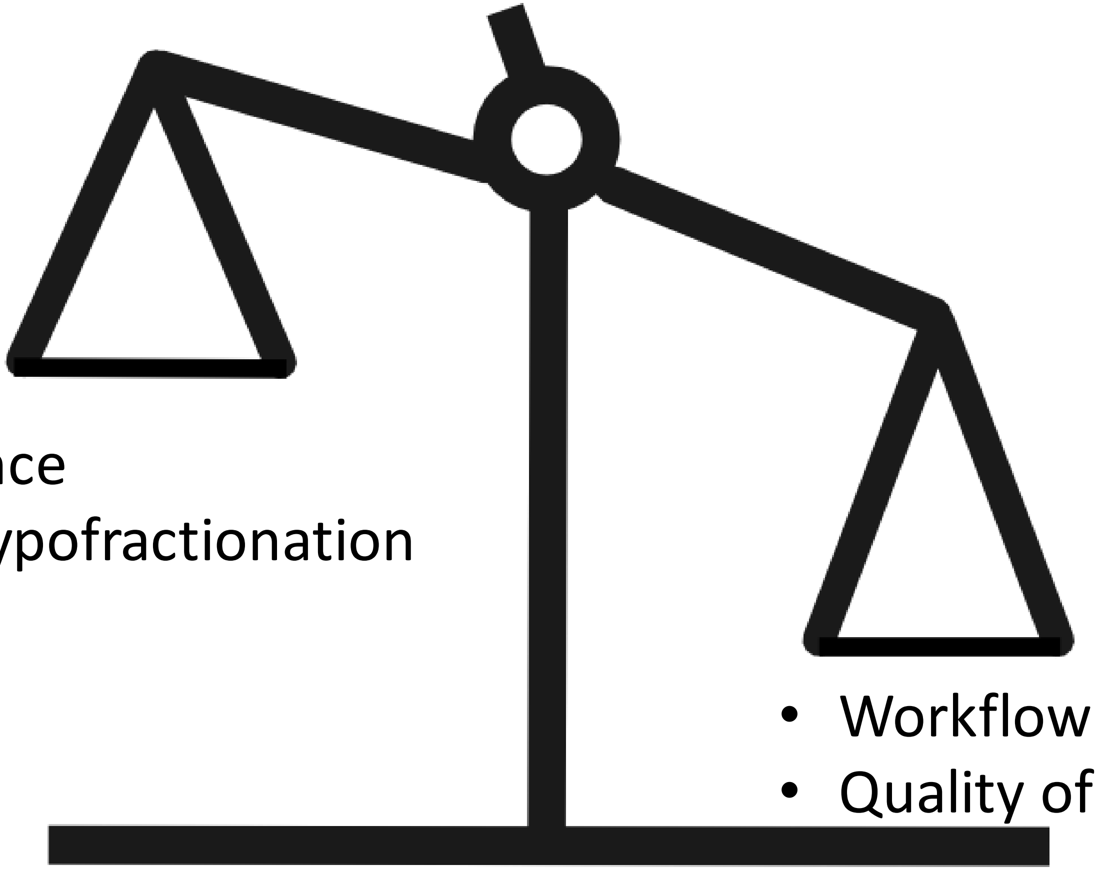
Clinical Role of Mask Based Gamma Knife Radiosurgery

Anuj Goenka, MD
Department of Radiation Medicine
Co-Director, Center for Stereotactic Radiosurgery
Zucker School of Medicine at Hofstra/Northwell

Northwell Health℠

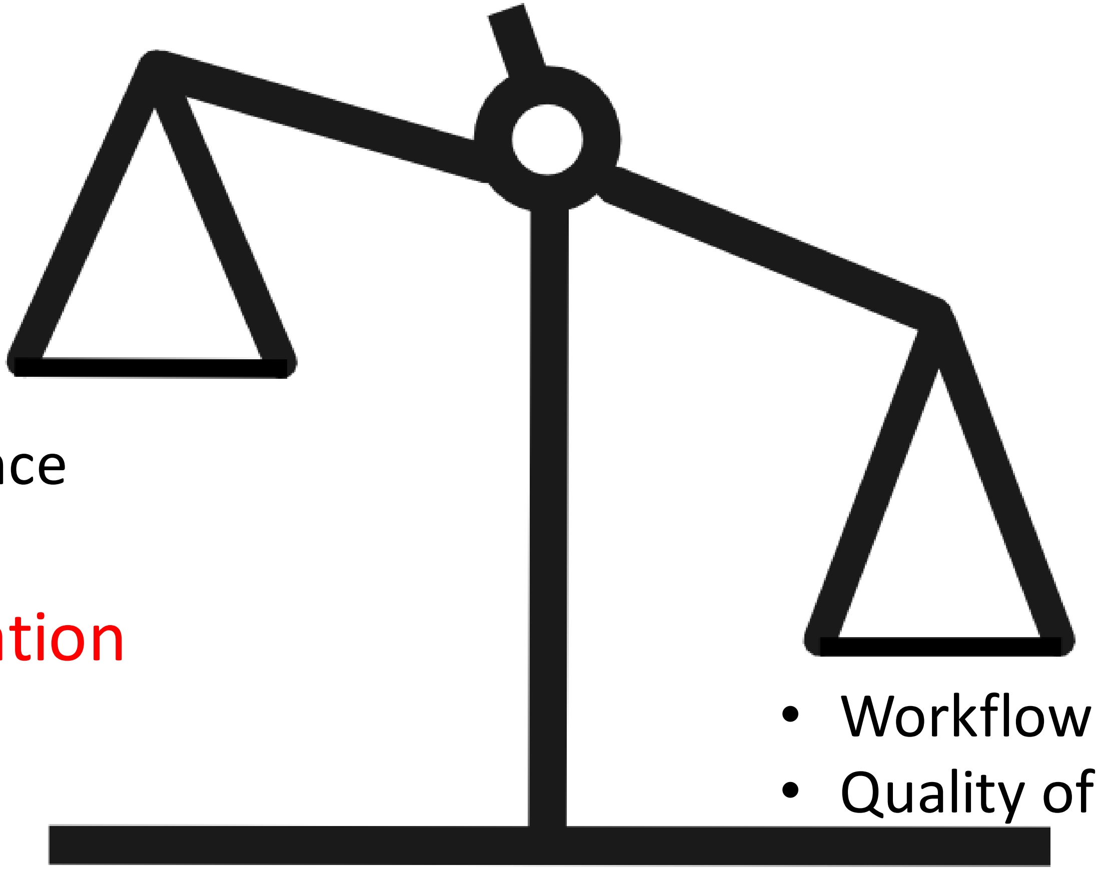
Clinical Implications of Mask Basked SRS/SRT



- Patient Experience
- Argument for Hypofractionation

- Workflow Disruption
- Quality of Immobilization

Clinical Implications of Mask Basked SRS/SRT



- Patient Experience
- Argument for Hypofractionation

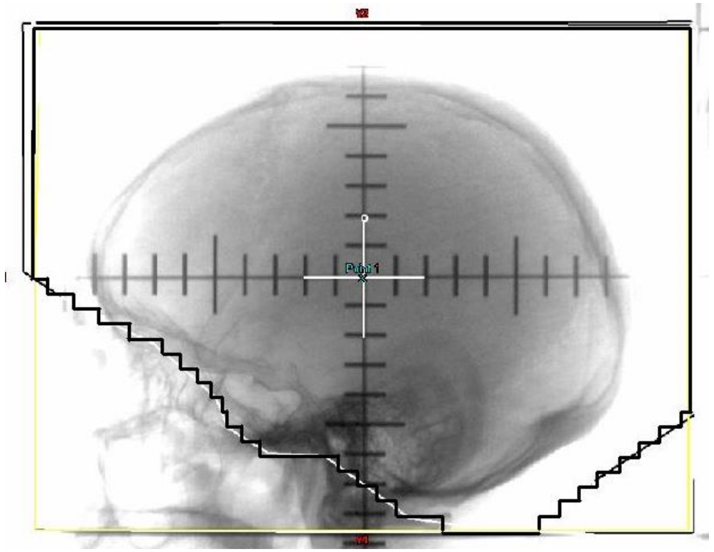
- Workflow Disruption
- Quality of Immobilization

Agenda

I. Theoretical Benefits for Hypofractionation

I. Clinical Indications
   - ❑ Intact Brain Metastases
   - ❑ Post-Operative Cavities
   - ❑ Other Indications

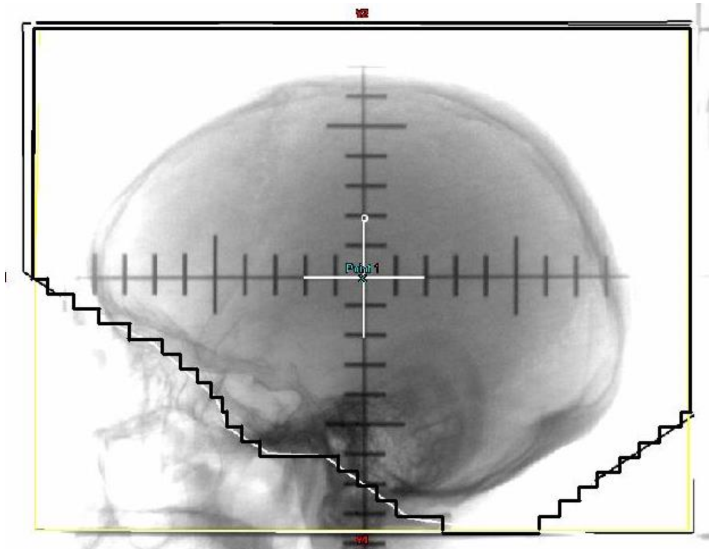
Role of Radiosurgery for Brain Metastases



<u>Survival: Historical Data</u>

- 1 month no treatment
- 2 months with steroids
- 4 months with whole brain RT

Role of Radiosurgery for Brain Metastases



<u>Cause of Death:</u>

50% intracranial progression

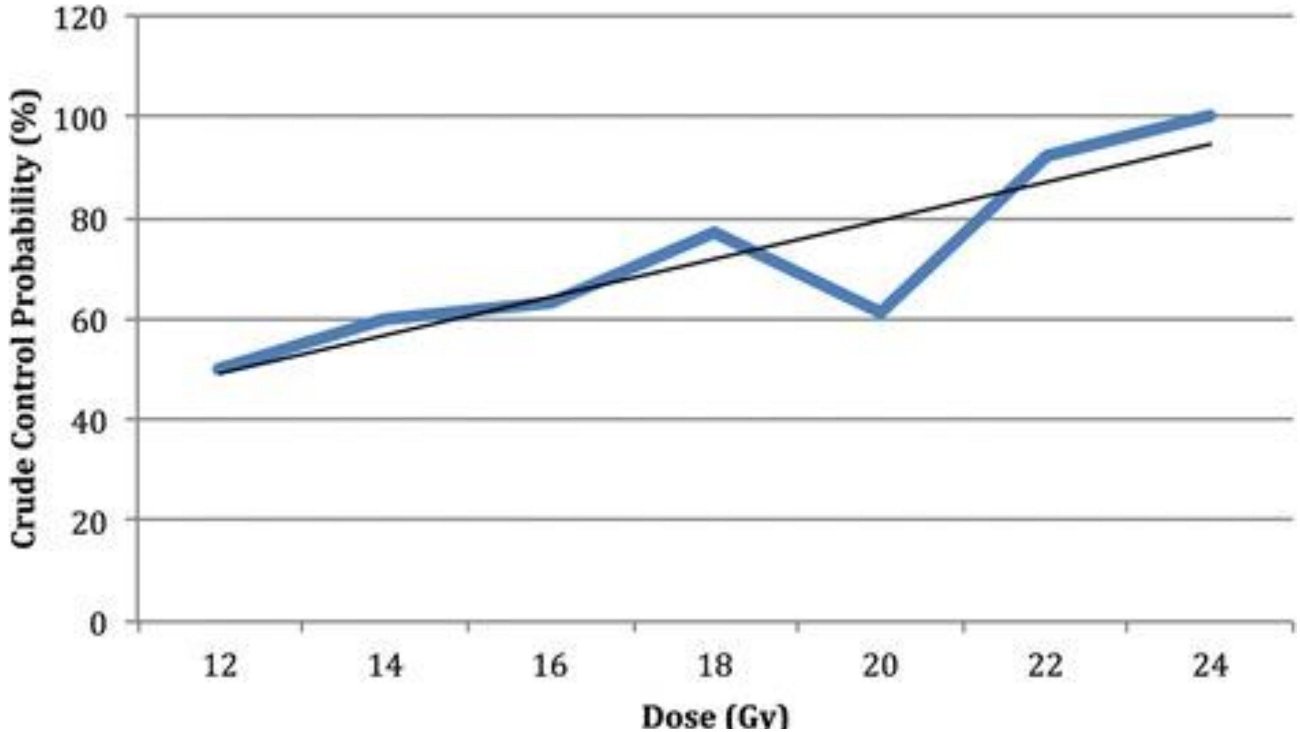
50% extracranial disease

Can we do better?

Role of Radiosurgery for Brain Metastases

Study	Treatment	Local Control	Neurological Death
JROSG 99-1	SRS	72.5%	19.3%
	SRS + WBRT	88.7%	22.8%
EORTC 22952	SRS/surgery	69%	44%
	SRS/Surgery + WBRT	81%	28%
MDA	SRS	67%	40%
	SRS + WBRT	100%	28%
NCCTG	SRS	72.8%	NR
	SRS + WBRT	90.1%	NR

Impact of Dose on Control Rates



Local control after radiosurgery for brain metastases: predictive factors and implications for clinical decision

Tâmara Ribeiro de Azevedo Santos, Carmen Freire Tundisi, Henderson Ramos, Maria Aparecida Conte Maia, Antônio Cássio Assis Pellizzon, Maria Letícia Gobo Silva, Ricardo César Fogaroli, Michael Jenwei Chen, Sérgio Hideki Suzuki, José Eduardo Souza Dias Jr, Paulo Issamu Sanematsu Jr, and Douglas Guedes de Castro

Radiat Oncol. 2015; 10: 63.
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SINGLE DOSE RADIOSURGICAL TREATMENT OF RECURRENT PREVIOUSLY IRRADIATED PRIMARY BRAIN TUMORS AND BRAIN METASTASES: FINAL REPORT OF RTOG PROTOCOL 90-05

Edward Shaw, M.D.,* Charles Scott, Ph.D.,[†] Luis Souhami, M.D.,[‡] Robert Dinapoli, M.D.,[§]
Robert Kline, Ph.D.,[‖] Jay Loeffler, M.D.,[¶] and Nancy Farnan, B.S.[†]

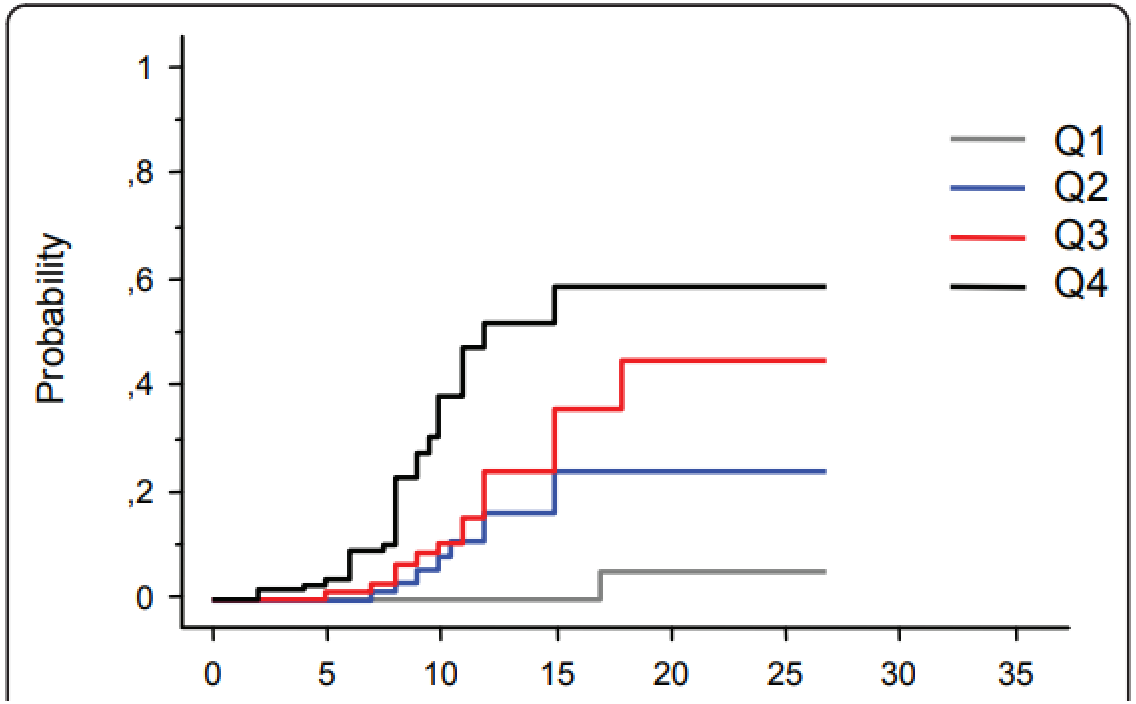
Table 5. Incidence of Grade 3, 4, and 5 CNS toxicity by tumor size and treatment arm

Incidence of Grade 3, 4, and 5 CNS Toxicity

Tumor size*	Arm	Dose	No. of patients	% of Patients With Toxicity		
				Acute	Chronic	Total
≤ 20 mm						
	1	18 Gy	12	0	8	8
	4	21 Gy	18	0	11	11
	7	24 Gy	10	0	10	10
21–30 mm						
	2	15 Gy	15	7	7	13
	5	18 Gy	15	0	20	20
	8	21 Gy	13	8	31	38
	11	24 Gy	12	33	25	58
31–40 mm						
	3	12 Gy	21	5	5	10
	6	15 Gy	22	0	14	14
	9	18 Gy	18	17	33	50

* Maximum tumor diameter.

Stereotactic radiosurgery for brain metastases: analysis of outcome and risk of brain radionecrosis



V12

Q1: <3.3 cm3

Q2: 3.3 – 5.9 cm3

Q3: 6.0 – 10.9 cm3

Q4: >10.9 cm 3

Giuseppe Minniti[1,2*], Enrico Clarke[1], Gaetano Lanzetta[2], Mattia Falchetto Osti[1], Guido Alessandro Bozzao[3], Andrea Romano[3] and Riccardo Maurizi Enrici[1]

RADIATION ONCOLOGY

Rationale for Hypofractionation

⇧Local Control

⇩Toxicity

Single versus Multifraction Stereotactic Radiosurgery for Large Brain Metastases: An International Meta-analysis of 24 Trials

Meta-Analysis – 24 Trials *Intact Brain Metastases*	Local Control: Single Fraction	Local Control: Multiple Fraction
• Group A: 4 – 14 cm3 (2-3 cm)	77.6%	92.9%
• Group B: >14 cm 3 (>3 cm)	77.1%	79.2%

Eric J. Lehrer, MD, MS,[*] Jennifer L. Peterson, MD,[†,‡] Nicholas G. Zaorsky, MD,[§] Paul D. Brown, MD,[‖] Arjun Sahgal, MD,[¶] Veronica L. Chiang, MD,[#] Samuel T. Chao, MD,[**] Jason P. Sheehan, MD, PhD,[††] and Daniel M. Trifiletti, MD[†,‡]

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Single versus Multifraction Stereotactic Radiosurgery for Large Brain Metastases: An International Meta-analysis of 24 Trials

Meta-Analysis – 24 Trials *Post-Operative Cavity*	Local Control Single Fraction	 Multiple Fraction
• Group B: >14 cm 3 (>3 cm)	62.4%	85.7%

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Single versus Multifraction Stereotactic Radiosurgery for Large Brain Metastases: An International Meta-analysis of 24 Trials

Meta-Analysis – 24 Trials	Necrosis: Single Fraction	Necrosis: Multiple Fraction
• Group A: 4 – 14 cm3 (2-3 cm)	23.1%	7.3%
• Group B: >14 cm 3 (>3 cm)	11.7%	6.5%

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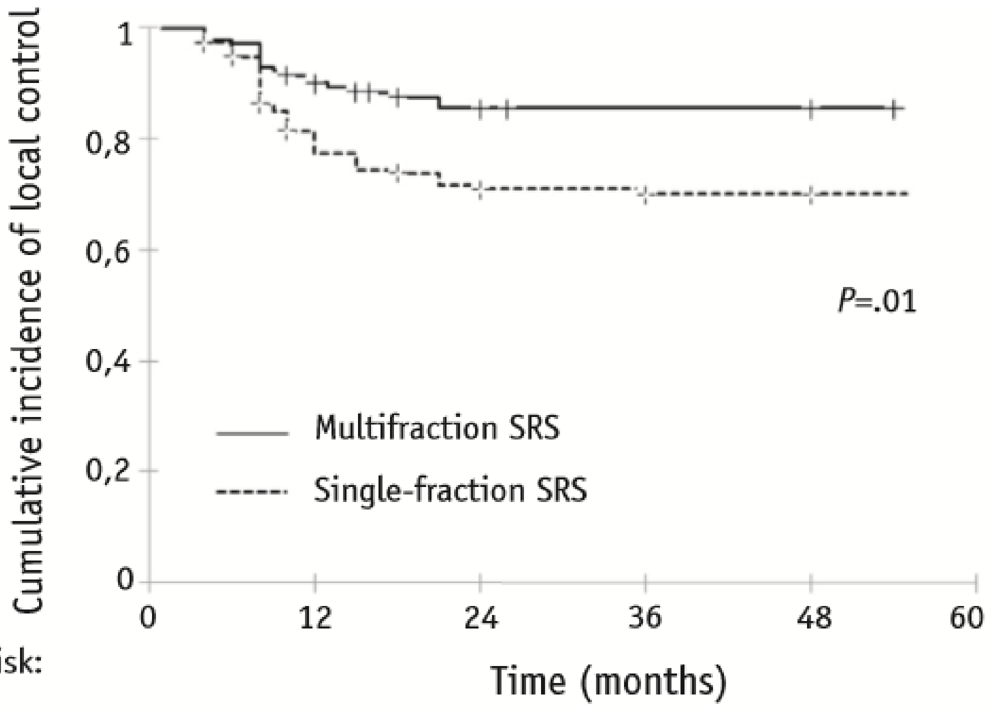
Single-Fraction Versus Multifraction (3 × 9 Gy) Stereotactic Radiosurgery for Large (>2 cm) Brain Metastases: A Comparative Analysis of Local Control and Risk of Radiation-Induced Brain Necrosis



Number at risk:

Single-fraction SRS	179	66	18	8
Multifraction SRS	164	62	15	7

Giuseppe Minniti, MD, PhD,[*,†] Claudia Scaringi, MD,[*] Sergio Paolini, MD,[†] Gaetano Lanzetta, MD,[†] Andrea Romano, MD,[‡] Francesco Cicone, MD,[§] Mattia Osti, MD,[*] Riccardo Maurizi Enrici, MD,[*] and Vincenzo Esposito, MD[†]

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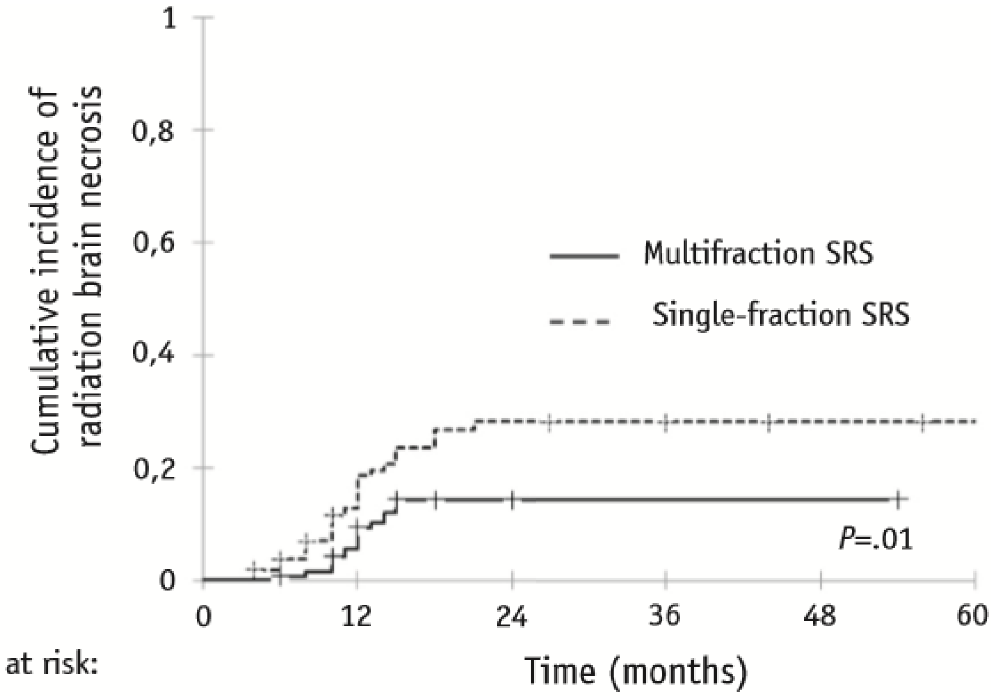

Number at risk:

Single-fraction SRS	179	64	17	6
Multifraction SRS	164	60	14	5

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Clinical Benefit of Hypofractionation

- Why may there be improvement in local control with hypofractionation
    - Is it the radiobiology

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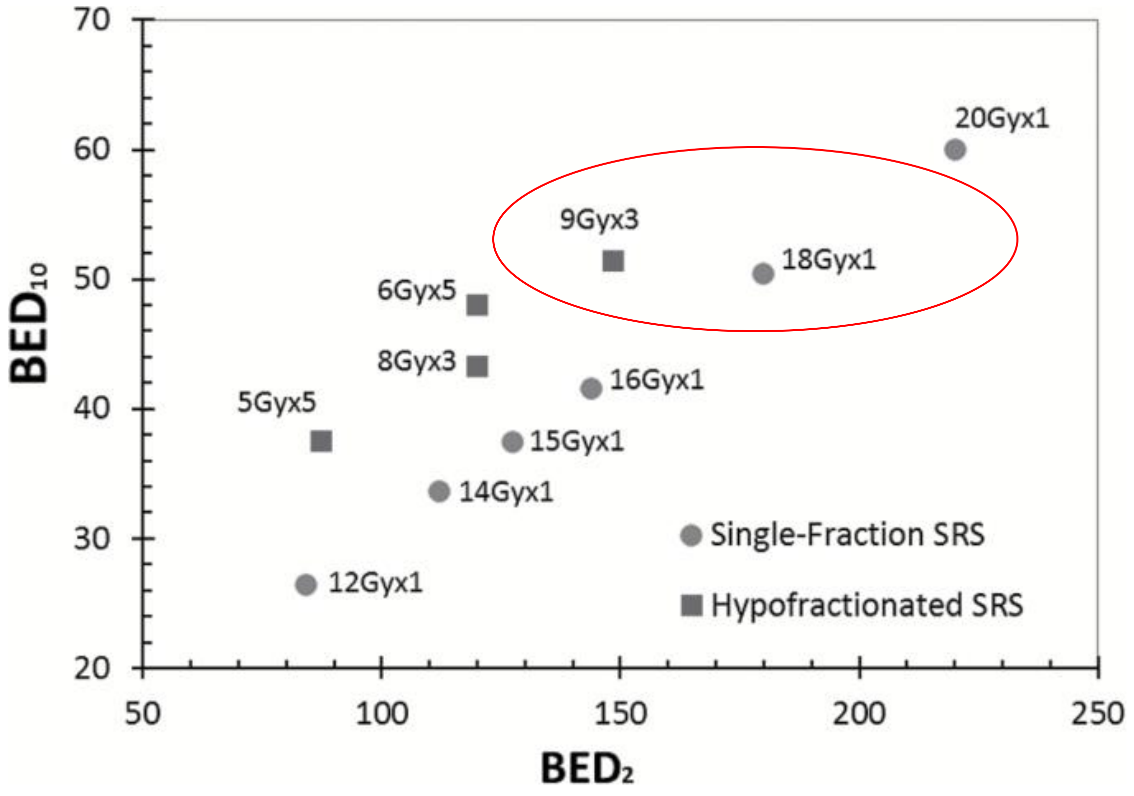
Neuro-Oncology
19, ii38–ii49, 2017 | doi:10.1093/neuonc/now301

The radiosurgery fractionation quandary: single fraction or hypofractionation?

John P. Kirkpatrick, Scott G. Soltys, Simon S. Lo, Kathryn Beal, Dennis C. Shrieve, and Paul D. Brown



Clinical Benefit of Hypofractionation

- Why may there be improvement in local control with hypofractionation
  - Is it the radiobiology
  - Is it margins/more generous contouring

Consensus Contouring Guidelines for Postoperative Completely Resected Cavity Stereotactic Radiosurgery for Brain Metastases

- Recommendations
  - CTV include entire surgical tract
  - CTV should include 5 to 10 mm margin along bone flap if initially in contact with the dura, 1 to 5 mm in not in contact
  - CTV 1-5 mm if in contact with venous sinus preoperatively

Hany Soliman, MD,* Mark Ruschin, PhD,* Lilyana Angelov, MD,[†]
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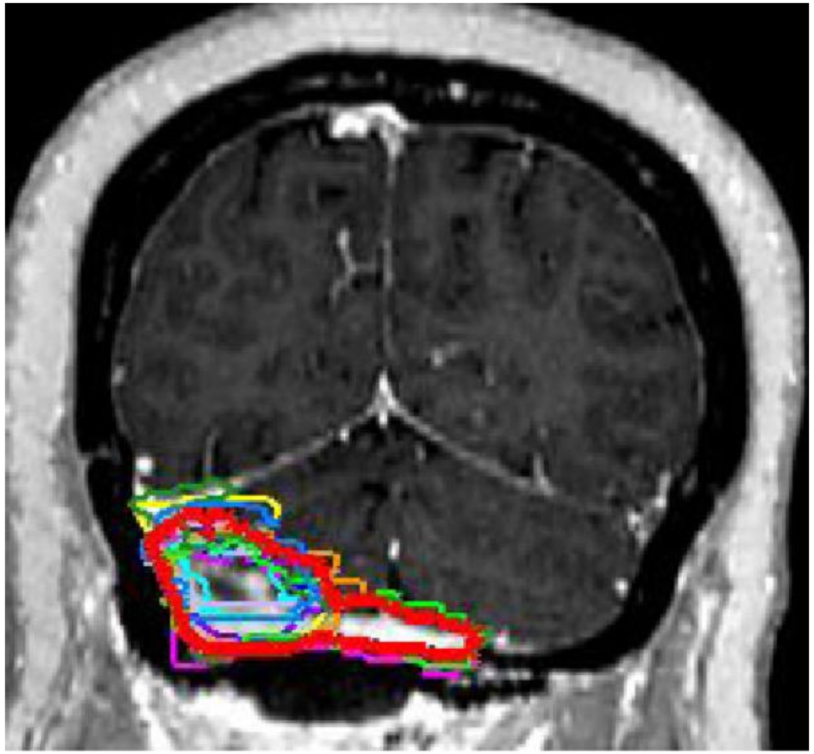

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Clinical Benefit of Hypofractionation

- Ability to treat Targets that are close to organs at risk
    - Brainstem
    - Optic Nerve
    - Optic Chiasm

Conclusion

- Gamma Knife ICON introduces the ability to use the Gamma Knife platform with a mask based system.
- Introduces the ability to treat with hypofractionation (nominally 2–5 sessions)
  - Clinical Benefit
    - Large Lesions
    - Adjacent to critical structures