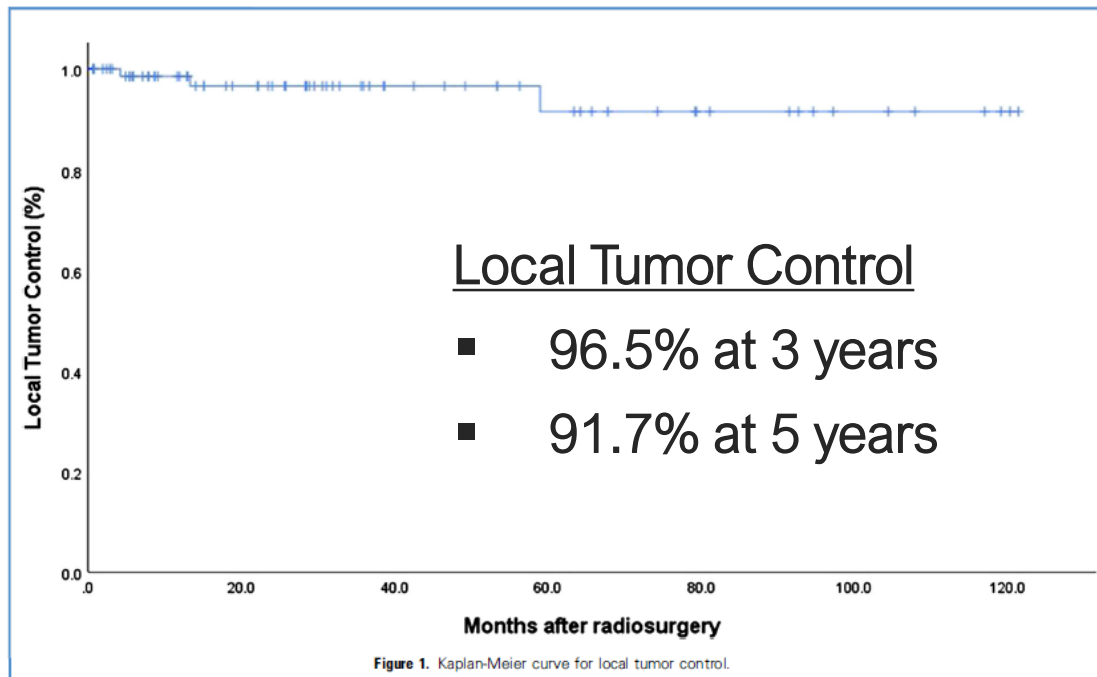
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WORLD NEUROSURGERY, [HTTPS://DOI.ORG/10.1016/J.WNEU.2019.10.005](https://doi.org/10.1016/j.wneu.2019.10.005)

World Neurosurg. (2020) 134:e172-e180.

- Retrospective single institution study
- Large = Tumor volume > 14 cm³: Equivalent to a 3-cm diameter sphere
- Total of 74 patients (2007-2018)
 - 59 Meningiomas
 - 9 Vestibular schwannomas
 - 6 Glomus jugulare tumors
- CyberKnife[®]
 - Definitive SRS: 47.3%
 - Adjuvant to surgical resection: 44.6%
 - Salvage after past radiation treatment: 8.1%

- Median tumor volume: 16.0 cm³ (range, 10.1-65.5 cm³)
- Median dose: 24.0 Gy (range, 14.0-30.0 Gy) in a median of 3 fractions
- Median SFED (with alpha/beta ratio of 3): 14.8 Gy (range, 11.3-18.0 Gy)
- Median clinical follow-up: 32.8 months (range, 0.6-125.9 months)
- Median radiographic follow-up: 28.5 months (range, 0.6-121.4 months)
- Adverse radiation effect: **13.5%** at a median of 13.5 months / No secondary malignancies

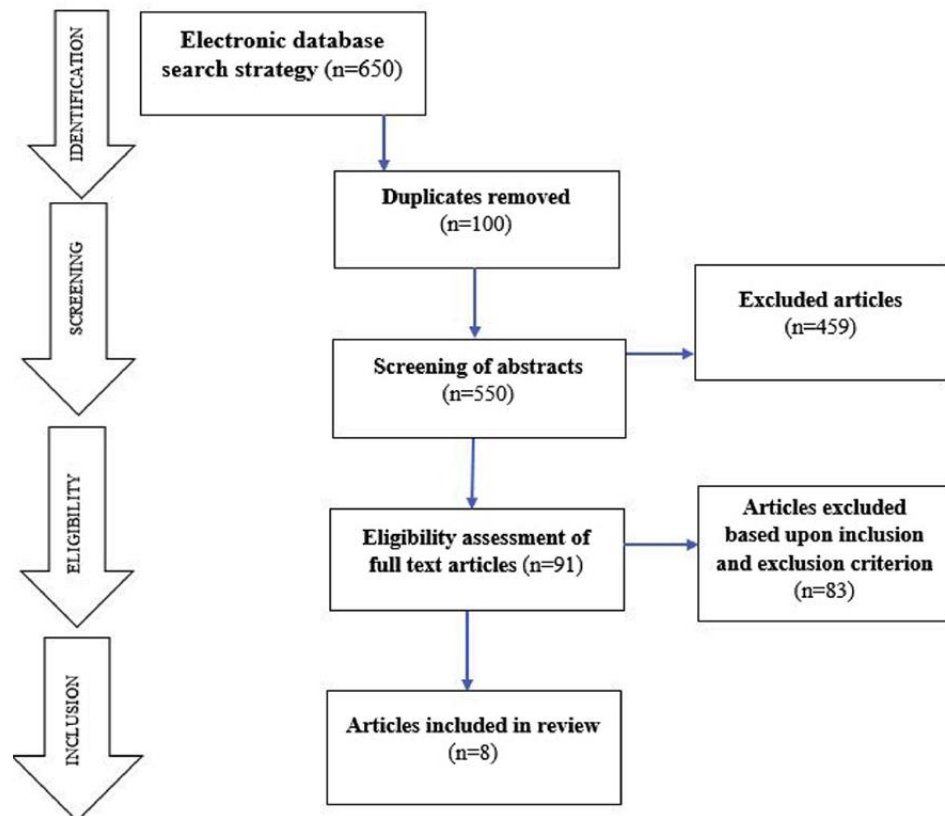


Stereotactic Radiosurgery in Large Intracranial Meningiomas: A Systematic Review

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WORLD NEUROSURGERY 129: 269-275, SEPTEMBER 2019

- Systematic review: A total of 8 articles (1999-2018)
- Large intracranial meningiomas ≥ 2.5 cm in maximum dimension (Tumor volume ≥ 8.1 cm³)



- 452 tumors in 496 patients, median age 60 years
- Local tumor control rate: 84~100%
over a median follow-up of 54 months
- Clinical improvement: 45.1%
Clinical deterioration: 15.7%
- Radiation-induced toxicity: 23%
 - Cranial nerve deficits: 5.5%
 - Peritumoral edema: 5.3%

Table 1. Baseline Characteristics of the Included Studies

Study	Number of Patients, <i>n</i>	Median Tumor Volume, cm ³	Median Treatment Volume, cm ³	SRS Technique	Location of the Tumor, <i>n</i>	Previous Surgery, <i>n</i>	Age, years (median)	Sex (M/F)	Median Follow-Up, months	Median dose, Gy	IDL	Clinically Improved	Declined	Tumor Control (Last FU)
Morito et al., 1999 ¹²	88 (44 tumors)	10 (2.3–30)*	NA	GKS	Skull based meningioma (100%)	49 (55.6%)	56.3 (20–83)	22/66	35 (12–83)	16 (12–20)	NA	NA	NA	92.9% (2 years)
Iwai et al., 2001 ⁶	7	Mean 53.5 (34.5–101)	6.8–29.6 (18.6)	2-staged GKS (6-mo interval)	Petroclival: 4 (57.1%) Cavernous sinus: 2 (28.57%) Petrocavernous: 1 (14.28)	3 (42.85%)	65 (47–79)	2/5	39 (24–72)	Mean (8–12)	50%	3 (42.8%)	1 (14.3%)	85.7%
Ganz et al., 2009 ¹⁰	97	Mean 15.9 (10–43.3)	NA	GKS	Supratentorial: 11 (11.3%) Skull base: 86 (88.6%)	NA	48.1 (20.4–87.2)	27/70	53 (25–86)	10.5 (6–11.5)	90%	94 (96.9%)	3 (3.1%)	100%
Haselberger et al., 2009 ¹¹	20	33.8 (13.6–79.8)	5.4–42.9	Staged GKS (1–2 mo. interval)	Cavernous sinus: 10 (50%) Petroclival: 9 (45%) Falco tentorial: 4 (20%) Sphenoidal wing: 6 (30%)	14 (70%)	60.5 (26–73)	6/14	90 (12–182)	12 (10–25)	45%	9 (45%)	7 (35%)	90% at 7.5 years
Bledsoe et al., 2009 ¹⁶	116	17.5 (10.1–48.6)	NA	GKS (single session)	Skull base: 91 (78.4%) Supratentorial: 25 (21.5%)	74(63.79%)	60 (20–84)	35/81	70.1 (12–199)	15.1 (12–18)	50%	14 (12%)	27 (23.3%)	92% (7-year)
Starke et al., 2015 ¹³	75	12.4 (8.1–54.8)	NA	GKS	Parasellar: 42 (56%) CPA: 10 (13.3%)	45 (60%)	55 (19–85)	24/51	78 (6–252)	13.5 ± 3.5 (4.8–30)	NA	16 (21.3%)	11 (14.6%)	84% at 6.5 years
Han et al., 2017 ¹⁵	70 SS (42) FGKS (28)	SS: 15.2 (10.3–48.3) FGKS: 21 (10.2–54.7)	NA	GKS Single session (SS) and fractionated (FGKS)	SS: Supratentorial: 18 (42.85%) Skull Base: 24 (57.14%) FGKS: Supratentorial: 12 (42.85%) Skull base: 16 (57.14%)	SS: 14 (33.33%) FGKS: 8 (28.57%)	64.5 (27–86)	24/46	SS: 57.8 (14.5–128.4) FGKS: 50 (12.5–90.6)	SS: 12 (8–14) FGKS: 7.5 in 2 fractions (5–8), 6 in 3 fractions (5–6) and 4.5 in 4 fractions	50%	SS: 28 (66.7%) FGKS: 26 (93%)	SS: 14 (33.3%) FGKS: 2 (7.1%)	SS: 88% FGKS: 92.8% 5 year
Park et al., 2018 ¹⁷	23	15.1 (10.09–71.42)	NA	GKS hypo fractionated	Middle†: 11 (47.82%) Posterior†: 12 (52.17%)	0 (0%)	65 (54–80)	6/17	38 (17–78)	18 (15–20)	NA	14 (61%)	6 (26%)	100%

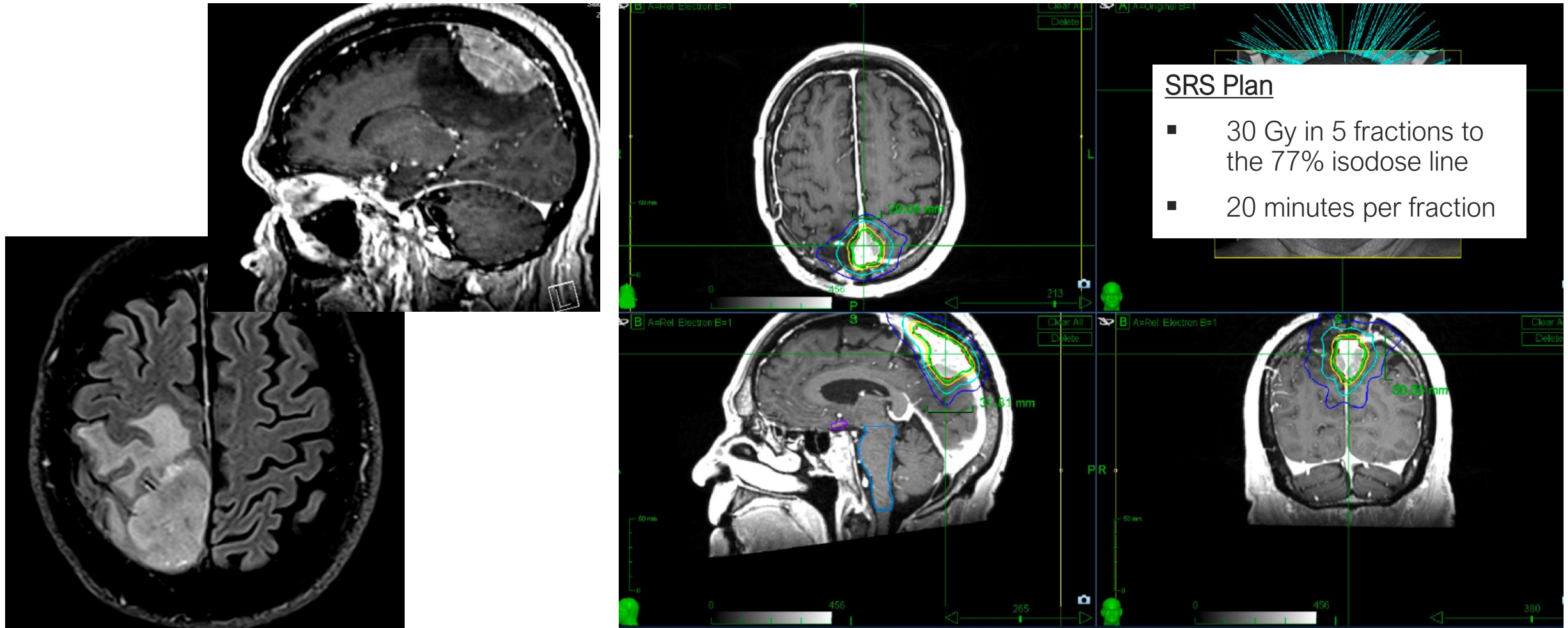
M, male; F, female; IDL, isodose line; FU, follow-up; NA, not available; GKS, Gamma Knife radiosurgery; CPA, cerebellopontine angle; FGKS, fractionated gamma knife radiosurgery; SS, single session.

*Only those tumors included with volume greater than 8.1 cm³.

†Middle: parasellar, sphenoid ridge and cavernous sinus; posterior means cerebellopontine angle, petroclival and tentorial.

Case (Meningioma)

- 75/M G1 meningioma R parietal s/p STR 2020 with growth in residual along superior sagittal sinus. CyberKnife[®] SRS, stable tumor as of 2024.



Tumor Control Following Stereotactic Radiosurgery in Patients with Vestibular Schwannomas – A Retrospective Cohort Study

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‡C. Eduardo Corrales, §Scott G. Soltys, *Chloe Santa Maria, ||Steven D. Chang,
*Nikolas H. Blevins, *Robert K. Jackler, and §Iris C. Gibbs

Otol Neurotol **42**:e1548–e1559, 2021.

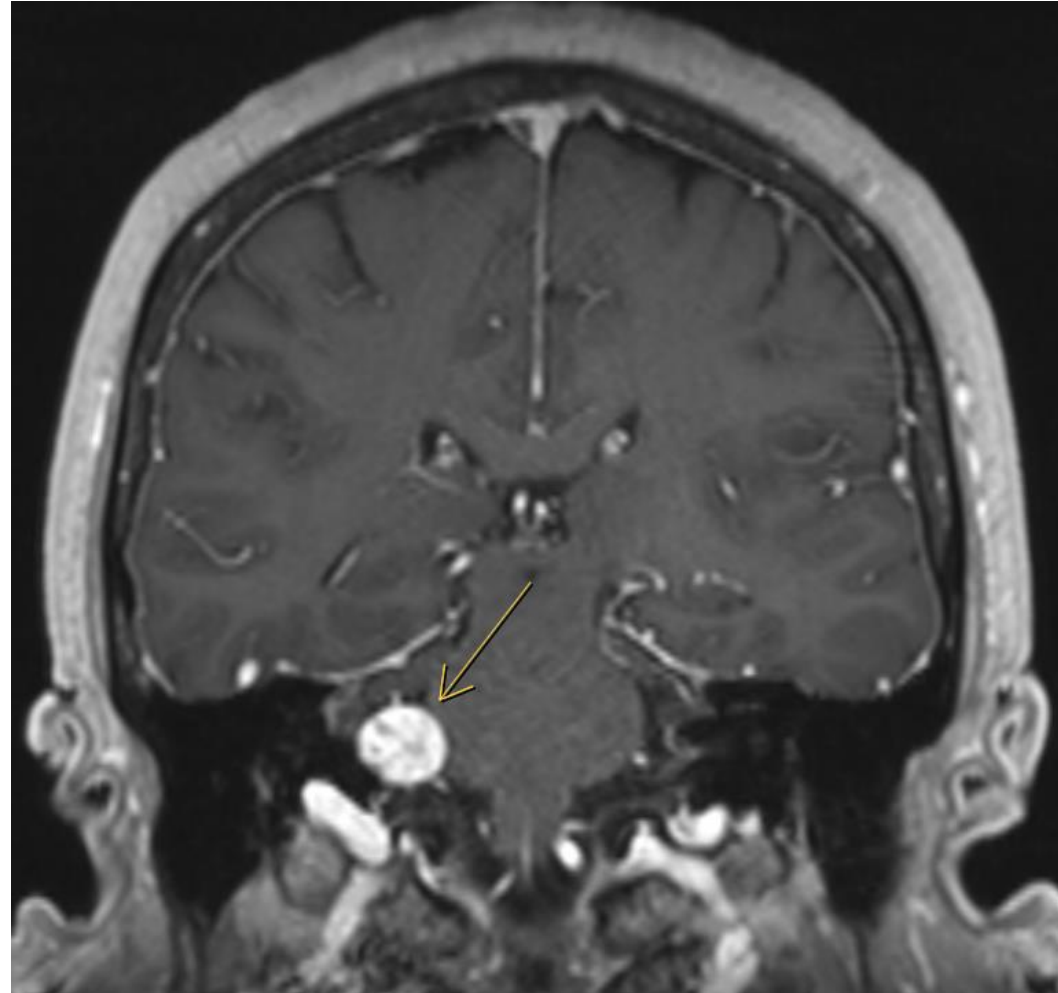
- Retrospective cohort study (1992~2013)
- 576 patients, 579 tumors, median follow-up of 4.6 years
- 88% primary SRS, 6.7% Salvage SRS
- Local tumor control: **89% control rate** at 3 years in sporadic VS
significantly lower (43%) in NF2-related tumors.
- Tumor control was inversely related to tumor size (maximum dimension) and documented pre-SRS growth.
- Complications: Facial nerve preservation in 100% of sporadic VS cases / trigeminal neuralgia or numbness (2%), new hemifacial spasm or blepharospasm (3%), and hydrocephalus requiring VP shunt (0.6%)

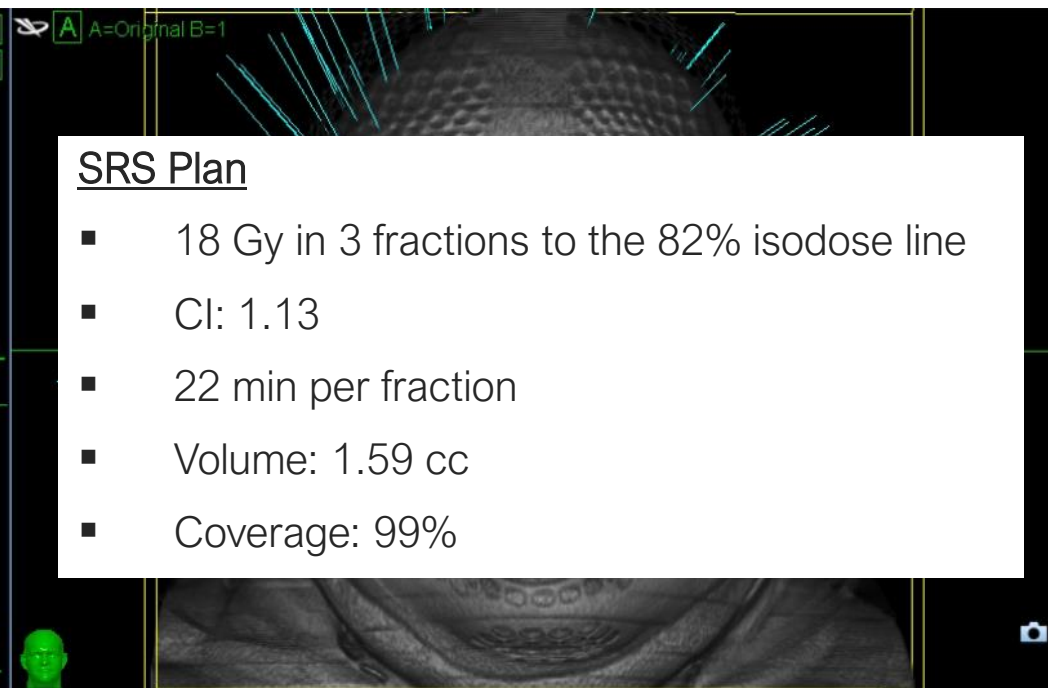
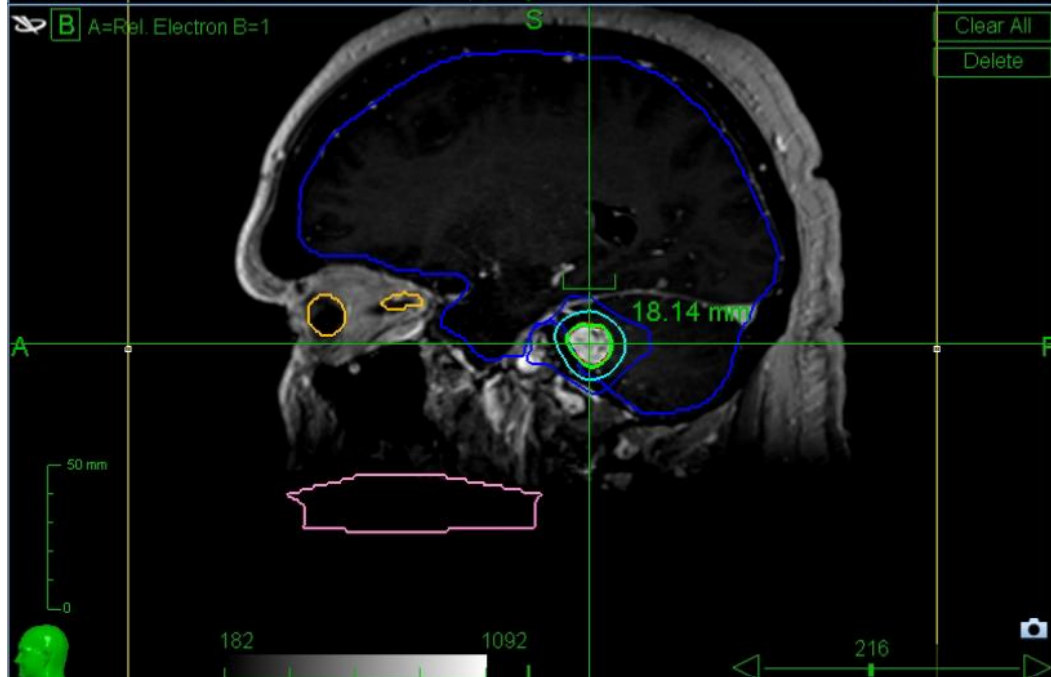
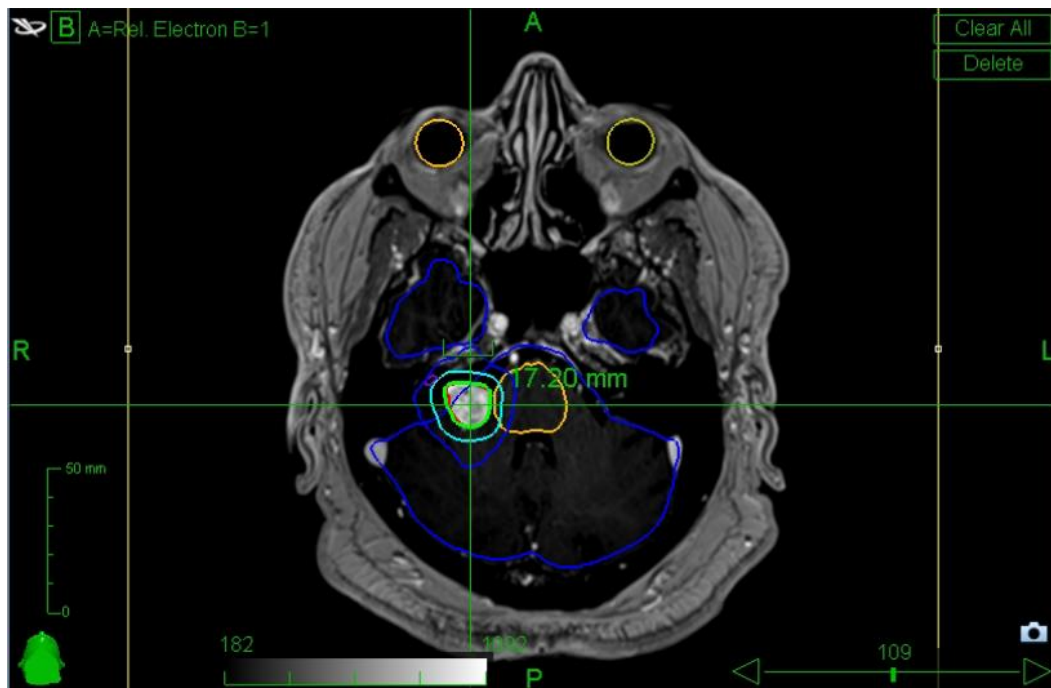
Variables	Bivariable Model	
	Hazard Ratio (95% CI)	<i>p</i>
Age	0.98 (0.96, 1.00)	0.067
Male gender	0.62 (0.37, 1.03)	0.065
NF2	3.85 (1.09, 7.80)	0.000
Pre-SRS growth	1.88 (1.13, 3.12)	0.014
Size in the CPA	1.00 (0.96, 1.05)	0.967
Target volume	1.07 (1.00, 1.14)	0.069
Maximum dimension	1.05 (1.02, 1.09)	0.001
Total radiation dose < 1800	1.82 (0.80, 4.17)	0.156
Total radiation dose > 1800	3.08 (1.49, 6.37)	0.002
SFED3 > 11.32	0.88 (0.29, 8.94)	0.003
Salvage radiation	2.64 (1.33, 5.26)	0.006
Primary SRS	0.43 (0.24, 0.77)	0.005
Adjuvant SRS	1.96 (0.62, 6.18)	0.254

- Our bivariable survival data analysis showed that
 - Neurofibromatosis type II,
 - documented pre-SRS growth,
 - tumor measured by maximum dimension,
 - SRS given as nonprimary treatment
 increased hazard of failure to control.

Case (Vestibular Schwannoma)

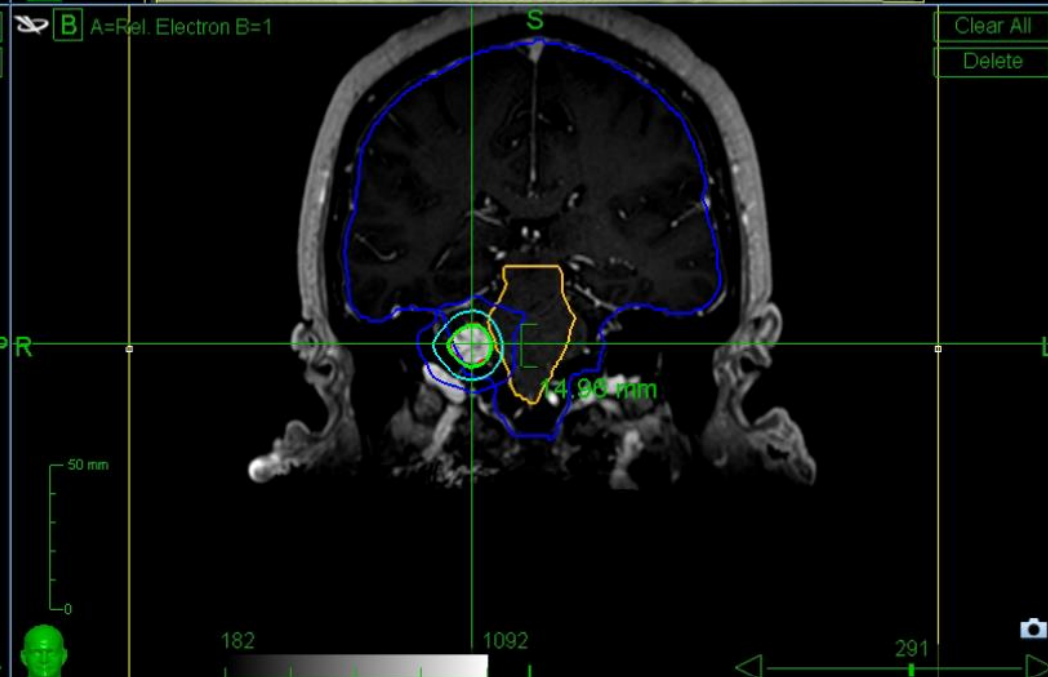
- 60/M, Koos 3 right VS (serviceable but decreased hearing)



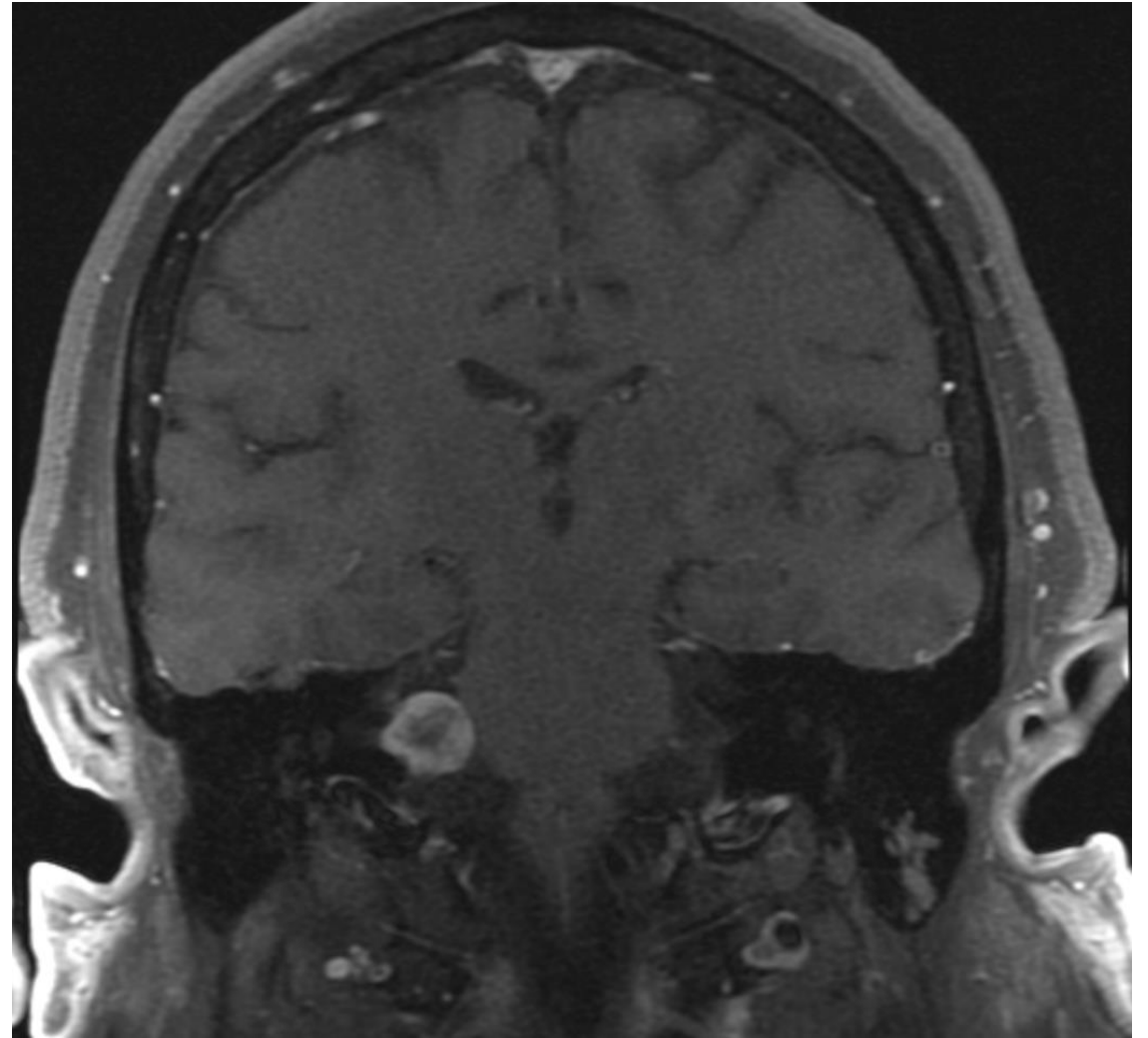
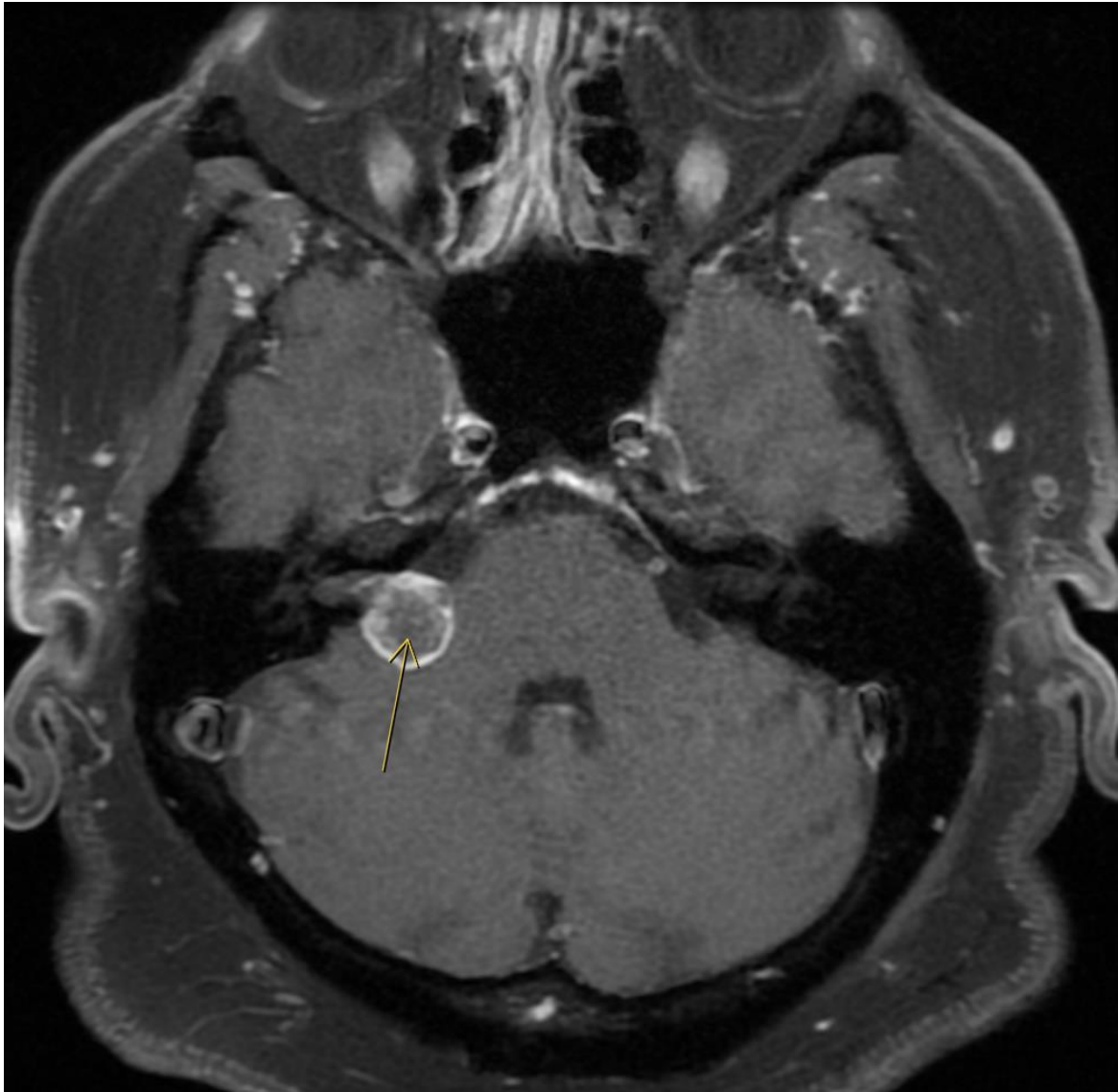


SRS Plan

- 18 Gy in 3 fractions to the 82% isodose line
- CI: 1.13
- 22 min per fraction
- Volume: 1.59 cc
- Coverage: 99%



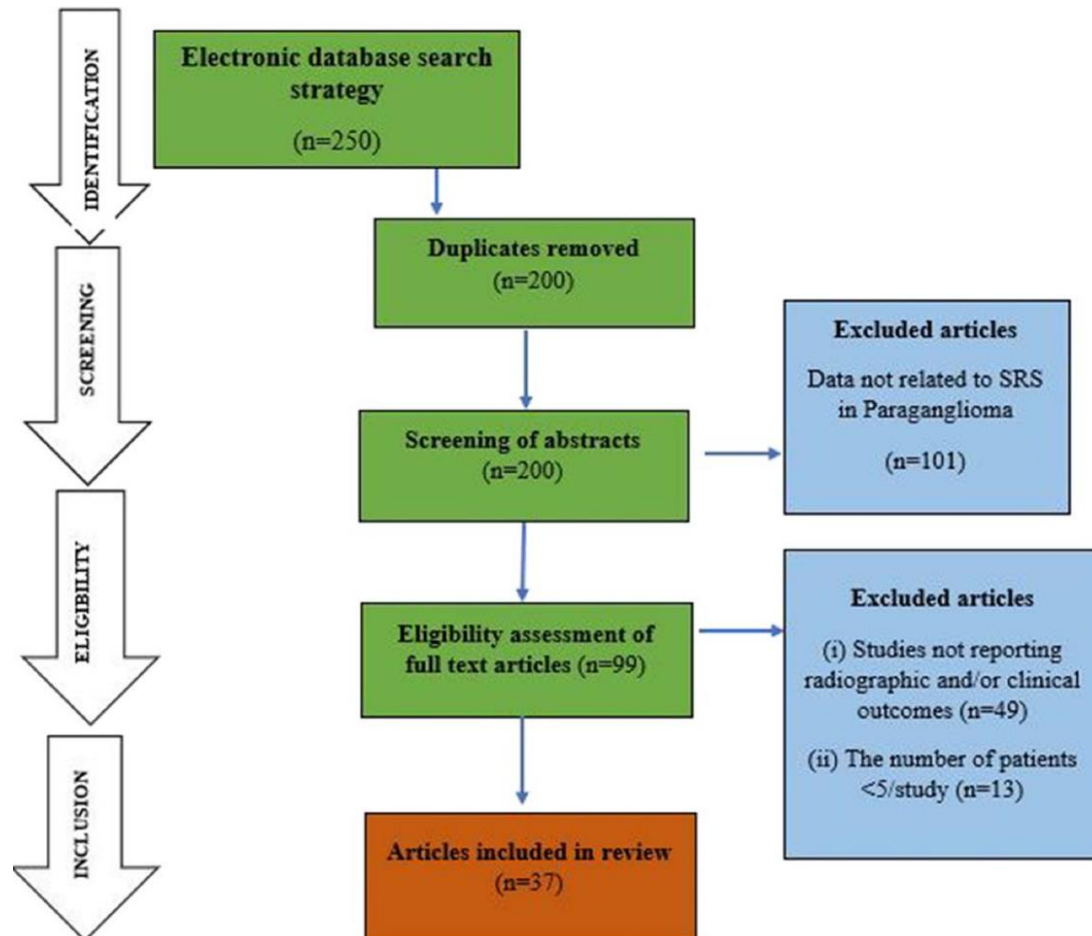
- 6-month follow-up: Hearing well preserved. No other symptoms



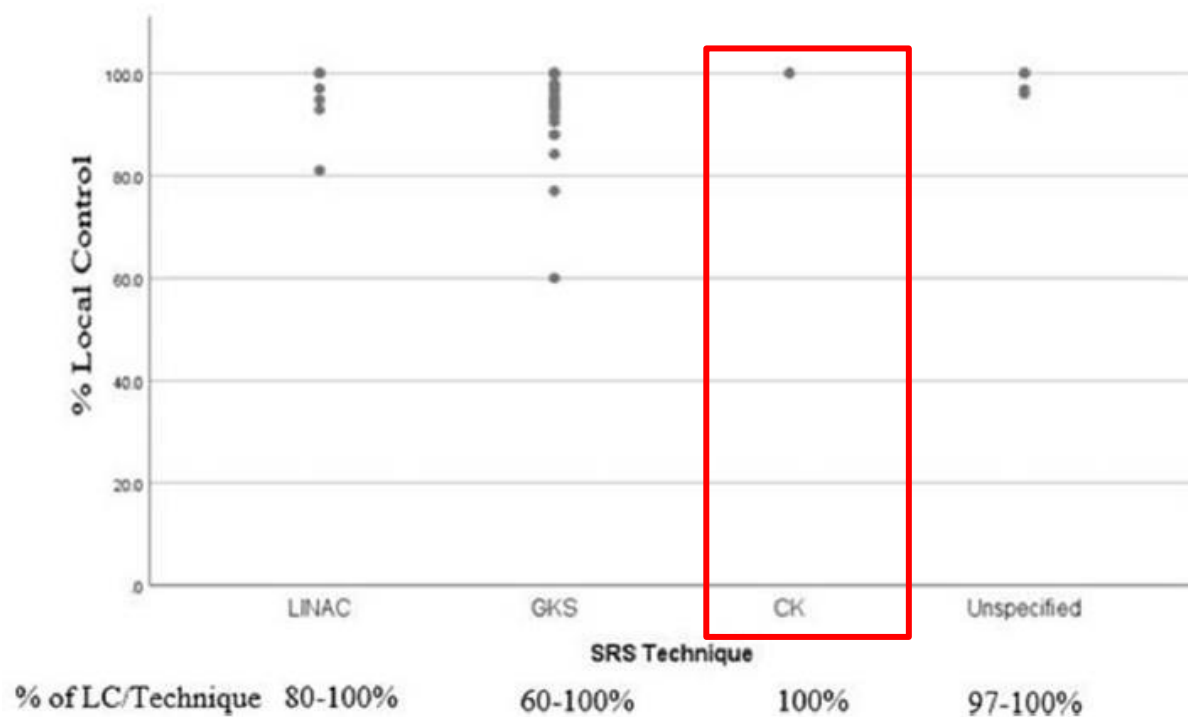
Stereotactic radiosurgery for head and neck paragangliomas: a systematic review and meta-analysis

Nida Fatima¹ • Erqi Pollom² • Scott Soltys² • Steven D. Chang¹ • Antonio Meola¹

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<https://doi.org/10.1007/s10143-020-01292-5>



- Meta-analysis of 37 studies
- 1,117 patients with 1,144 tumors.
- Tumor Types:
 - Glomus jugulare (87%)
 - Glomus tympanicum (8.2%)
 - Carotid body (2.4%)
 - Glomus vagale (1.4%)
- Local tumor control: **94.2%** with median follow-up of 44 months.



Symptoms	GKS		LINAC		CYBER KNIFE	
	Transient	Permanent	Transient	Permanent	Transient	Permanent
Total (% of cases treated with each SRS modality)	46 (6.7)	21 (3.0)	13 (4.8)	2 (0.7)	7 (4.2)	1 (0.1)
Nausea and vomiting	1 (2.1)	0 (0)	6 (46.2)	0 (0)	0 (0)	0 (0)
Trigeminal neuralgia	3 (6.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
VII nerve palsy	5 (10.8)	4 (19)	5 (38.5)	1 (50)	0 (0)	0 (0)
Hearing loss	1 (2.1)	9 (42.8)	0 (0)	1 (50)	0 (0)	0 (0)
Dizziness and vertigo	12 (26)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
X nerve palsy	3 (6.5)	4 (19)	0 (0)	0 (0)	0 (0)	0 (0)
XII nerve palsy	2 (4.3)	0 (0)	2 (15.3)	0 (0)	0 (0)	0 (0)
Unspecified	15 (32.6)	0 (0)	0 (0)	0 (0)	7 (100)	1 (100)

- No significant difference in LC and adverse events between SRS techniques (Gamma Knife, LINAC, CyberKnife®).

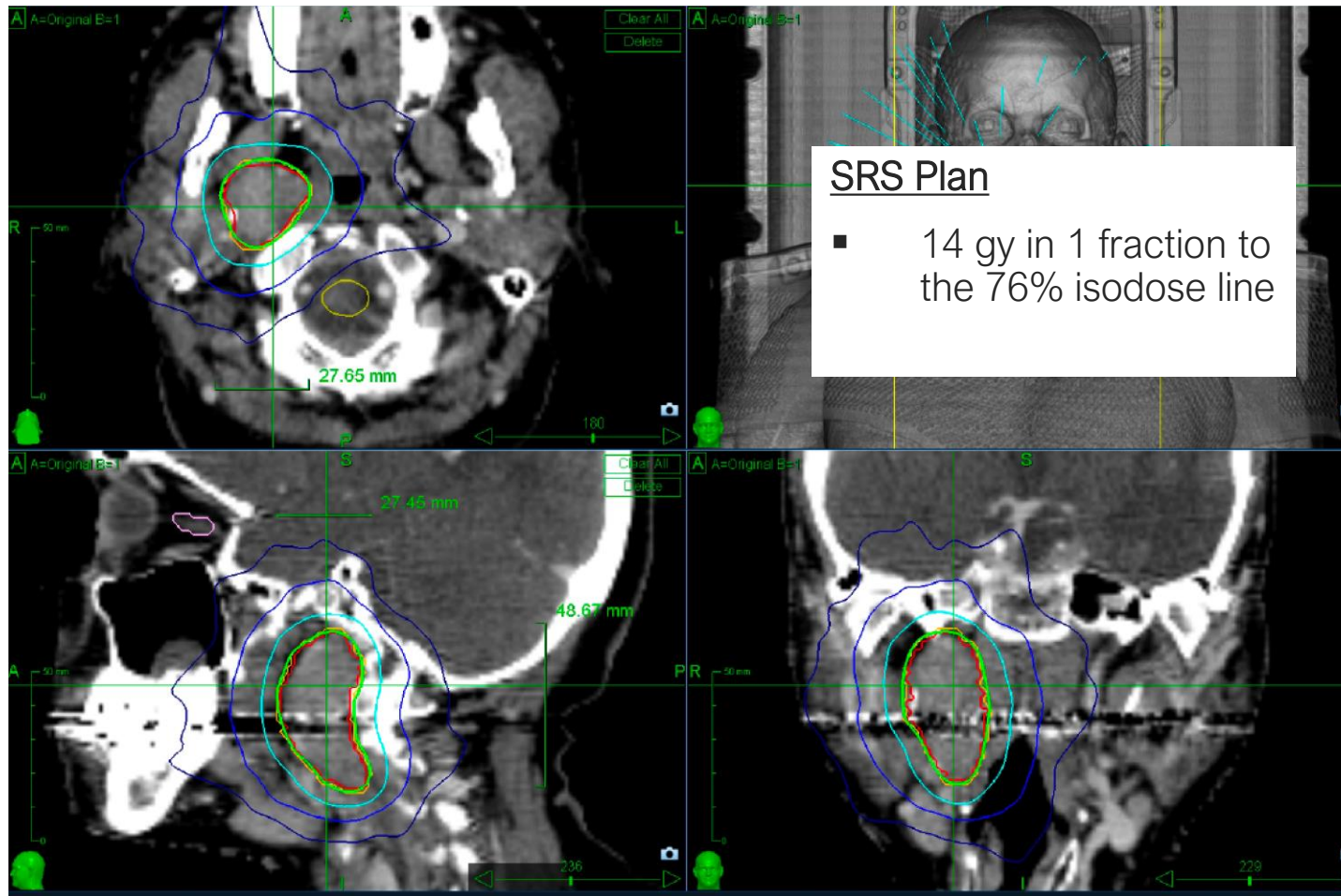
Table 3 Correlation between variables and tumor control using Spearman's coefficient correlation

Variables	Tumor control	
	<i>r</i>	<i>p</i>
Age	− 0.19	0.1
Sex		
Male	− 0.3	0.08
Female	− 0.4	0.001
Site of tumor		
Right	− 0.3	0.03
Left	− 0.2	0.05
SRS		
Primary	− 0.5	< 0.001
Secondary	− 0.3	0.04
Presenting symptoms		
Hearing loss	− 0.4	0.001
Pulsatile tinnitus	− 0.3	0.009
Lower CN palsy	− 0.2	0.09
Median tumor volume (cm ³)	− 0.1	0.2
Median dose (Gy)	0.1	0.4

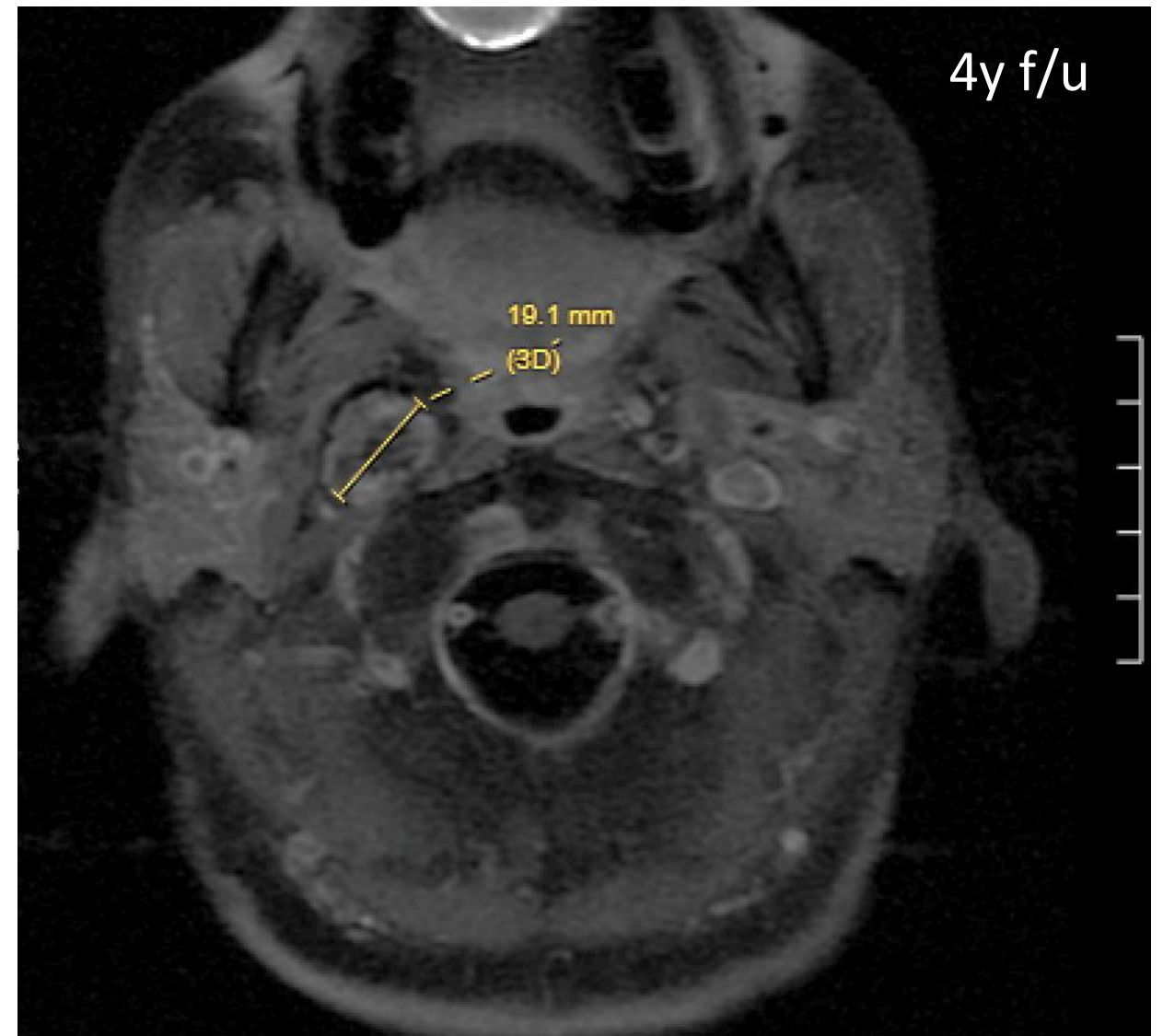
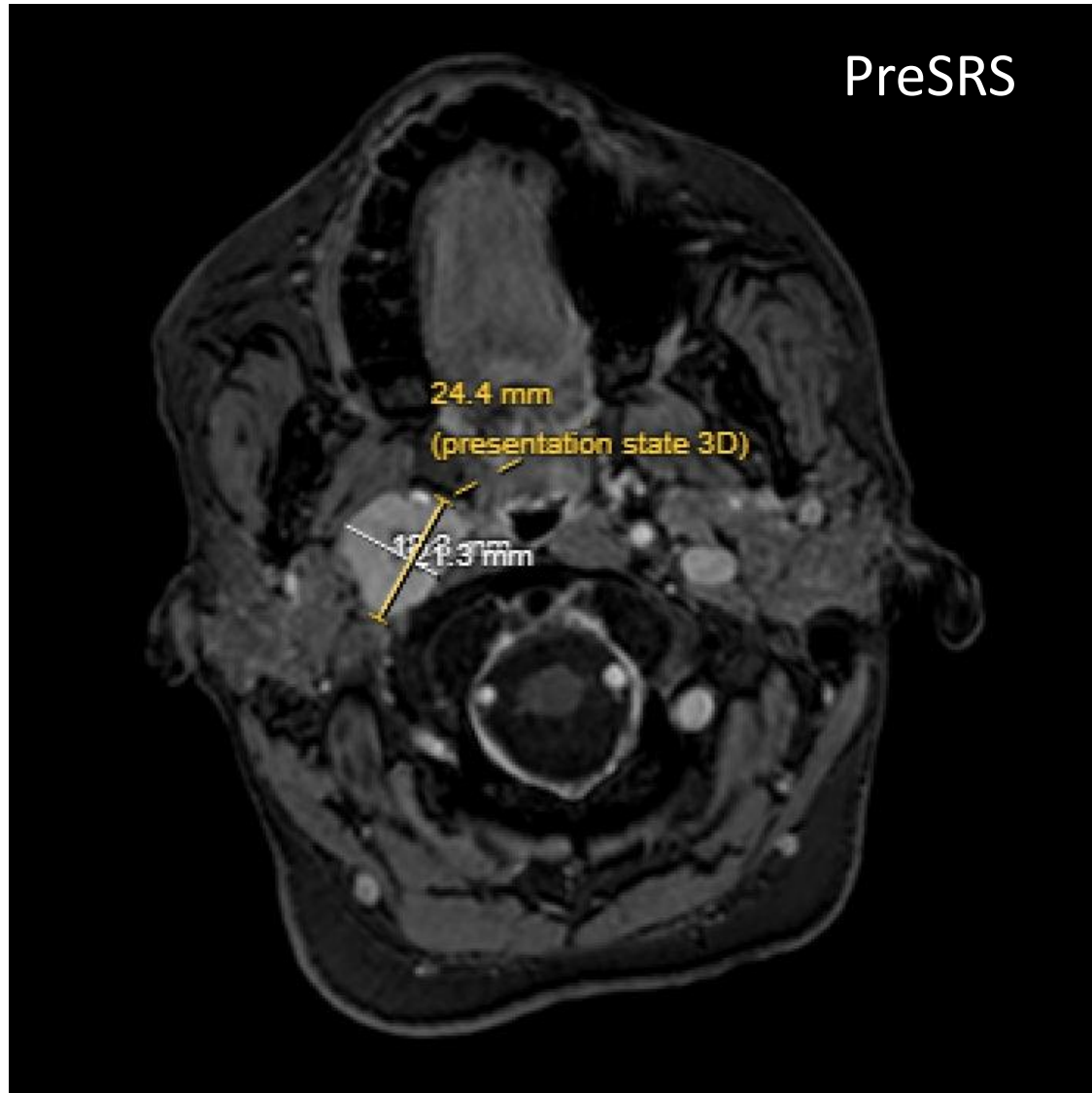
- Initial clinical presentation with hearing loss, female gender, right-sided tumors, and primary SRS were associated with lesser LC.

Case (Paraganglioma)


- 67/F paraganglioma in R carotid body C1-2 with growth (Asx), SRS 2019.
+ Hx of small AVM p/w/with hemorrhage s/p SRS 2005 and complete obliteration on angiogram.



- 4-year follow-up: Decreased in size with internal necrosis. No toxicity



Stereotactic Radiosurgery for Cranial and Spinal Hemangioblastomas: A Single-Institution Retrospective Series

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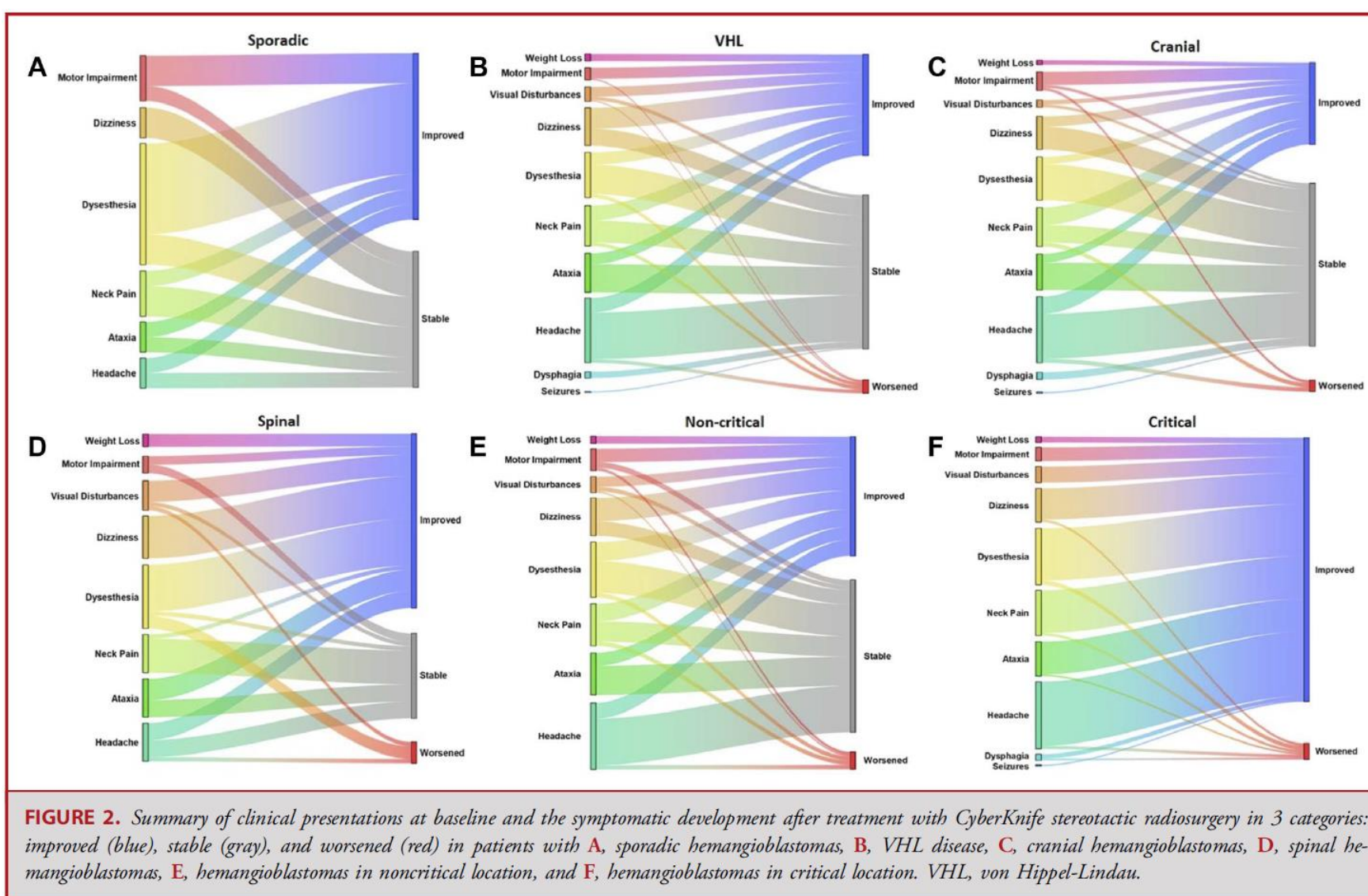
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- Single-institution retrospective series
- 135 hemangioblastomas in 35 patients (1998~2022)
 - VHL associated: 28 patients with 123 hemangioblastomas
 - Sporadic: 7 patients with 12 hemangioblastoma
- Median age: 36 years
- Median tumor volume: 0.4 cc
- CyberKnife® SRS
 - Median SFED of 18 Gy
 - 77% median isodose line

TABLE 2. Summary of Patient Outcomes

Variables	Entire series	Sporadic	VHL	Statistical significance (P value ^a)	Cranial	Spinal	Statistical significance (P value ^a)	Noncritical	Critical ^b	Statistical significance (P value ^a)
LTC										.32
5 y, %	91.3	91.7	92.9	.8	87.8	97.4	.038	93.2	100	
Final FU, %	40.5	91.7	39.9		31.6	48.7		32.2	66.7	
OS										.71
Rate (5 y, %)	99.3	100	99.1	.79	98.8	100	.52	99	100	
Final FU (mean, mo)	174.7	120.8	179.4	.077	185.6	146.8	.046	99	100	
SI, %	74.8	72.7	75	.31	52.5	83.7	.071	83.7	88	.12
SW, %	9.2	0	10	.004	7.6	12.5	.87	13.2	11.3	.06
NS, %	4.4	0	4.9	.01	5.4	2.4	.08	4.3	0	.02

- Median follow-up: 57 months
- The 5-year local tumor control rate: 91.3% for all hemangioblastomas
 - Sporadic: 91.7%
 - VHL-related: 92.9%
- Two patients developed radiation necrosis (5.7%), and 1 of them required surgical resection.

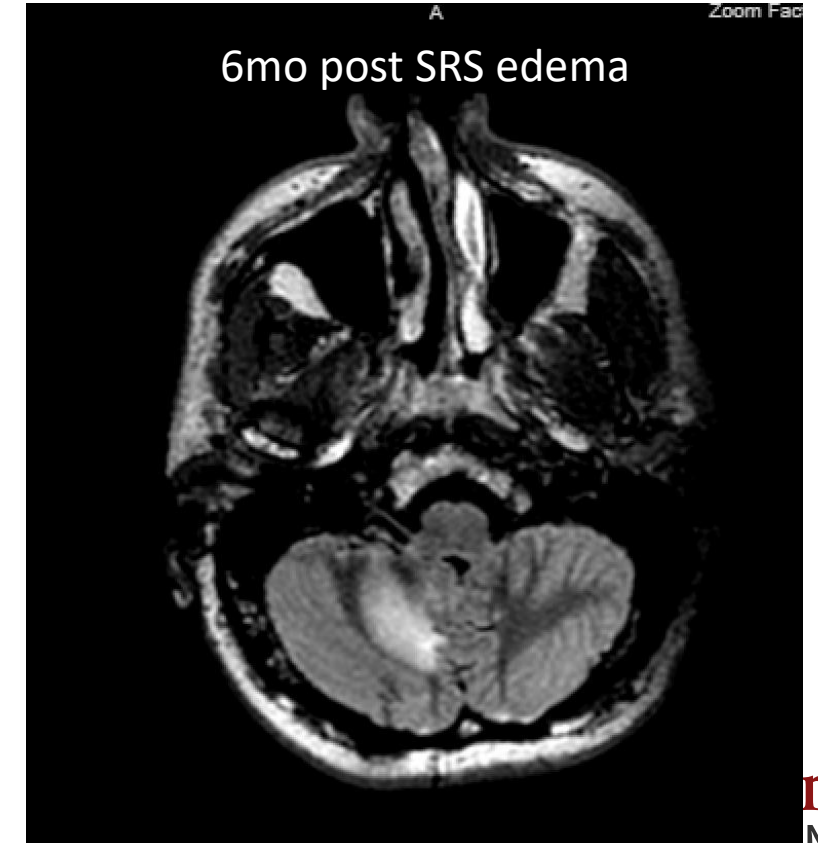
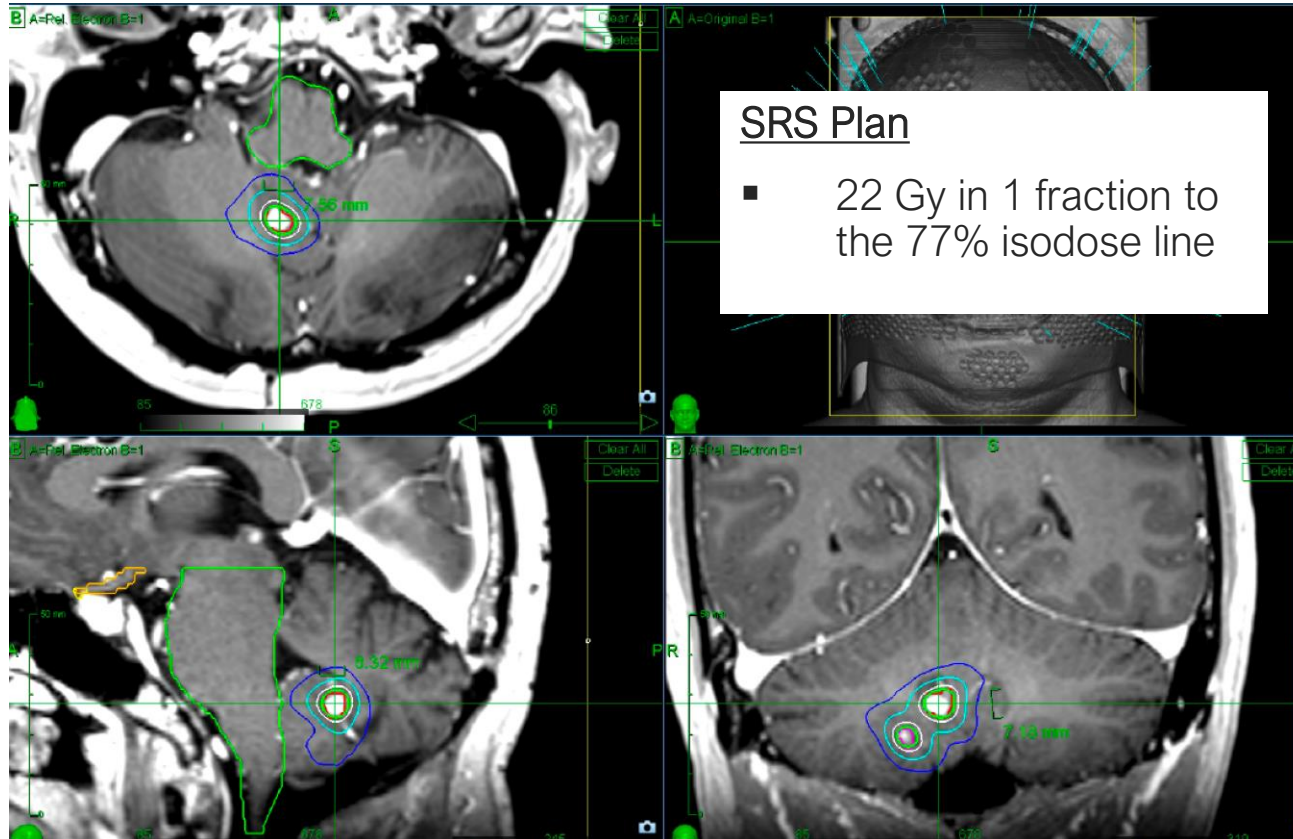


- SRS improved tumor-associated symptoms of 98 (74.8%) of 131 symptomatic hemangioblastomas, including headache, neck pain, dizziness, visual disturbances, dysesthesia, ataxia, motor impairment, seizures, and dysphagia.


Case (Hemangioblastoma)

- 48/M VHL, RCC s/p nephrectomy, HBs cerebellum + spine.

CyberKnife® 2019 to 2 growing cerebellar HBs. Belzutifan (Welirig) 2023-now



Stereotactic Radiosurgery for Ependymoma in Pediatric and Adult Patients: A Single-Institution Experience

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- Single-institution retrospective series
- 34 patients with 75 ependymomas (1998~2023)
 - Pediatric: 14 / Adult: 20 (patients)
 - WHO Grade 2: 46 / WHO grade 3: 29 (tumors)
- Median age: 21 years
- Median tumor volume: 0.64 cc
- CyberKnife® SRS
 - Median SFED of 16.6 Gy
 - 77% median isodose line

TABLE 3. Summary of Patient Outcomes

Variables	Entire series	Pediatric	Adult	Statistical significance (<i>P</i> value ^a)	Grade 2	Grade 3	Statistical significance (<i>P</i> value ^a)
LTC							
5 y, %	78.1	59.6	90.2	.03	85.9	58.5	.14
Final FU, %	57.9	29.8	70.7		62.4	58.5	
OS							
Rate (5 y, %)	73.6	41	94.7	<.001	100	35.9	<.001
Final FU (mean, mo)	97.1	60.5	132.5				
PFS							
Rate (5 y, %)	68.5	49.2	78.3	.19	88.8	32.6	<.001
Final FU (mean, mo)	110.3	61.4	151.4				
SI, %	67.6	71.4	65	.04	75	57.1	.03
SW, %	2.9	0	5	.004	5	0	.004
NS, %	5.9	14.3	0	.01	5	7.1	.06

- Median follow-up: 42.7 months
- The 5-year local tumor control rate: 78.1%
 - 59.6% for pediatric vs 90.2% for adults
 - 85.9% for WHO grade 2 vs. 58.5% for WHO grade 3
- Symptom improvement observed in 85.3% of patients

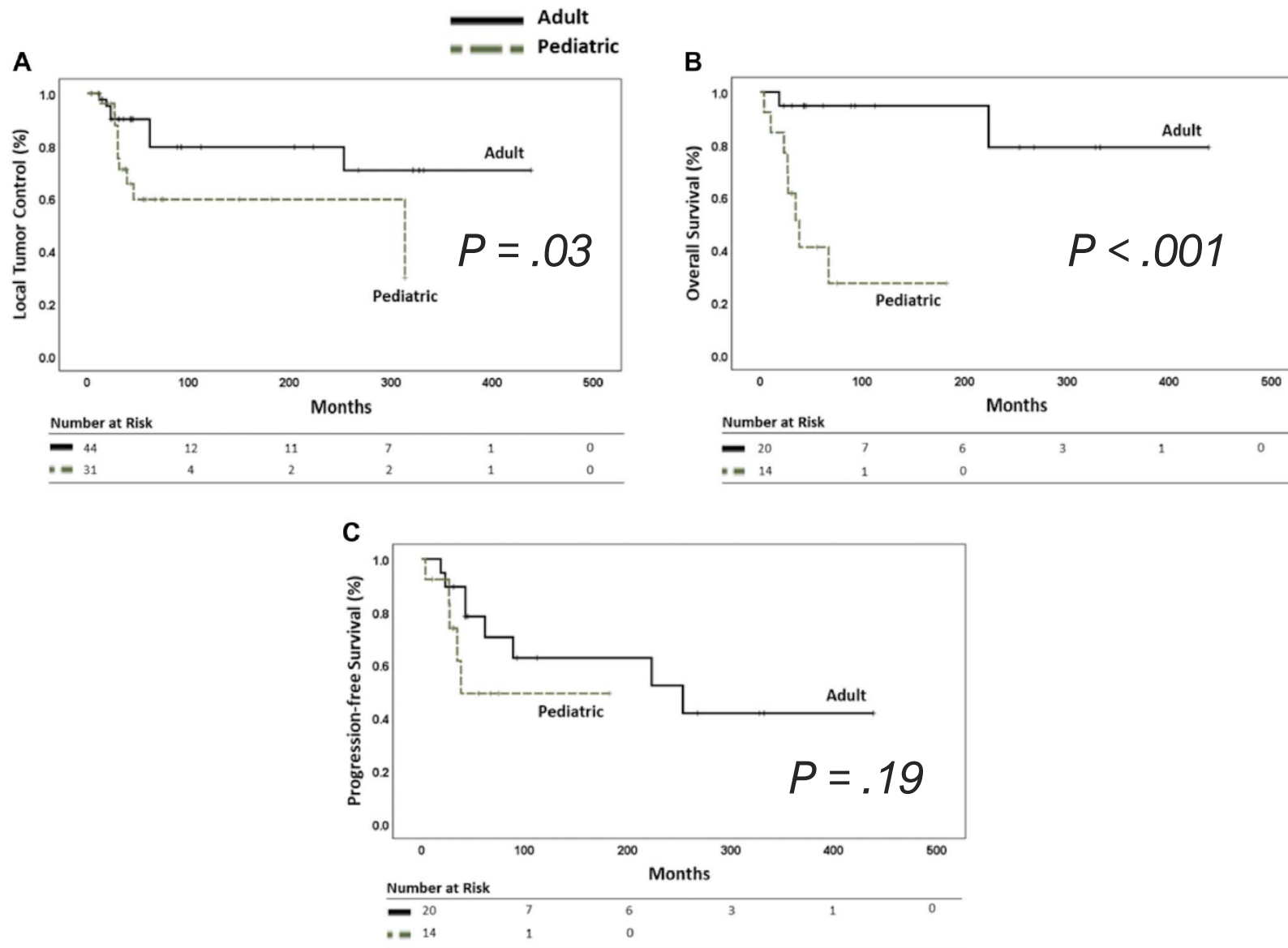


FIGURE 2. Overview of patient outcomes with a comparative analysis between pediatric (green, dashed) vs adult (black, solid) populations based on the Kaplan-Meier method with number of lesions and patients at risk. The specific outcome parameters evaluated are as follows: **A**, Local tumor control rate ($P = .03$); **B**, overall survival rate ($P < .001$); and **C**, progression-free survival rate ($P = .19$).

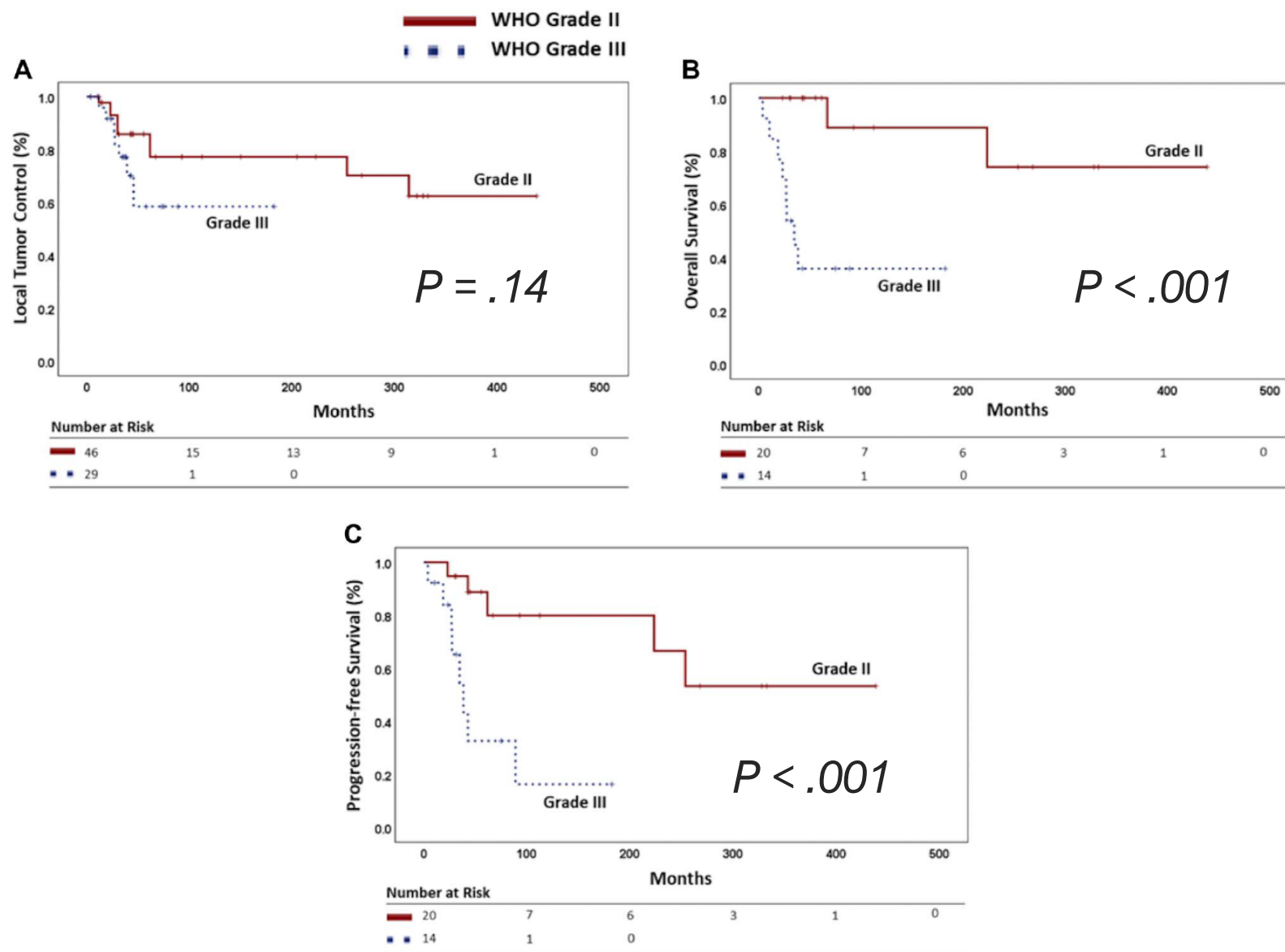
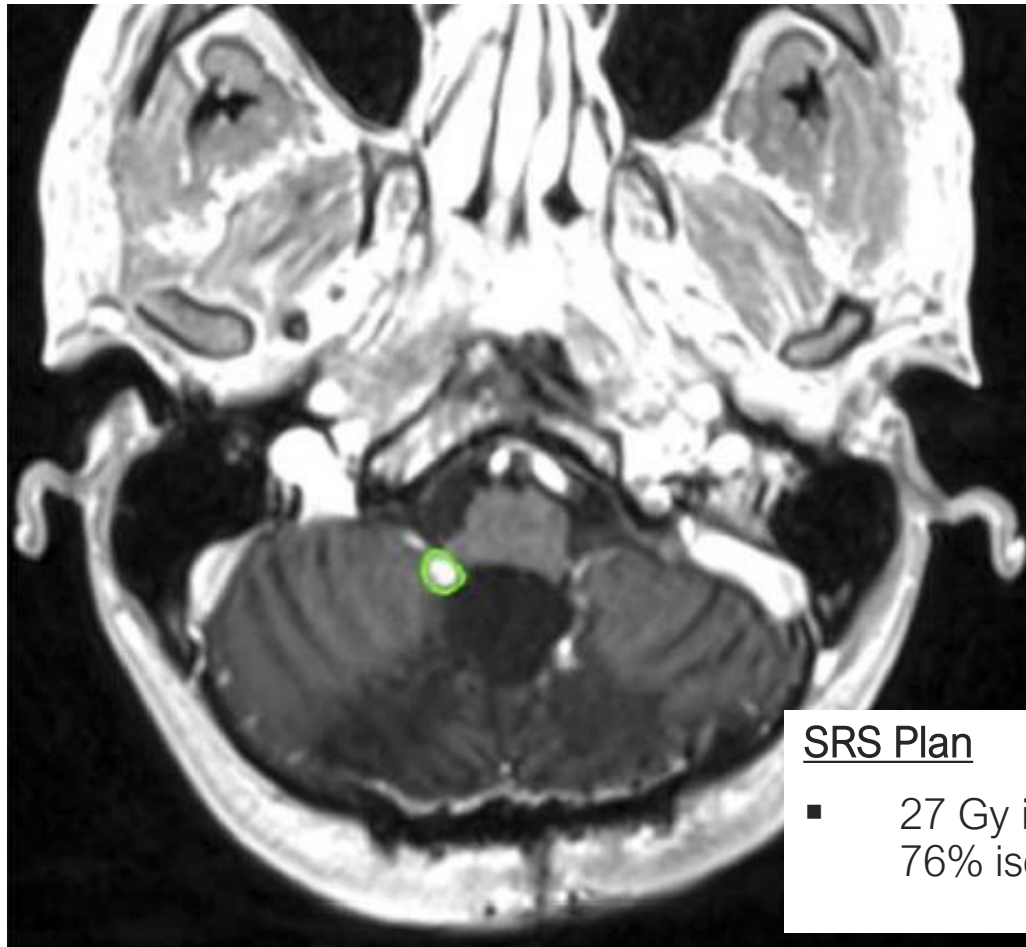


FIGURE 3. Overview of patient outcomes in relation to comparative analysis between WHO grade 2 ependymomas (red, solid) vs grade 3 lesions (blue, dashed) utilizing the Kaplan-Meier method with number of lesions and patients at risk. The specific outcome parameters evaluated are as follows: **A**, Local tumor control rate ($P = .14$); **B**, overall survival rate ($P < .001$); and **C**, progression-free survival rate ($P < .001$). WHO, World Health Organization.



Case (Ependymoma)

- 20/M, multiple recurrent grade 3 ependymoma (EP-PF-A) s/p multiple CyberKnife® treatments for the cranial lesions, presented with a recurrent right cerebellar lesion during surveillance.



SRS Plan

- 27 Gy in 3 fractions to 76% isodose line.



Take Home Message

- **Effective Tumor Control:** SRS achieves >90% local control for benign brain tumors, including large lesions.
- **Minimally Invasive:** SRS provides a non-surgical option with fewer risks compared to traditional surgery.
- **Symptom Improvement:** Many patients experience stabilization or improvement in clinical symptoms post-treatment.
- **Low Toxicity:** Adverse effects are minimal, making SRS a safe and well-tolerated treatment.

TEAM





Thank you

Questions?

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