

Métastases cérébrales et ré-irradiation

Ré irradiation: modalités et pratiques

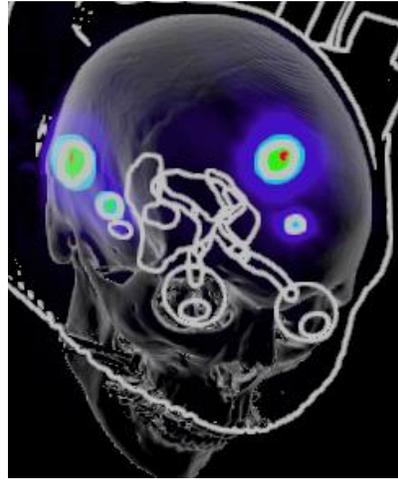
Perspectives de diagnostic

Gestions des toxicités

*Mélanie Doré – ICO Nantes
Octobre 2024*

Ré irradiation: modalités et pratiques

SRS/SRT



SRS



1 séance

SFRS ou SRT



3 à 5 séances

Score pronostic DS GPA



- Âge
- PS/Karnofsky

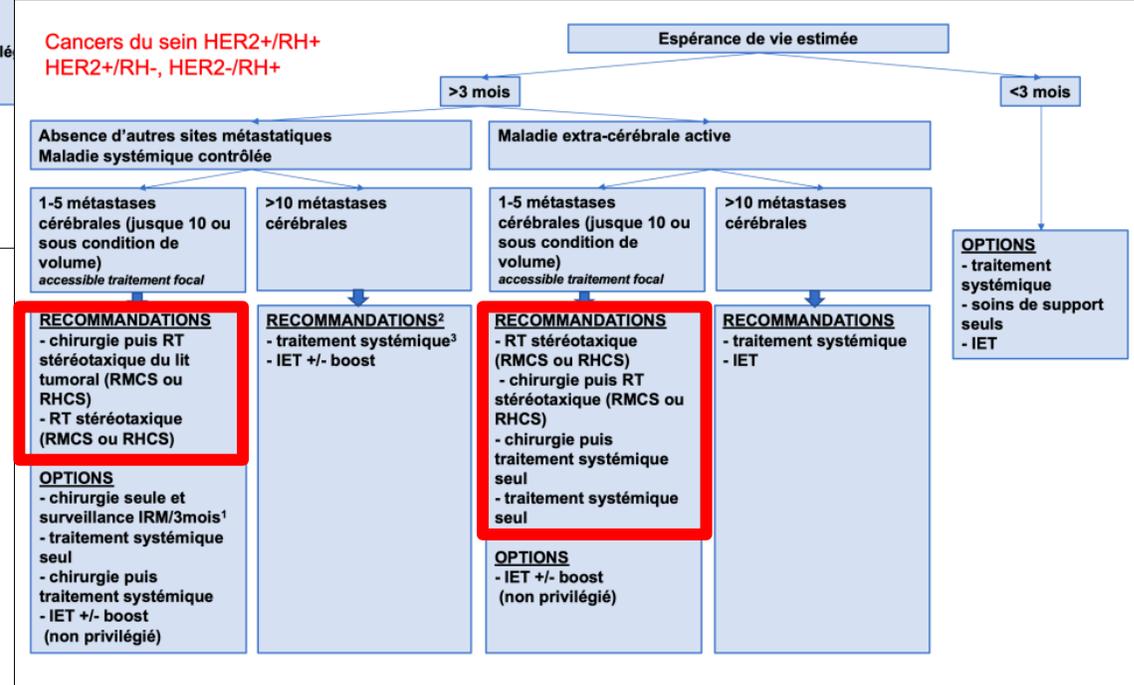
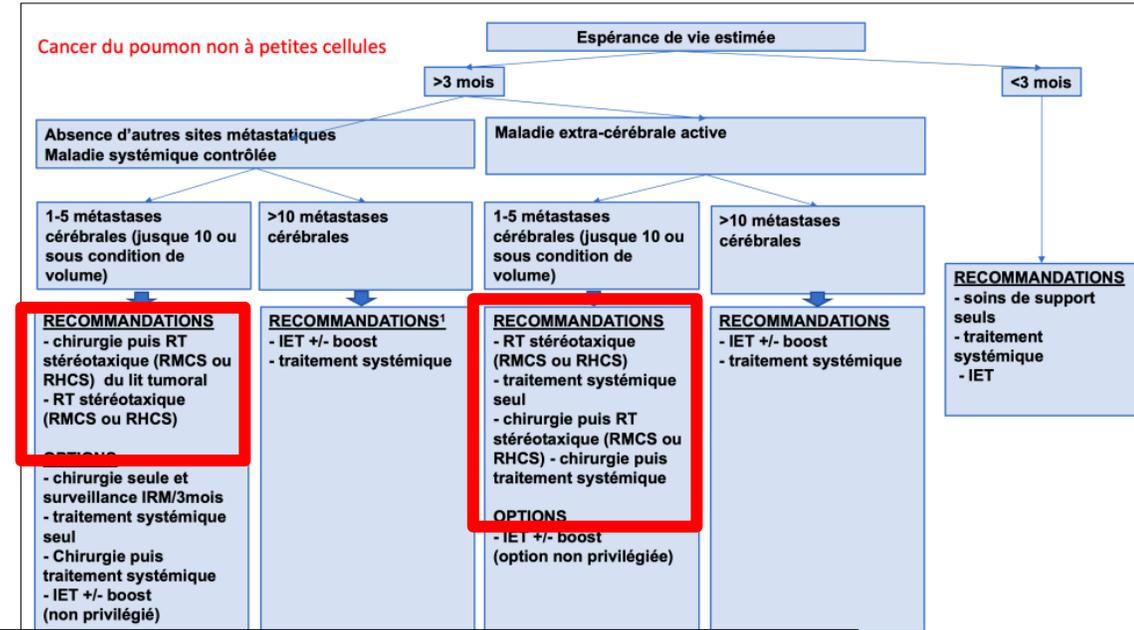
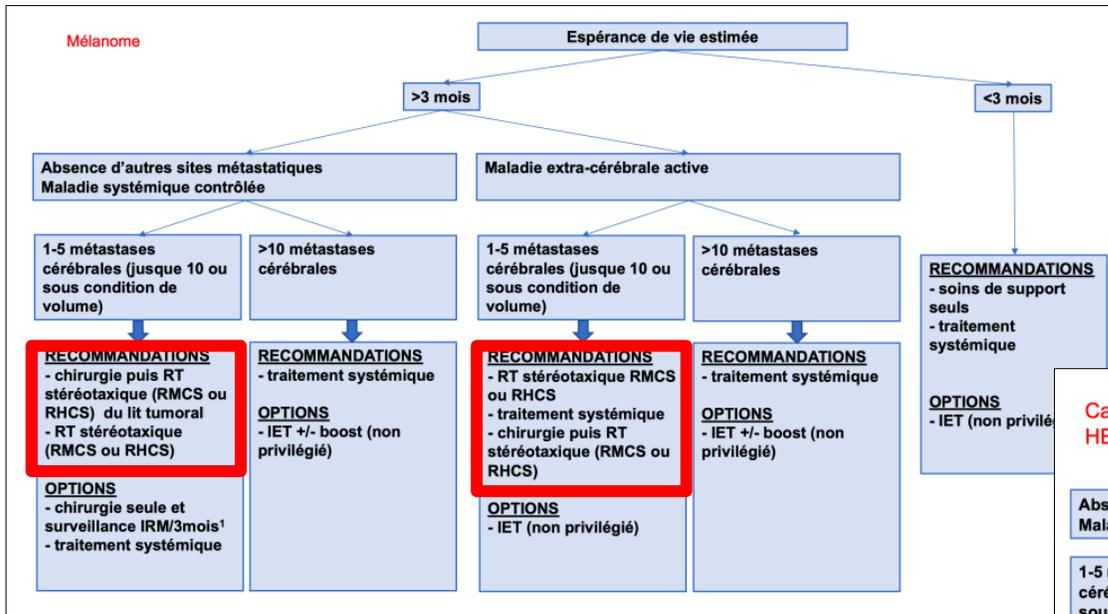


- Nombre
- Statut maladie extra-cérébrale

Médianes de survie selon le DS-GPA et la localisation de la tumeur primitive

Localisation	DS-GPA 0-1.0	DS-GPA 1.5-2.0	DS-GPA 2.5-3.0	DS-GPA 3.5-4.0
Pulmonaire CBNPC	3.2	5.49	9.43	14.78
Pulmonaire CBPC	2.79	4.90	7.67	17.05
Mélanome	3.38	4.70	8.77	13.23
Cancer du sein	3.25	7.70	15.07	25.30

SRS/SRT = STANDARD



EANO/ASTRO
< 10 M+

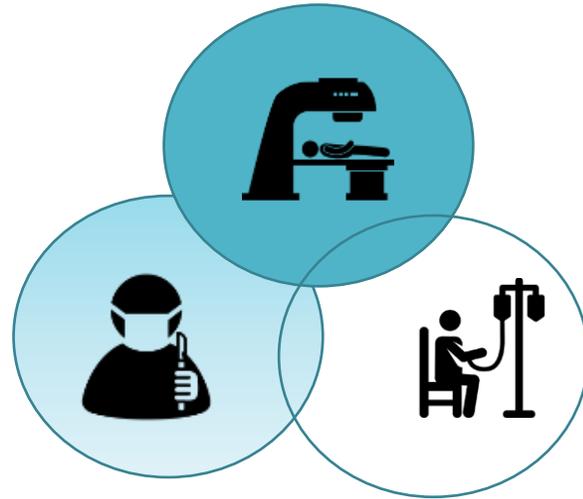
SRS/SRT = STANDARD

Taux de RL: 10 à 25 %



- Métastase initiale
- RL

Traitement de la RL

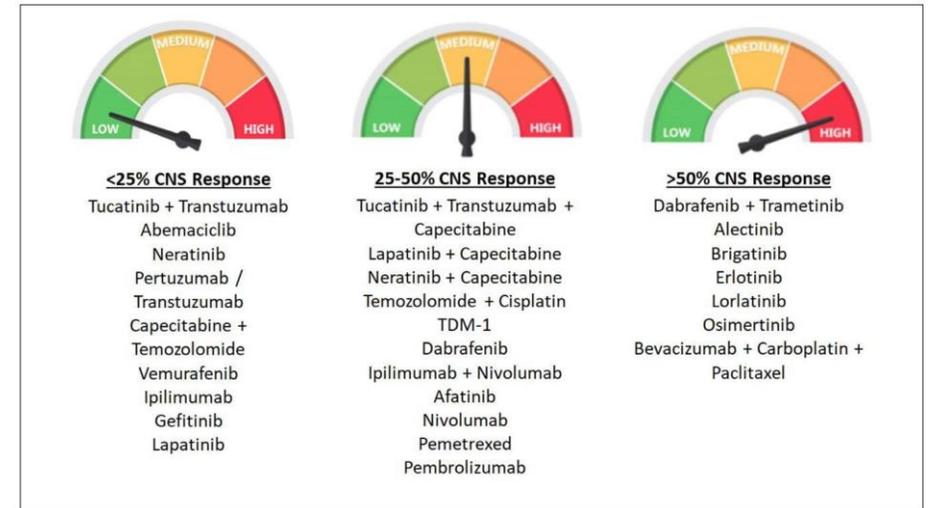


fonction

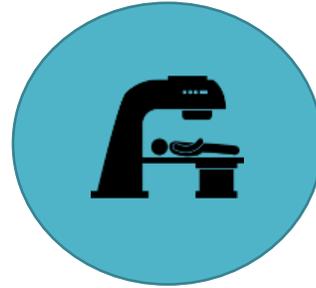


Objectif
carcinologique

Taux de RL après chirurgie seule: 40 %

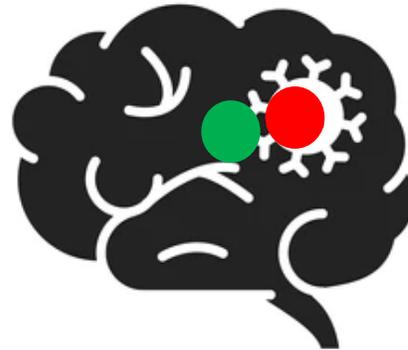


Ré-irradiation



Type I

Type II



- iRT (initial)
- nRT (noval)

Overlap

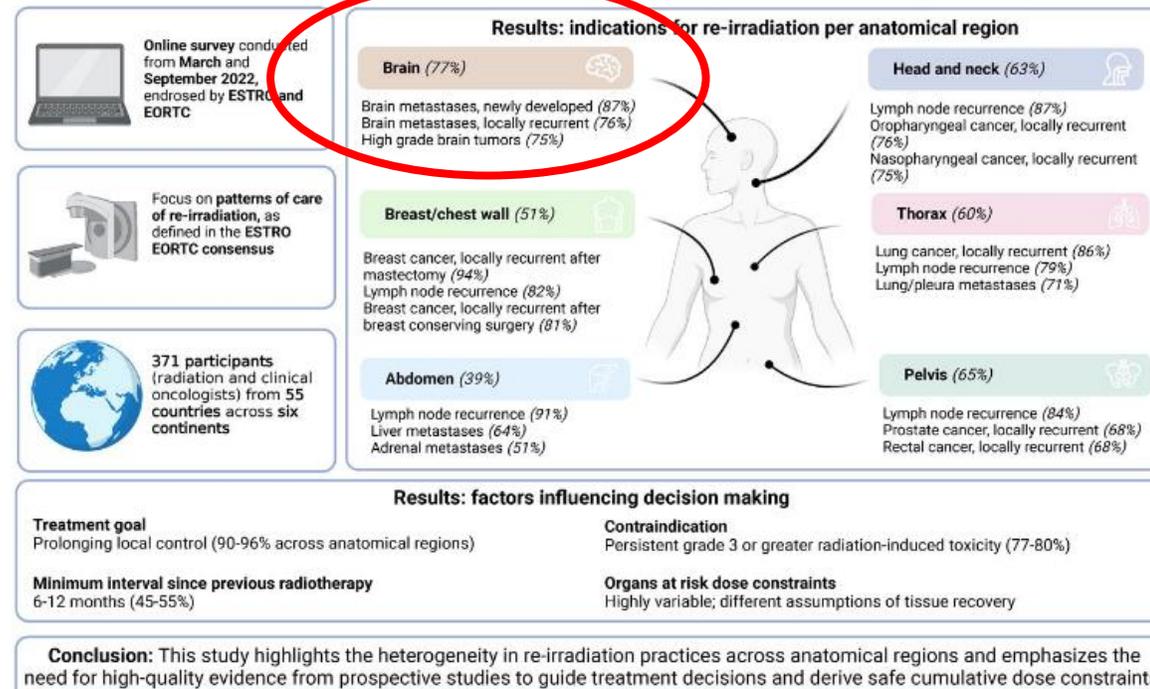
Pas d'overlap

Ré-irradiation



Original Article

Re-irradiation in clinical practice: Results of an international patterns of care survey within the framework of the ESTRO-EORTC E²-RADIatE platform

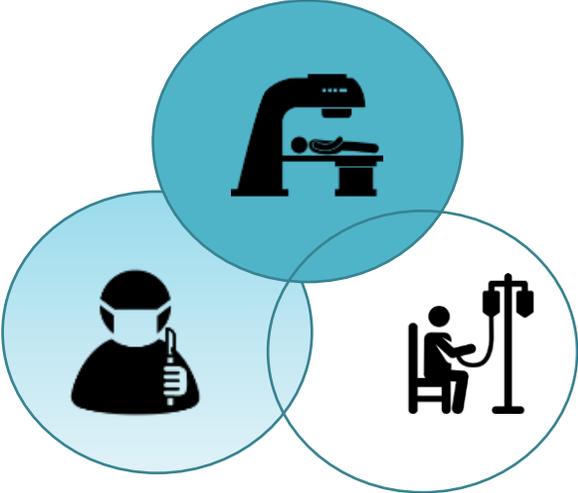


~~Recommande de A~~

efficacité



toxicité



RCP dédiée
+++

Modalités de réirradiation – sélection patients



- Âge
- PS
- Statut neuroC
- Comorbidités
- Espérance de vie



- Nombre / taille / localisation
- Type histo
- Statut maladie extra-cérébrale

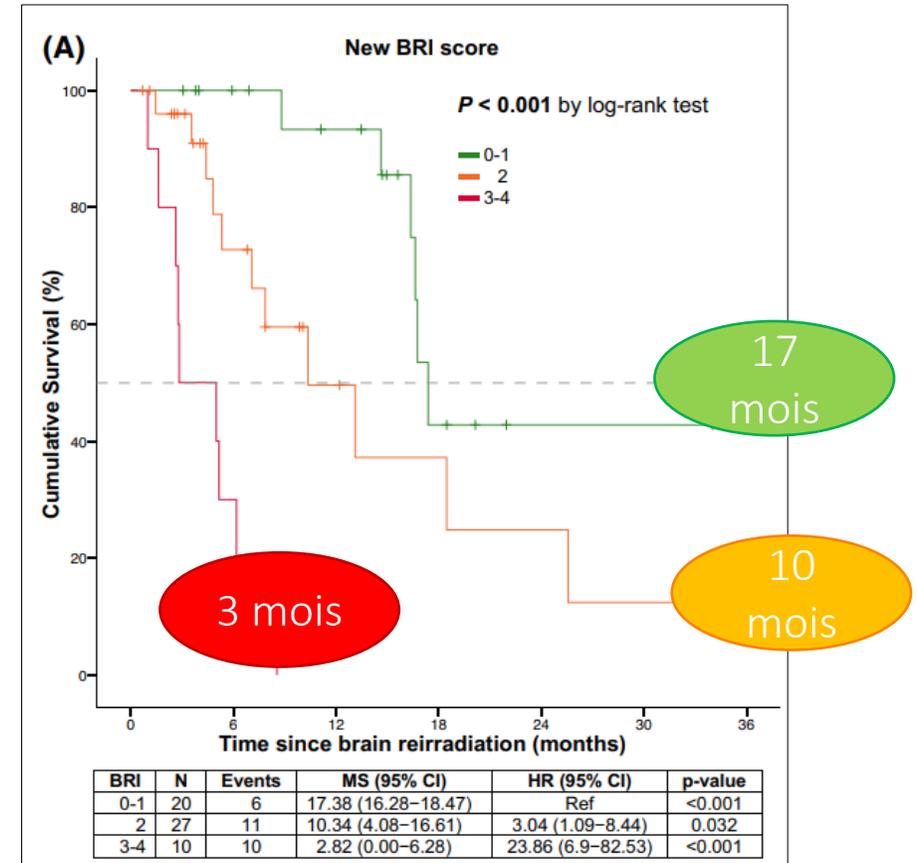


- Délai primo-RT
- Dose primo-RT (cible/OAR)
- Volume total ré-irradié
- Type I ou II

Modalités de réirradiation — sélection patients

Score **BRI** : Brain Re-irradiation Index

	Groupe BRI 3
Âge	> 50 ans
Maladie extra-cérébrale	Non contrôlée
Taille métastase	≥ 20 mm
Délai primo-irradiation	< 12 mois



Modalités de réirradiation - délai

Study	Median Delay SRS1/SRT1 to SRS2/SRT2 (in Months)	Number of SRS2	Number of SRT2	Median Volume cc	Median Isodose Line (%)	Median Maximum Dose SRS/SRT2	Median Maximum Dose BED SRS/SRT2	Median Margin Dose SRS/SRT2	Median Margin Dose BED SRS/SRT2
Terakedis 2013 [57]	9	43	0	1.5	95	18.9	53.1	18	50.4
Greto 2014 [56]	13 (4–34)	7	4	40.43 (7–374)	80 (70–80)	24.375	71.9	19.5 (12–30)	57.53
Holt 2015 [58]	6.4 (2.4–15.2)	6	9	9.4 (0.57–23)	80	26.25 (20–37.5)	73.5	21 (16–30)	58.8
Minniti 2015 [55]	17 (6–56)	0	47	12.3 (1.5–33.1)	85 (80–90)	50.8 (42–50.8)	35.7 (35.7–43.2)	24 (21–24)	43.2 (35.7–43.2)
Miyakawa 2016 [61]	7.5 (1–33)	0	50	28.8 (7.1–103)	90	33.3	43.3	30	39
Kim 2017 [60]	9.1 (2.5–58.3)	108	0	5.94 (0.42–29.9)	50%	34 (12–48)	92.2	17 (12–24)	46.08
Koffer 2017 [59]	13.4 (1.9–52.4)	24	0	3.3	NA	NA	NA	15.5 (10–20)	39.53 (20–60)
McKay 2017 [54]	19 (2–98)	46	0	0.98 (0.01–19.7)	NA	NA	NA	20 (14–22)	60 (33.6–70.4)
Balermipas 2018 [52]	12.4 (3.2–88.2)	24	8	2.5 (0.1–37.5)	69 (53–80)	28 (17.4–38.1)	97.2 (40.1–126.3)	23.5 (14.3–33)	70.6 (34.5–89.9)
Moreau 2018 [51]	15.4 (11–78)	36	0	4.8 (0.13–24.8)	90	20	45.36	18 (12–20)	50.4
Dincoglan 2019 [50]	13.5 (3.7–49)	0	30	14.6 (1.6–35.6)	85–95	23.33	39.7	21 (21–30)	35.7 (35.7–48)
Rana 2019 [53]	9.7 (2.5–56.9)	19	13	1.35 (0.11–34.9)	83.5 (69–96)	31.73	77.96	26.5 (18–36)	65.1
Iorio Morin 2019 [62]	13 (3–47)	75	0	1.19 (0.07–20.6)	50 (30–80)	100.8 (52.8–120)	36 (24–40)	18 (12–20)	50.4 (26.4–60)

Abbreviations: SRS1 = first course of stereotactic radiosurgery; SRT1 = first course of fractionated stereotactic radiotherapy; SRS2 = second course of stereotactic radiosurgery; SRT2 = second course of fractionated stereotactic radiotherapy; NA = not available; BED = biological effective dose.

12 mois

Modalités de réirradiation - dose

Study	Median Delay SRS1/SRT1 to SRS2/SRT2 (in Months)	Number of SRS2	Number of SRT2	Median Volume cc	Median Isodose Line (%)	Median Maximum Dose SRS/SRT2	Median Maximum Dose BED SRS/SRT2	Median Margin Dose SRS/SRT2	Median Margin Dose BED SRS/SRT2
Terakedis 2013 [57]	9	43	0	1.5	95	18.9	53.1	18	50.4
Greto 2014 [56]	13 (4-34)	7	4	40.43 (7-374)	80 (70-80)	24.375	71.9	19.5 (12-30)	57.53
Holt 2015 [58]	6.4 (2.4-15.2)	6	9	9.4 (0.57-23)	80	26.25 (20-37.5)	73.5	21 (16-30)	58.8
Minniti 2015 [55]	17 (6-56)	0	47	12.3 (1.5-33.1)	85		35.7 (35.7-43.2)	24 (21-24)	43.2 (35.7-43.2)
Miyakawa 2016 [61]	7.5 (1-33)	0	50	28.8 (7.1-103)			43.3	30	39
Kim 2017 [60]	9.1 (2.5-58.3)	108		5.94 (0.42-29.9)			92.2	17 (12-24)	46.08
Koffer 2017 [59]	13.4 (1.9-52.4)	24		3.3			NA	15.5 (10-20)	39.53 (20-60)
McKay 2017 [54]	19 (2-98)	46		0.98 (0.01-19.7)			NA	20 (14-22)	60 (33.6-70.4)
Balermipas 2018 [52]	12.4 (3.2-88.2)	24		2.5 (0.1-37.5)	69		97.2 (40.1-126.3)	23.5 (14.3-33)	70.6 (34.5-89.9)
Moreau 2018 [51]	15.4 (11-78)	36		4.8 (0.13-24.8)			45.36	18 (12-20)	50.4
Dincoglan 2019 [50]	13.5 (3.7-49)	0	30	14.6 (1.6-35.6)	8		39.7	21 (21-30)	35.7 (35.7-48)
Rana 2019 [53]	9.7 (2.5-56.9)	19	13	1.35 (0.11-34.9)	83.5 (69-96)	31.73	77.96	26.5 (18-36)	65.1
Iorio Morin 2019 [62]	13 (3-47)	75	0	1.19 (0.07-20.6)	50 (30-80)	100.8 (52.8-120)	36 (24-40)	18 (12-20)	50.4 (26.4-60)

↗ dose

↗ contrôle local
↗ survie globale
↗ radionécrose

17 Gy en SRS
25 Gy en SFRT

Abbreviations: SRS1 = first course of stereotactic radiosurgery; SRT1 = first course of fractionated stereotactic radiotherapy; SRS2 = second course of stereotactic radiosurgery; SRT2 = second course of fractionated stereotactic radiotherapy; NA = not available; BED = biological effective dose.

Modalités de réirradiation - dose

Table 3

Summary of treatment-related characteristics. *extrapolated from 8/11 studies. sfSRS: single fraction SRS. mfSRS: multiple fractions SRS. BED: biological effective dose.

Study	Number of patients	Number of metastases	WBRT	Median SRS1 dose (in Gy)	Median delay SRS1	Median SRS2 dose	Median SRS2 n° of fractions	Number of metastases received sfSRS	Number of	% of	Median SRS2 BED (in Gy)	Tumor size at SRS2 (cc)
Terakedis	43	43	17	18			1	43			10,4	2,2
Greto	13	13	6	n/a			1	9			13,5	40,0
Minniti	43	43	0	n/a			3	0			15,7	12,0
McKay	46	46	8	20			1	46			10	1,0
Rana	32	32	8	24			3	19			15,1	1,35
Balermipas	32	32	4	18			1	24			10,4	2,5
Moreau	36	36	24	n/a			1	36			10,4	4,8
Dincoglan	30	30	0	18			3	0			35,7	14,0
Holt	15	15	1	21	6,4	21	3	6	9	60	35,7	9,8
Koffer	24	24	8	18	13	15,5	1	24	0	0	33	3,3
Iorio-Morin	75	75	26	20	13	18	1	75	0	0	50,4	1,19
Summary	335	389	102	20*	13	19	1	282	107	28	50,4	3,30

SRS ou SFRT ?

∅ ↗ en SFRT

Modalités de réirradiation – contraintes OAR

Organ	Number of fractions					
	1	2	3	4	5	≥ 8
Brain	V _{10 Gy} < 10 mL [172] V _{12 Gy} < 5–10% [173] V _{12 Gy} < 7.9–8.5 mL [173] V _{12 Gy} ≤ 5 mL [174,175]		V _{20 Gy} ≤ 20 mL [174,175] V _{23.1 Gy} < 7 mL [176]		V _{24 Gy} ≤ 20 mL [174,175] V _{28.8 Gy} < 3–7 mL [177]	
Optic tracts	Dmax < 8 Gy [178,179] Dmax < 10–12 Gy [172] Dmax > 12 Gy [174,180] V _{8 Gy} < 0.2 mL [178]	Dmax < 13.7 Gy [178] V _{11.7 Gy} < 0.2 mL [178]	Dmax < 10.5 Gy [176] Dmax < 17.4 Gy [178] Dmax < 20 Gy [174,180] V _{15.3 Gy} < 0.2 mL [178] Dmax < 14.4 Gy [178]	Dmax < 21.2 Gy [178] V _{19.2 Gy} < 0.2 mL [178]	Dmax < 25 Gy [178] Dmax < 15 Gy [177] Dmax < 25 Gy [174,180] V _{23 Gy} < 0.2 mL [178] Dmax < 22 Gy [178]	Dmax < 29.6 Gy [178] V _{27.2 Gy} < 0.2 mL [178]
Cochlea	Dmax < 6 Gy [172] Dmax < 9 Gy [178]	Dmax < 11.7 Gy [178]		Dmax < 18 Gy [178]		Dmax < 26.4 Gy [178]
Hippocampus	Dmax < 6.65 Gy [181] V _{4.21 Gy} < 100% [181]					
Brain stem	Dmax < 10–12 Gy [172] Dmax < 15 Gy [178,182] V _{10 Gy} < 0.5 mL [178]	Dmax < 19.1 Gy [178] V _{13 Gy} < 0.5 mL [178]	Dmax < 23.1 Gy [178] Dmax < 24 Gy [182] V _{15.9 Gy} < 0.5 mL [178]	Dmax < 27.2 Gy [178] V _{20.8 Gy} < 0.5 mL [178]	Dmax < 31 Gy [178] V _{23 Gy} < 0.5 mL [178] V _{30 Gy} < 5% [182]	Dmax < 37.6 Gy [178] V _{27.2 Gy} < 0.5 mL [178]
Spinal cord + medulla oblongata	Dmax < 10 Gy [182] Dmax < 12.4 Gy [182] Dmax < 13 Gy [182] Dmax < 14 Gy [178] [182,183] V _{7 Gy} < 1.2 mL [182,183] V _{10 Gy} < 0.35 mL [172,182,183] V _{14 Gy} < 0.035 mL [172,182] 6 mm on either side PTV V _{10 Gy} < 10% [182]	Dmax < 18.3 Gy [178] V _{13 Gy} < 0.35 mL [178]	Dmax < 20.3 Gy [182] Dmax < 21 Gy [182] Dmax < 22.5 Gy [178] V _{15.9 Gy} < 0.35 mL [178] 6 mm on either side PTV V _{18 Gy} < 10% [182]	Dmax < 25.6 Gy [178] V _{18 Gy} < 0.35 mL [178] 6 mm on either side PTV Dmax < 26 Gy [182]	Dmax < 25 Gy [182] Dmax < 25.3 Gy [182] Dmax < 28 Gy [178] V _{22 Gy} < 0.35 mL [178] 6 mm on either side PTV V _{10 Gy} < 10% [182]	Dmax < 33.6 Gy [178] V _{26.4 Gy} < 0.35 mL [178]

Modalités de réirradiation – contraintes OAR

- Cerveau

Vx metric (x in Gy)			Toxicity grade	Toxicity rate for Vx ≥		
1 fraction	3 fractions*	5 fractions*		5 cm ³	10 cm ³	20 cm ³
V12	V19.6	En situation de ré irradiation ?	1-3	3.6%	4.8%	8.6%
V12	V19.6		1-3	19.6%	25.8%	41.5%
V14	V23.1		1-3	4.1%	6.0%	12.1%
V14	V23.1		3	0.4%	0.8%	3.4%

- Voies optiques et chiasma

SRS: Dmax < 12Gy => <1% neuropathie

SRT: Dmax < 20Gy (3f) ou 25Gy (5f) => < 1% neuropathie

- Tronc cérébral: Dmax ≤ 17.5Gy (SRS) ou équivalent BED (SRT) ≤ 70Gy

Modalités de réirradiation – contraintes OAR

			Median	Maximum	Minimum
Brain	0.1 cc > 80 Gy ₃ EQD2 (n = 69)	D(0.1 cc) in Gy ₃ EQD2	107.40	161.50	80.03
		D(mean) in Gy ₃ EQD2	34.40	50.80	0.90
	0.1 cc > 90 Gy ₃ EQD2 (n = 62)	D(0.1 cc) in Gy ₃ EQD2	108.37	161.50	90.26
		D(mean) in Gy ₃ EQD2	34.16	50.80	0.90
0.1 cc > 100 Gy ₃ EQD2 (n = 46)	D(0.1 cc) in Gy ₃ EQD2	114.00	161.50	100.1	
	D(mean) in Gy ₃ EQD2	33.30	50.80	0.90	
Brainstem	0.1 cc > 70 Gy ₃ EQD2 (n = 12)	D(0.1 cc) in Gy ₃ EQD2	86.07	100.68	76.33
		D(mean) in Gy ₃ EQD2	37.81	72.14	9.35
	0.1 cc > 80 Gy ₃ EQD2 (n = 9)	D(0.1 cc) in Gy ₃ EQD2	90.36	100.68	80.57
		D(mean) in Gy ₃ EQD2	41.60	72.14	15.91
Chiasm	0.01 cc > 50 Gy ₃ EQD2 (n = 11)	D(0.01 cc) in Gy ₃ EQD2	57.71	76.01	50.52
		D(mean) in Gy ₃ EQD2	47.97	70.61	32.53
	0.01 cc > 70 Gy ₃ EQD2 (n = 2)	D(0.01 cc) in Gy ₃ EQD2	75.21	76.01	74.41
		D(mean) in Gy ₃ EQD2	53.17	70.61	35.72
Optical Nerve right	0.01 cc > 50 Gy ₃ EQD2 (n = 5)	D(0.01 cc) in Gy ₃ EQD2	56.67	59.11	51.32
		D(mean) in Gy ₃ EQD2	45.96	50.20	39.02
Optical Nerve left	0.01 cc > 50 Gy ₃ EQD2 (n = 6)	D(0.01 cc) in Gy ₃ EQD2	57.08	58.02	51.80
		D(mean) in Gy ₃ EQD2	34.25	43.48	26.68

Cerveau D_{0,1cc} < 120 Gy
 TC D_{0,1cc} < 100 Gy
 Voies optiques D_{0,01cc} < 75 Gy

Modalités de réirradiation

efficacité



toxicité

8 études
546 patients

Table 4 Selected studies on reirradiation for recurrent Brain Metastasis

Author	No Pts	Most common tumor histology (No)	SRS dose Gy/fr	Concurrent Systemic Therapy	Interval between SRS courses (months)	Median follow-up (months)	Median OS (months)	Median LC rate	Symptomatic RN (%)
Terakedis et al., 2014	37	Melanoma (20), Lung (9), Breast (8)	18/1	NR	9	7	8.3	80.6% at 1 year	16; 16.5 at 12 months
Minniti et al., 2015	43	NSCLC, Breast, Melanoma, Others	21–24/3	none	17	19	10	70% 1 year	14 grade 2 or more); 34 at 12 months
Shultz et al., 2015	95	Melanoma (16), Lung (38), Breast (14), GI (11)	22/1 (91%) 24/3 (8%)	NR	4	15	11	95% at 1 year	7.6
Balermipas et al., 2018	31	Breast (10), NSCLC (10), Melanoma (5), Other (6)	1 fr (24) 3–5 fr (7)	Concurrent targeted therapy (14)	12.4	11.9	61.7% and, 46.3% at 1 and 2 years	79.5% and 71.5% at 1 and 2 years	12.9, grade 3 or more
Jiang et al., 2019	63	Lung (45), Breast (8), Colorectal (3), Renal (2), Other (5)	20/1 30/2	none	10	12	18	94.4% at 1 year	14.2
Kowalchuk et al., 2021	102	NSCLC	18/1	none	12	14	NR	79% and 72% at 1 and 2 years	7
Bhatia et al., 2022	51	NSCLC (19), Breast (12), Other (20)	24/3	none	NR	32	14.1	79.5% at 1 year	10.9
Sneed et al., 2022	124	Breast, Lung, Melanoma	18/1	TKI, ICI	15.4	13.4	18.6	80% at 1 year	10

Legend: GI, Gastrointestinal; ICI, immune checkpoint inhibitors; LC, local control; NSCLC, non-small-cell lung cancer
NR, not reported; OS, overall survival; PFS, progression-free survival; Pts, patients; RN, radionecrosis;
SRS, radiosurgery; TKI, tyrosine kinase inhibitors

Suivi médian 7-19 mois

Contrôle local à 1 an
70 à 95%

Taux RN symptomatique
7 à 16 %

Modalités de réirradiation

efficacité



toxicité

8 études
546 patients

Table 4 Selected studies on reirradiation for recurrent Brain Metastasis

Author	No Pts	Most common tumor histology (No)	SRS dose Gy/fr	Concurrent Systemic Therapy	Interval between SRS courses (months)	Median follow-up (months)	Median OS (months)	Median LC rate	Symptomatic RN (%)
Terakedis et al., 2014	37	Melanoma (20), Lung (9), Breast (8)	18/1	NR	9	7	8.3	80.6% at 1 year	16; 16.5 at 12 months
Minniti et al., 2015	43	NSCLC, Breast, Melanoma, Others	21–24/3	none	17	19	10	70% 1 year	14 grade 2 or more); 34 at 12 months
Shultz et al., 2015	95	Melanoma (16), Lung (38), Breast (14), GI (11)	22/1 (91%) 24/3 (8%)	NR	4	15	11	95% at 1 year	7.6
Balermipas et al., 2018	31	Breast (10), NSCLC (10), Melanoma (5), Other (6)	1 fr (24) 3–5 fr (7)	Concurrent targeted therapy (14)	12.4	11.9	61.7% and 46.3% at 1 and 2 years	79.5% and 71.5% at 1 and 2 years	12.9, grade 3 or more
Jiang et al., 2019	63	Lung (45), Breast (8), Colorectal (3), Renal (2), Other (5)	20/1 30/2	none	10	12	18	94.4% at 1 year	14.2
Kowalchuk et al., 2021	102	NSCLC	18/1	none	12	14	NR	79% and 72% at 1 and 2 years	7
Bhatia et al., 2022	51	NSCLC (19), Breast (12), Other (20)	24/3	none	NR	32	14.1	79.5% at 1 year	10.9
Sneed et al., 2022	124	Breast, Lung, Melanoma	18/1	TKI, ICI	15.4	13.4	18.6	80% at 1 year	10

Legend: GI, Gastrointestinal; ICI, immune checkpoint inhibitors; LC, local control; NSCLC, non-small-cell lung cancer

NR, not reported; OS, overall survival; PFS, progression-free survival; Pts, patients; RN, radionecrosis;

SRS, radiosurgery; TKI, tyrosine kinase inhibitors

∅ < 1 cm

CL 1 an 82%
RN sympto 11%



∅ 2 à 3 cm

CL 1 an 65%
RN sympto 24%

Modalités de réirradiation

efficacité



toxicité

8 études
546 patients

Table 4 Selected studies on reirradiation for recurrent Brain Metastasis

Author	No Pts	Most common tumor histology (No)	SRS dose Gy/fr	Concurrent Systemic Therapy	Interval between SRS courses (months)	Median follow-up (months)	Median OS (months)	Median LC rate	Symptomatic RN (%)
Terakedis et al., 2014	37	Melanoma (20), Lung (9), Breast (8)	18/1	NR	9	7	8.3	80.6% at 1 year	16; 16.5 at 12 months
Minniti et al., 2015	43	NSCLC, Breast, Melanoma, Others	21–24/3	none	17	19	10	70% 1 year	14 grade 2 or more); 34 at 12 months
Shultz et al., 2015	95	Melanoma (16), Lung (38), Breast (14), GI (11)	22/1 (91%) 24/3 (8%)	NR	4	15	11	95% at 1 year	7.6
Balermipas et al., 2018	31	Breast (10), NSCLC (10), Melanoma (5), Other (6)	1 fr (24) 3–5 fr (7)	Concurrent targeted therapy (14)	12.4	11.9	61.7% and, 46.3% at 1 and 2 years	79.5% and 71.5% at 1 and 2 years	12.9, grade 3 or more
Jiang et al., 2019	63	Lung (45), Breast (8), Colorectal (3), Renal (2), Other (5)	20/1 30/2	none	10	12	18	94.4% at 1 year	14.2
Kowalchuk et al., 2021	102	NSCLC	18/1	none	12	14	NR	79% and 72% at 1 and 2 years	7
Bhatia et al., 2022	51	NSCLC (19), Breast (12), Other (20)	24/3	none	NR	32	14.1	79.5% at 1 year	10.9
Sneed et al., 2022	124	Breast, Lung, Melanoma	18/1	TKI, ICI	15.4	13.4	18.6	80% at 1 year	10

Legend: GI, Gastrointestinal; ICI, immune checkpoint inhibitors; LC, local control; NSCLC, non-small-cell lung cancer

NR, not reported; OS, overall survival; PFS, progression-free survival; Pts, patients; RN, radionecrosis;

SRS, radiosurgery; TKI, tyrosine kinase inhibitors

Risque RN sympto:

D cum > 40 Gy

Cerveau sain: V12Gy >9cc

Modalités de réirradiation

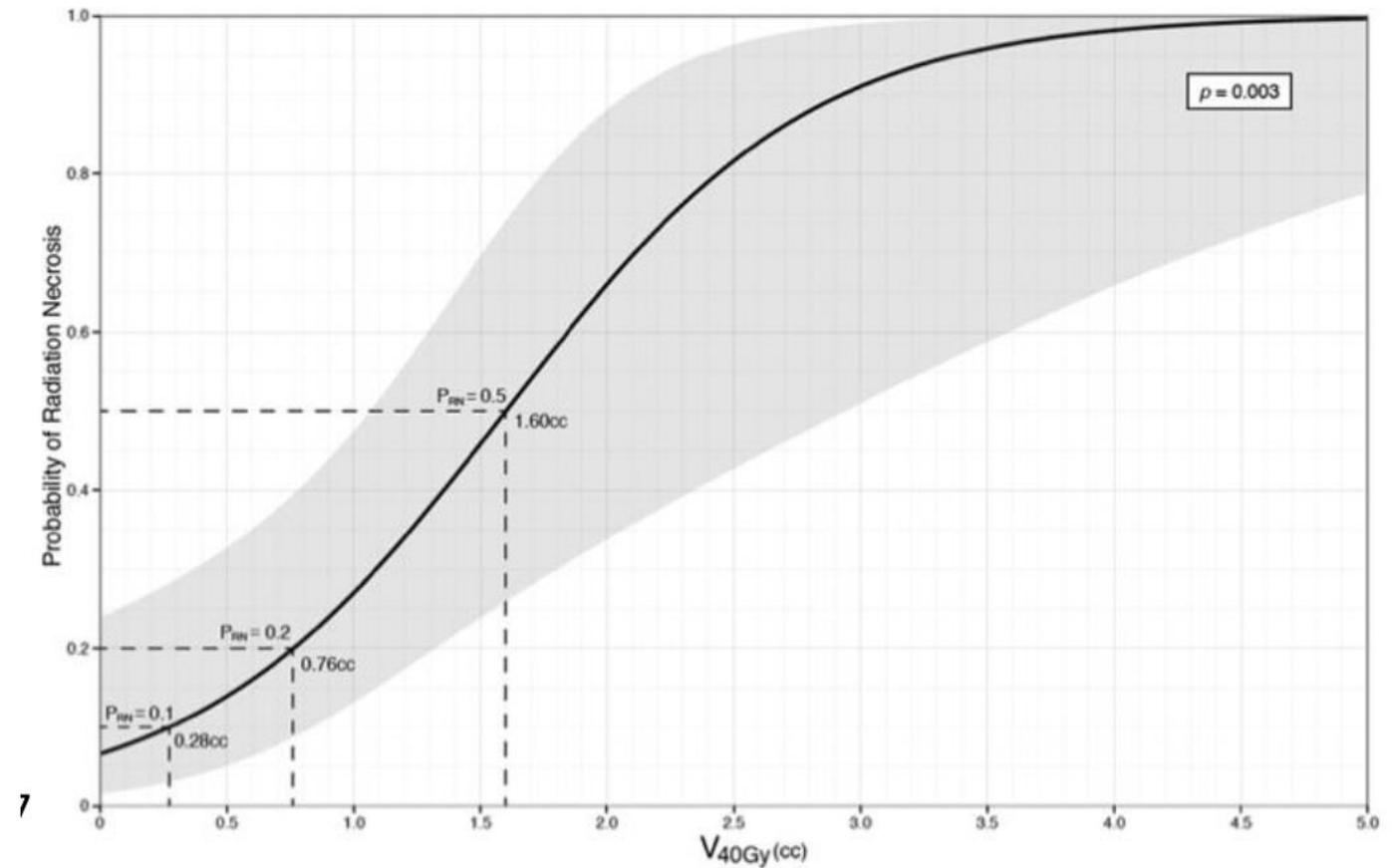
efficacité



toxicité

risque 10% $V_{40} > 0,28\text{cc}$
risque 20% $V_{40} > 0,76\text{cc}$
risque 50% $V_{40} > 1,6\text{cc}$

Cohorte de 32 patients, 46 lésions
SRS uniquement



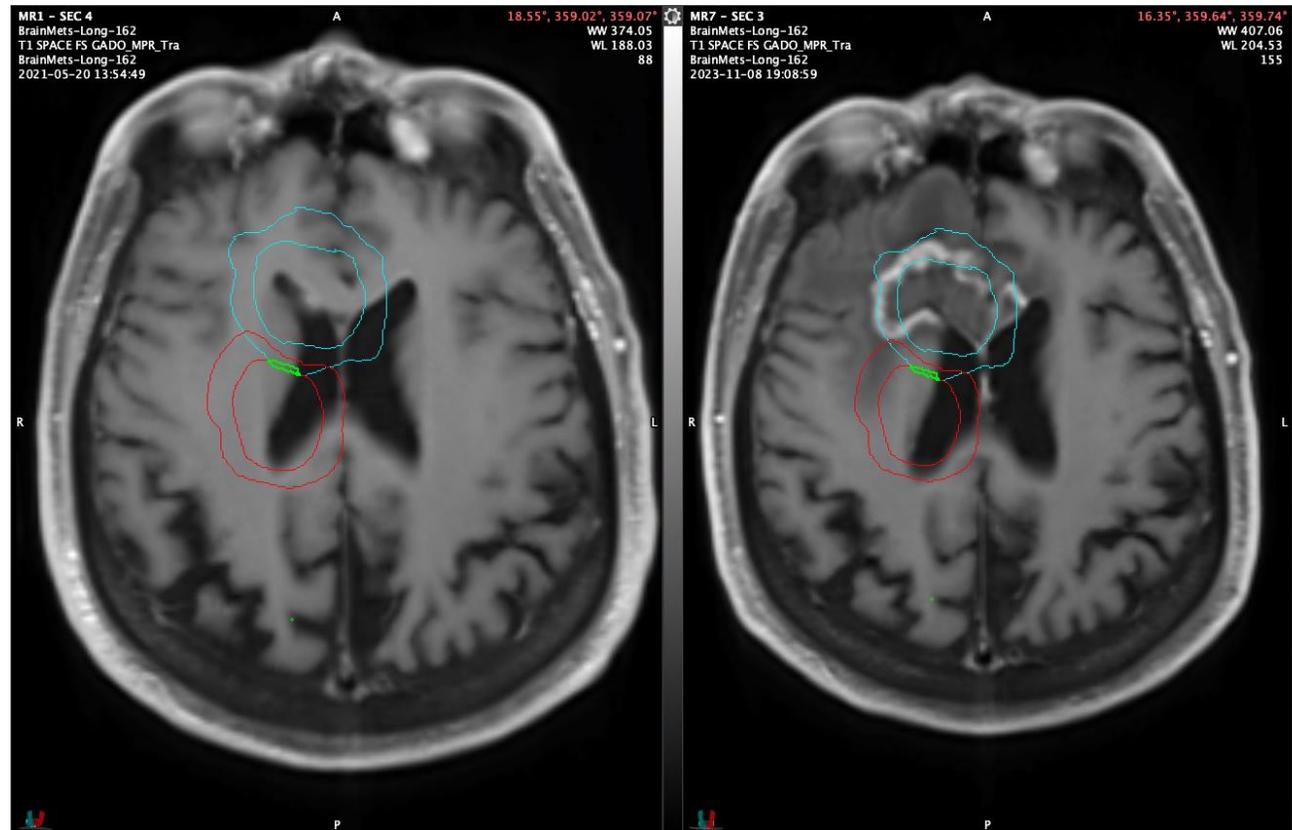
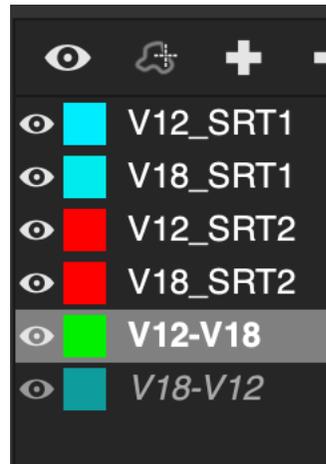
Modalités de réirradiation

efficacité



toxicité

V18-V12 Gy



Suivi médian 19 mois

Taux RN :

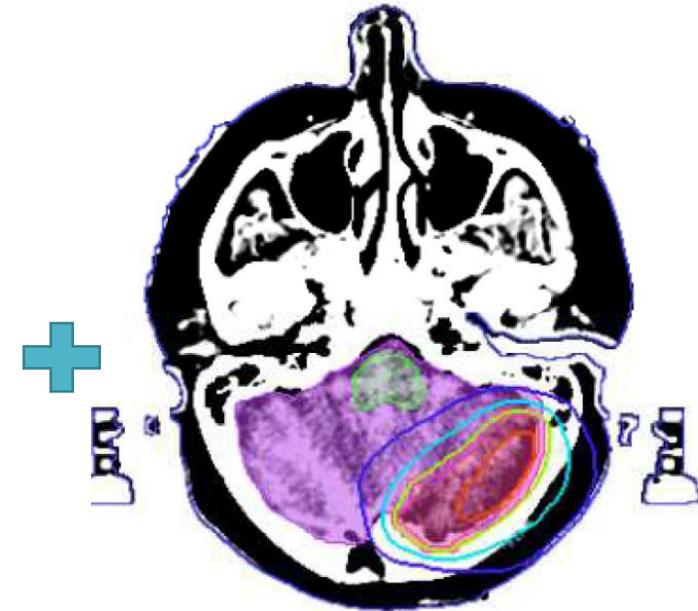
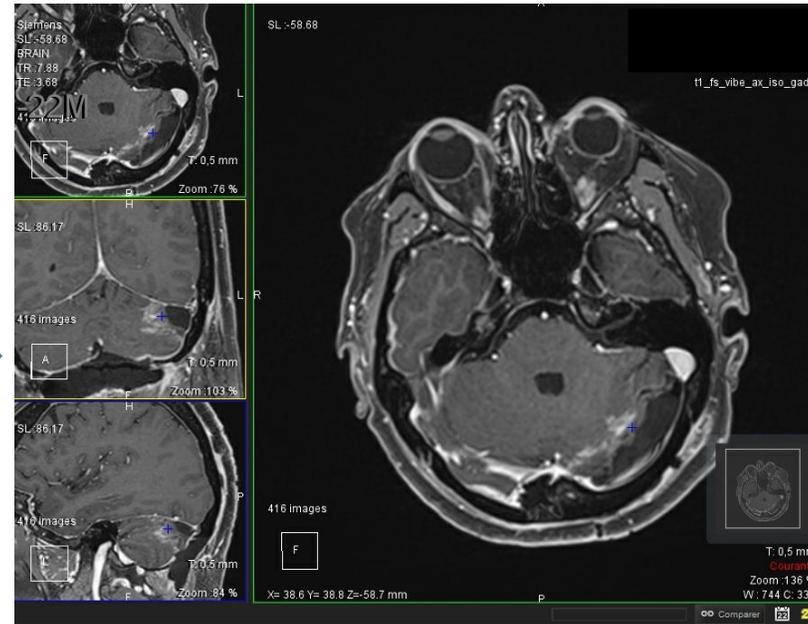
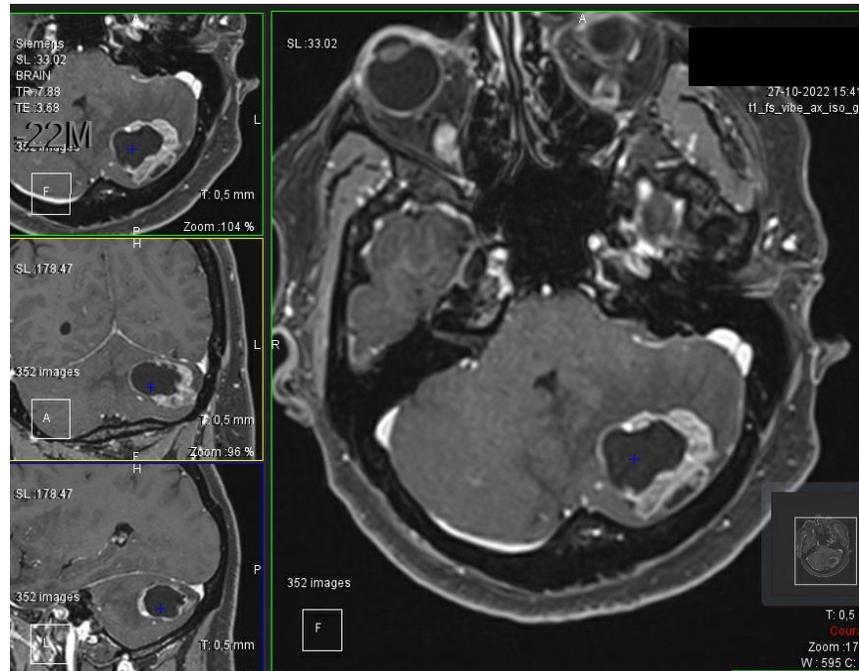
53% pour V18-12 Gy \geq 10 cm³

15% pour V18-12 Gy < 10 cm³

Modalités de réirradiation – gestion des ttt précédents en pratique

2022

Type I

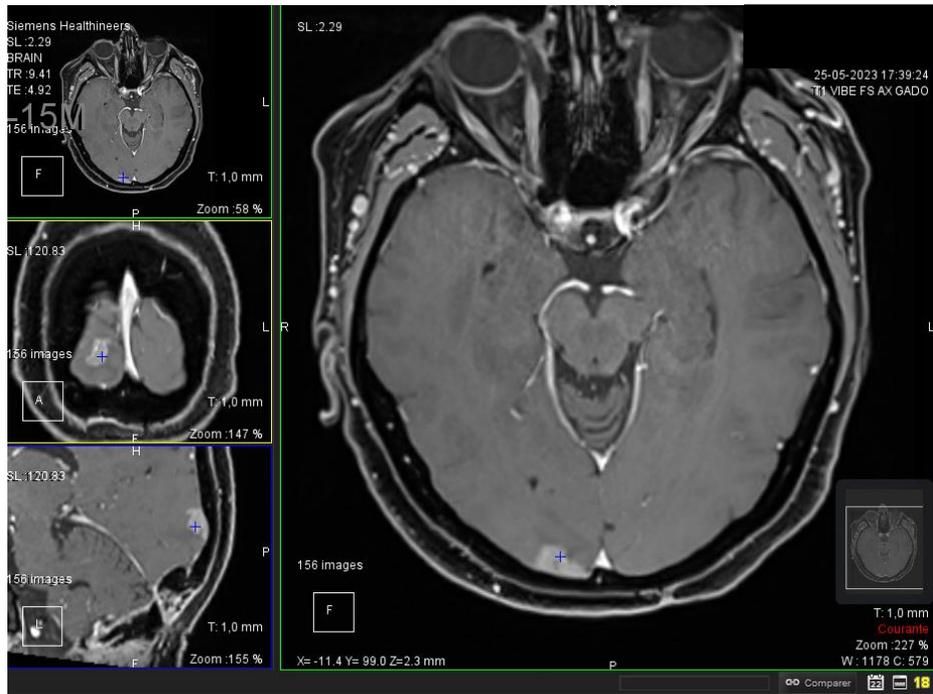


3 x 7,7 Gy



Modalités de réirradiation – gestion des ttt précédents

2023



3 x 7,7 Gy

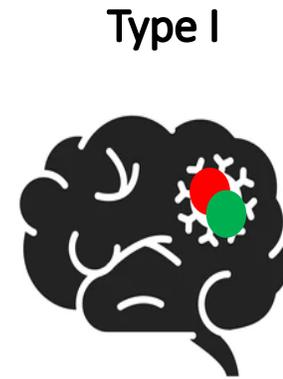
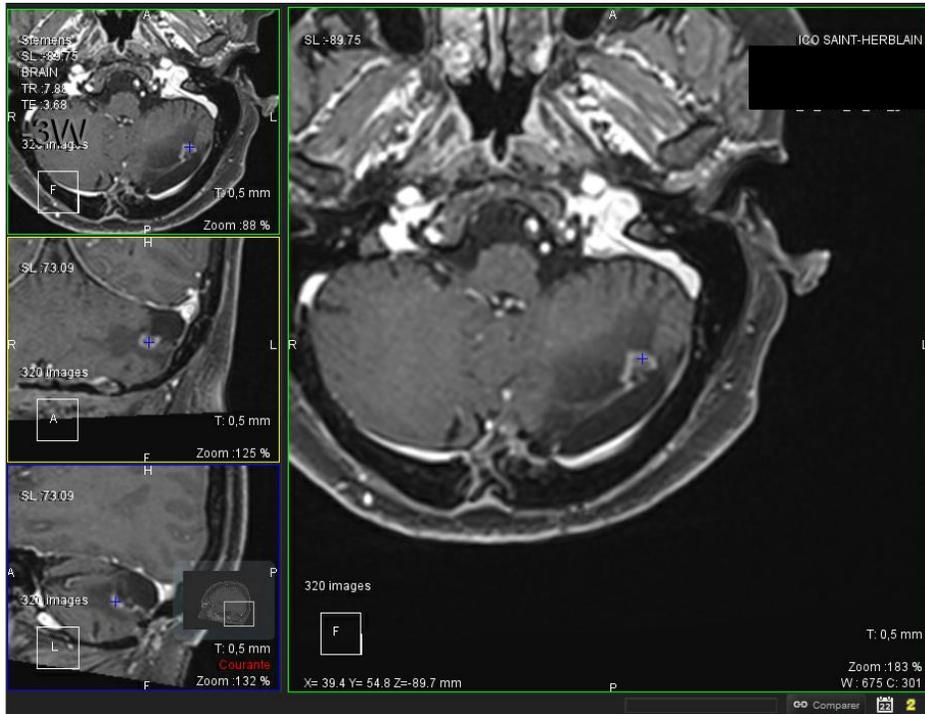
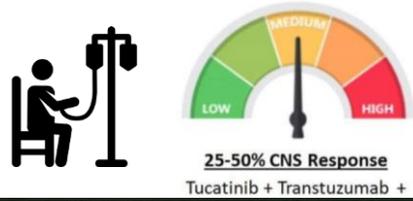


inclusion INTERCEPT
(+TUCATINIB)



Modalités de réirradiation – gestion des ttt précédents

2024





Modalités de réirradiation – gestion des ttt précédents

2024

The screenshot displays the Brainlab software interface. On the left, there are three CT scan views: Axial, Coronal, and Sagittal. The main window shows a fusion tree under 'DONNÉES SÉLECTIONNÉES'. The tree lists the following acquisitions:

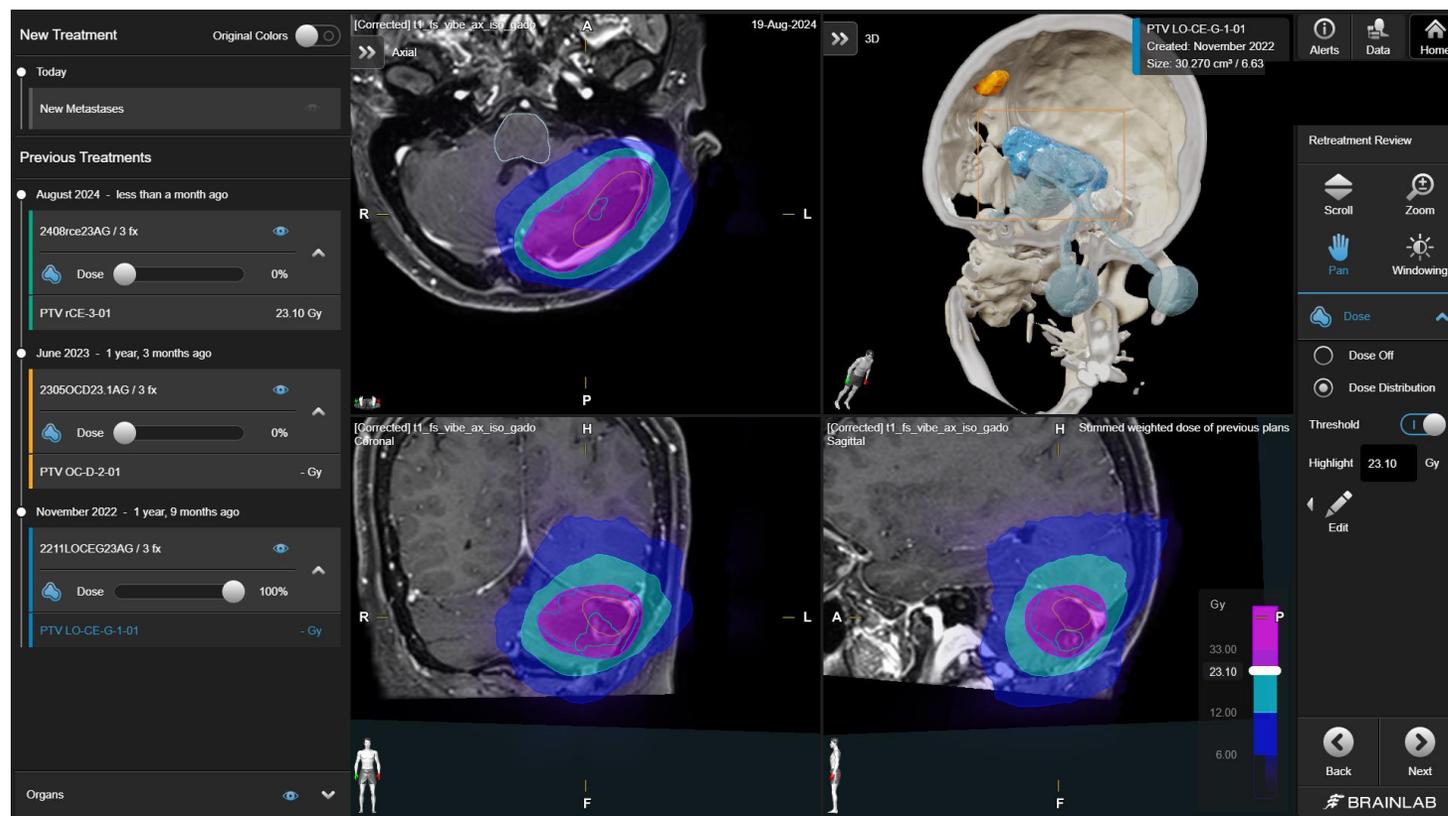
- Acquisition 1 (August 2024):** TDM 221, CRANE STEREO IV Br36, 1.0 mm, 8/22/2024, 12:07:56 PM. Includes an IRM [Corrected] 320, 11.5>vibe_ax_iso_gado, 0.5 mm, 8/19/2024, 12:30:31 PM.
- Acquisition 2 (June 2023):** TDM 194, CT #2, 1.0 mm, 6/5/2023, 11:29:18 AM.
- Acquisition 3 (November 2022):** TDM 208, CT #1, 1.0 mm, 11/22/2022, 11:22:05 AM.

Select previous treatments		
2408rce23AG	27-Aug-2024, 16:25:24	APPROVED
August 2024 - less than a month ago	Cranial SRS; 23 10 Gy / 3 fx / SRS / D99 5 % = 23 10 Gy, D2 0 % = 33 00 Gy, 3 VMAT Arcs	Plan Id: 2408rce23AG
2305OCD23.1AG	05-Jun-2023, 15:15:14	APPROVED
June 2023 - 1 year, 3 months ago	17 Objects 3 fx, 5 beams, head_first_supine 1 of 1 available dose(s), Dose Type(s): PHY...	Plan Id: 2305OCD23.1AG
2211LOCEG23AG	22-Nov-2022, 14:28:45	APPROVED
November 2022 - 1 year, 9 months ago	19 Objects 3 fx, 5 beams, head_first_supine 1 of 1 available dose(s), Dose Type(s): PHY...	Plan Id: 2211LOCEG23AG



Modalités de réirradiation – gestion des ttt précédents

2022/2023/2024



CTV post op 2022
GTV 2024

Iso 3x7,7 2022



Modalités de réirradiation – gestion des ttt précédents

2022/2023/2024

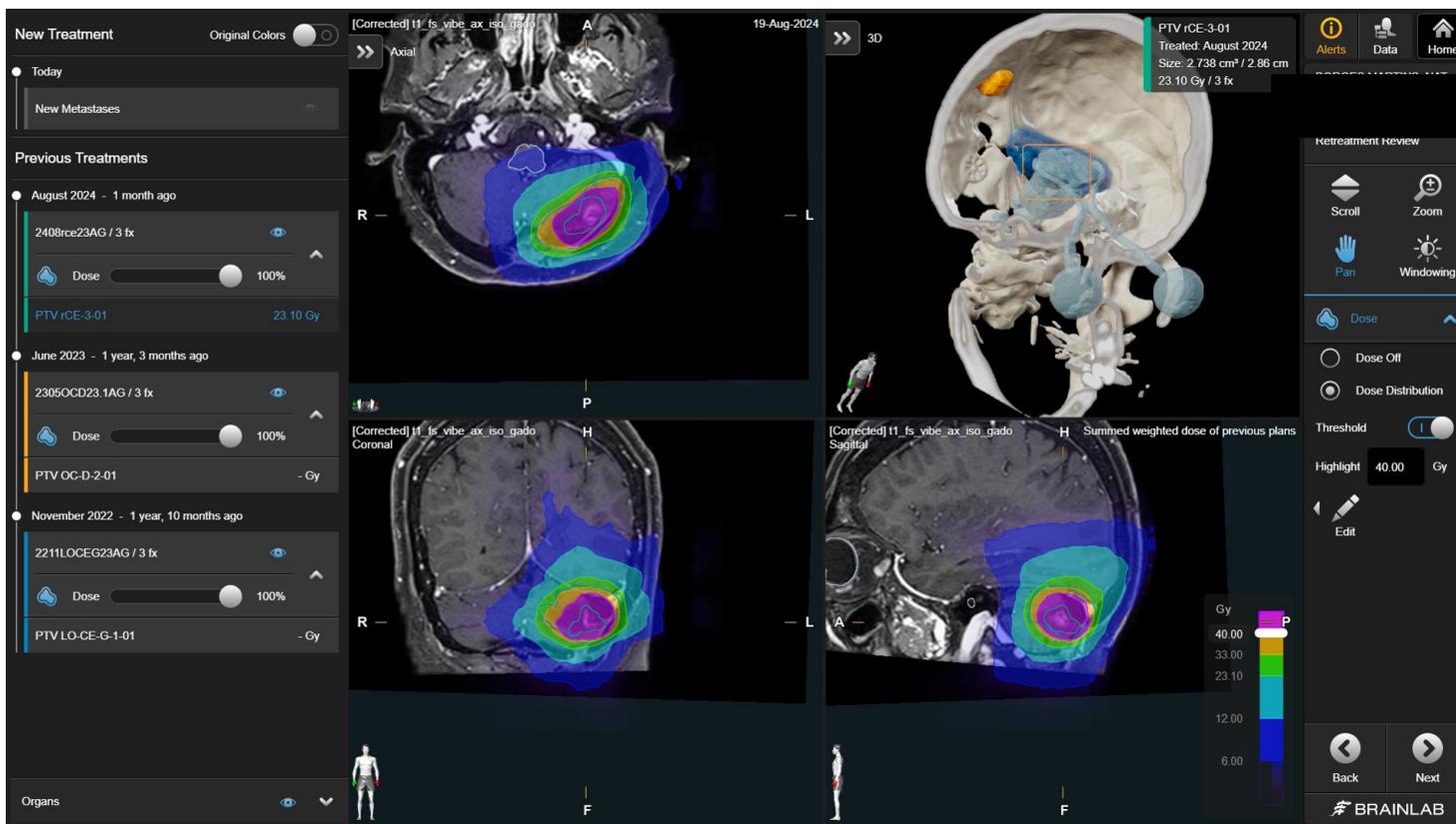
CTV post op 2022
GTV 2024

Iso 3x7,7 2024



Modalités de réirradiation – gestion des ttt précédents

2022/2023/2024

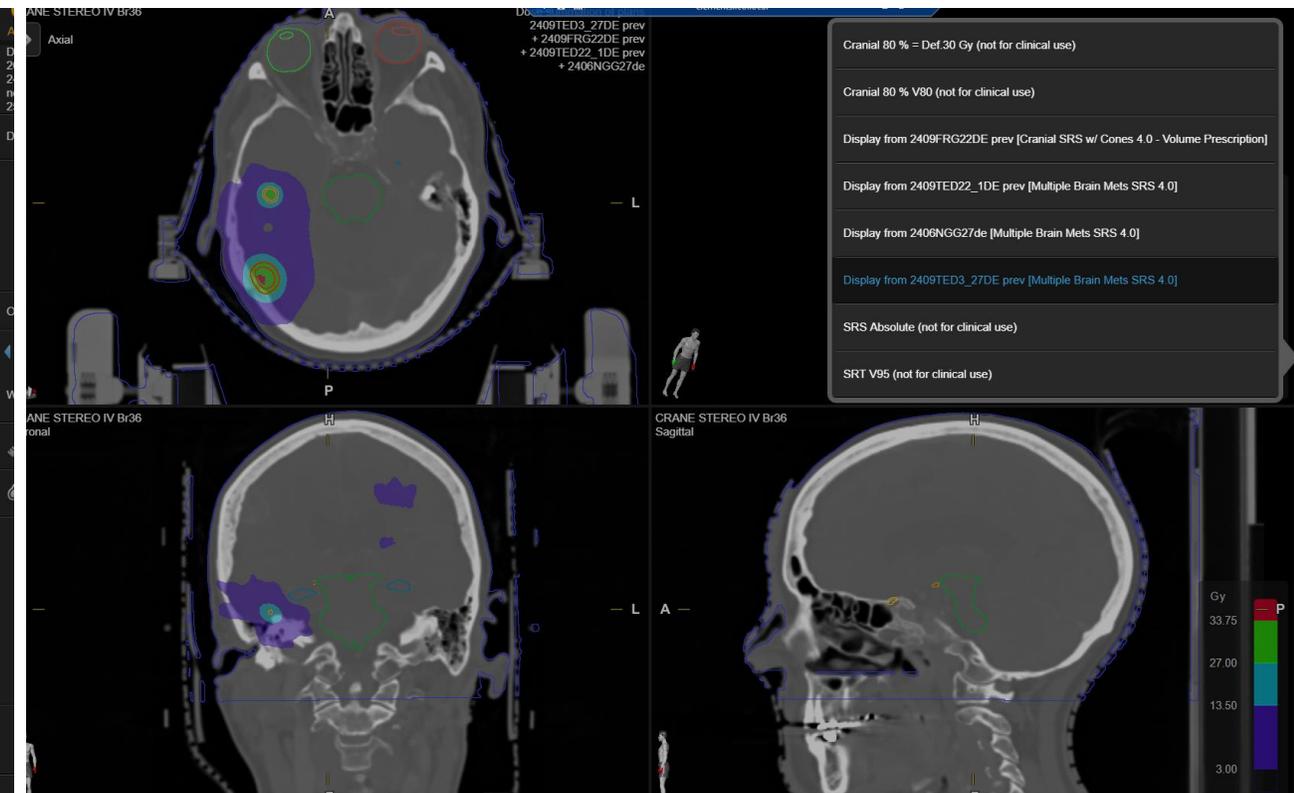
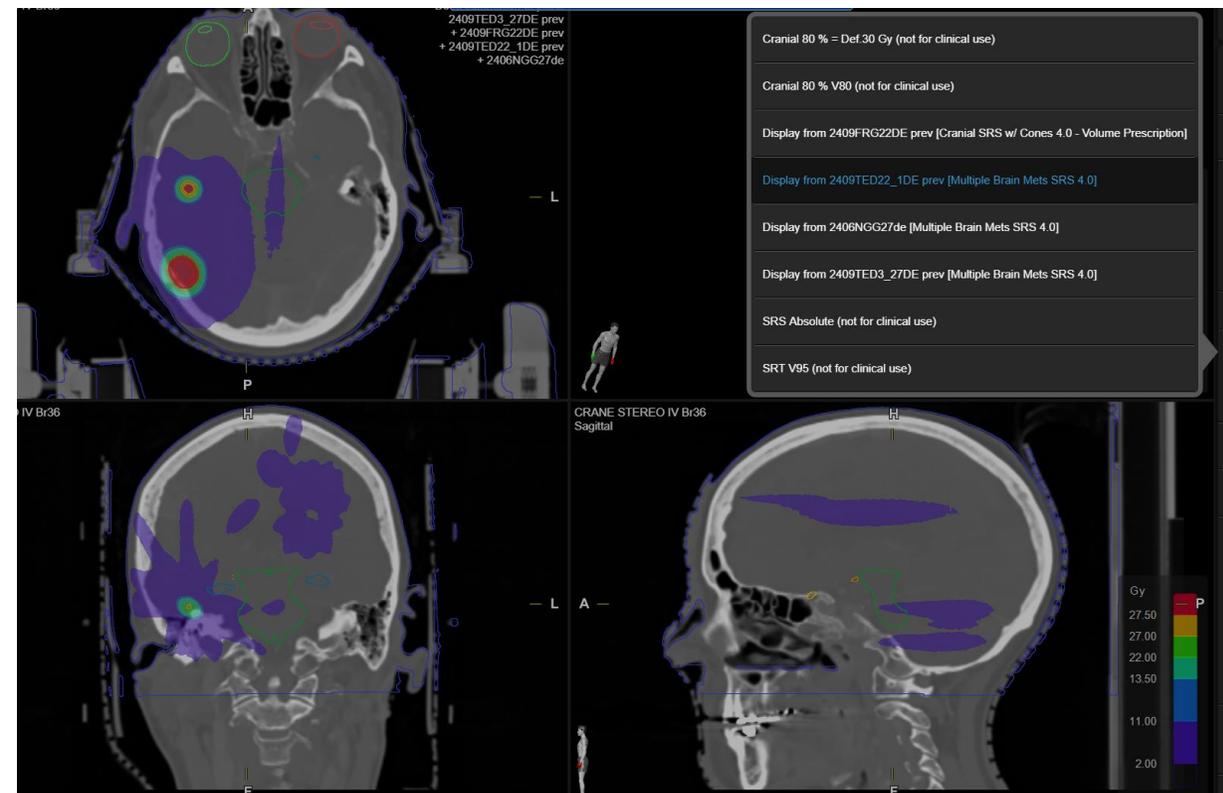
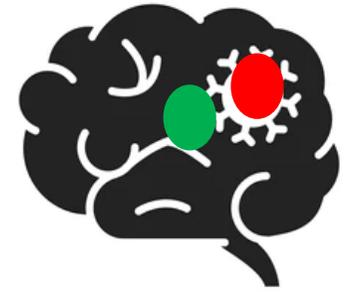


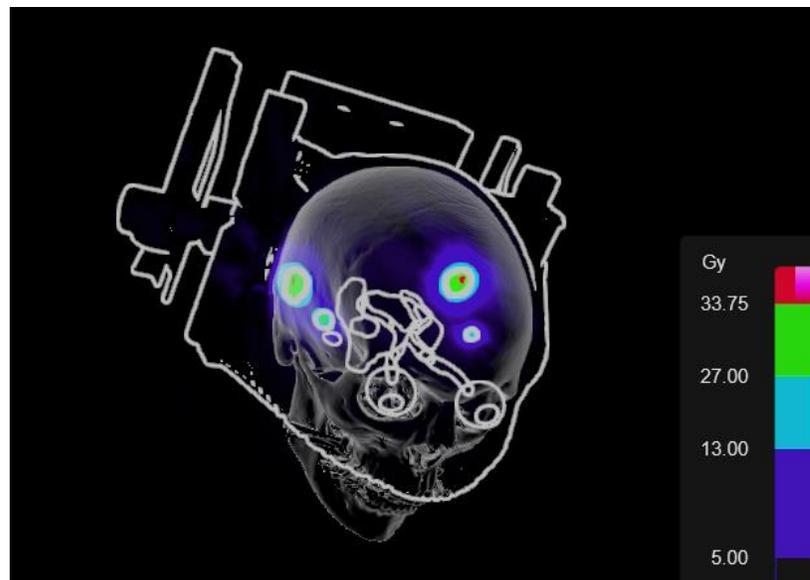
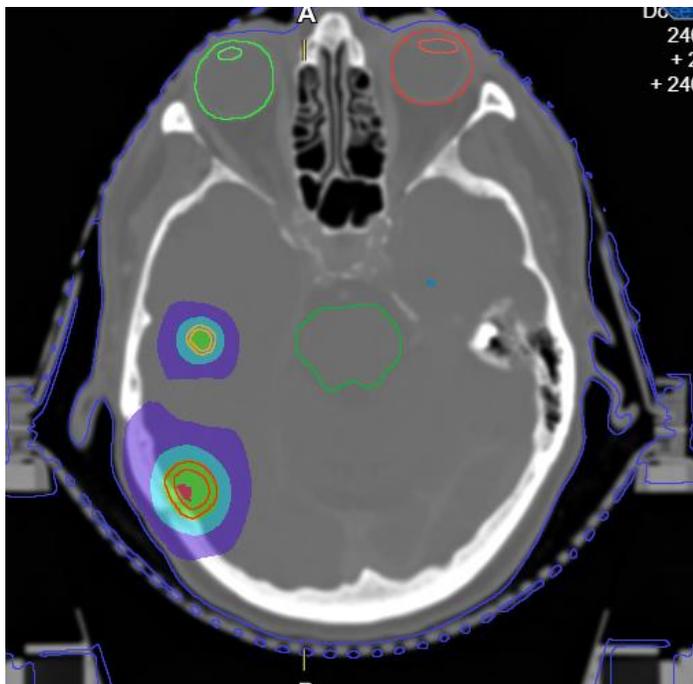
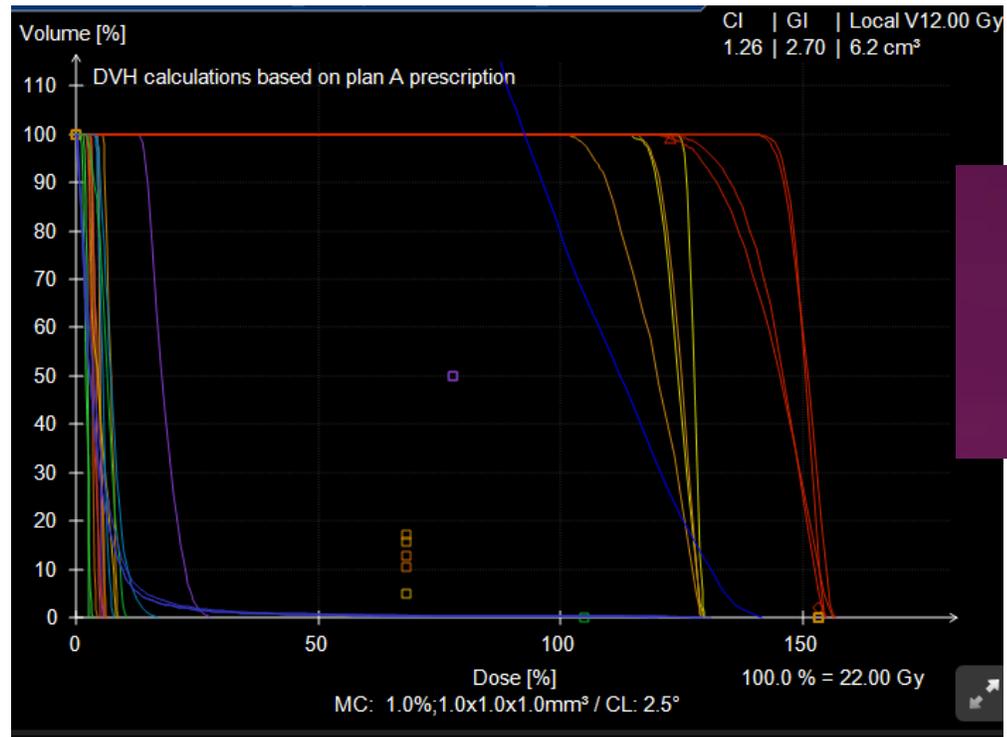
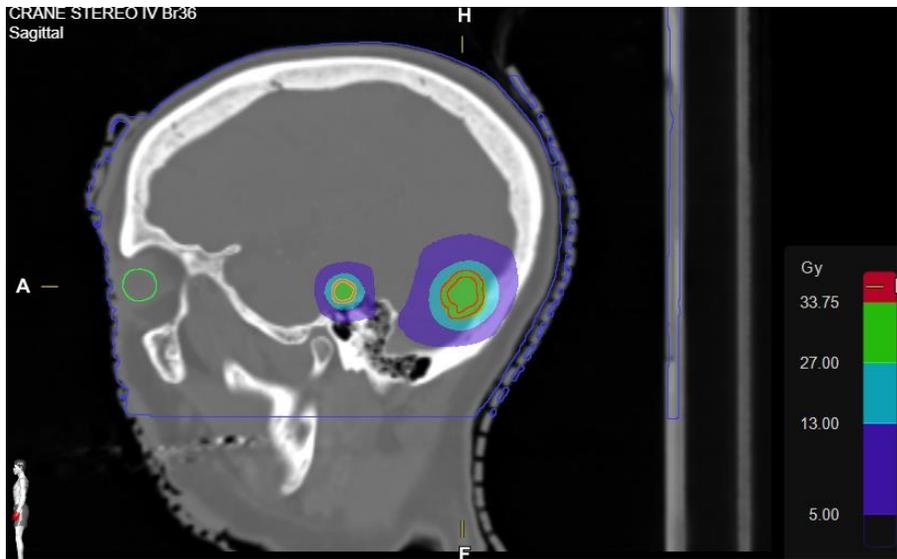
CTV post op 2022
GTV 2024

Iso 40Gy 2022 + 2024

Modalités de réirradiation – gestion des ttt précédents en pratique

Type II





BRAINLAB

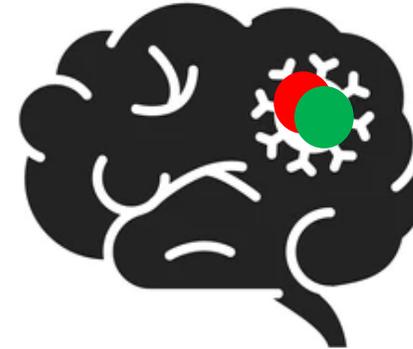
Elements Retreatment Review¹

Perspectives de
diagnostic

SRS/SRT primotraitement

Rechute Locale

10 à 25 %



● Métastase initiale
● RL

Radionécrose

5 à 35 %



★ RN

SRS/SRT primotraitement / ré-irradiation

Rechute Locale

10 à 25 %



12 à 54 %

Radionécrose

5 à 35 %



2 à 36 %

SRS/SRT primotraitement / ré-irradiation

Rechute Locale

10 à 25 %

12 à 54 %

Les deux ??

Radionécrose

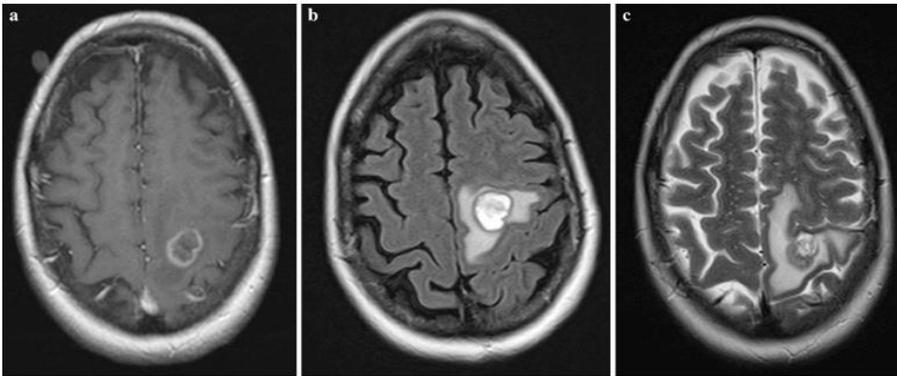
5 à 35 %

2 à 36 %



Diagnostic différentiel RL/RN

	RL	RN	Sensibilité	Spécificité
IRM T1	LQ<0,3	LQ>0,6	8%	91%

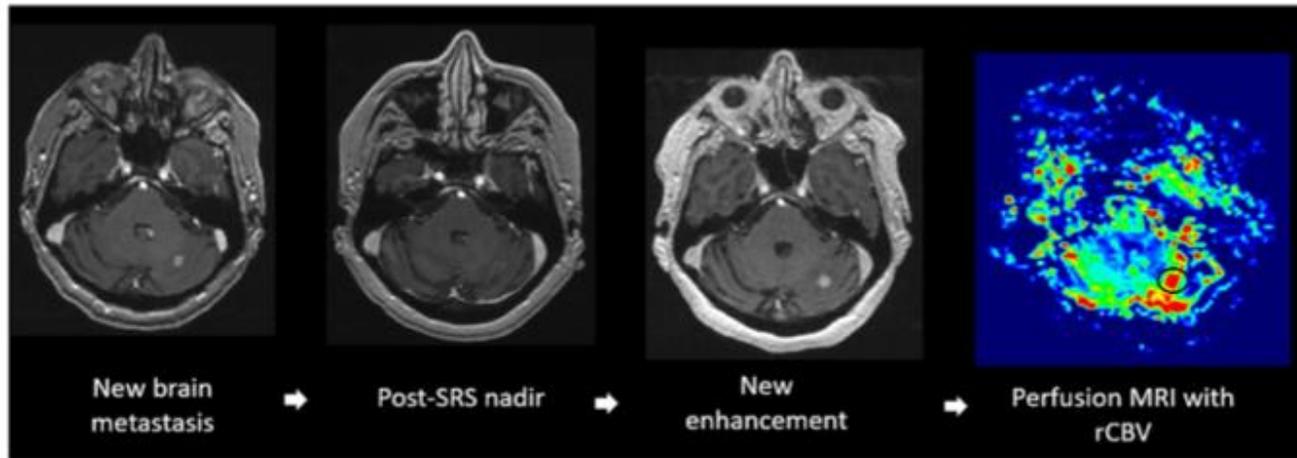


« Mismatch T1/T2 »

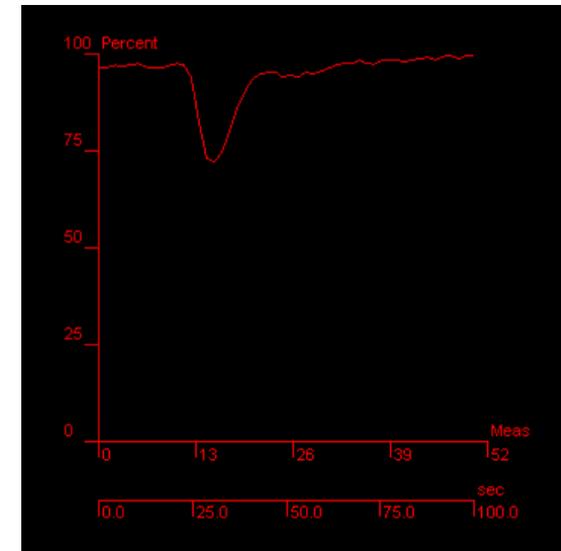
$$LQ \text{ (quotient de lésion)} = \frac{\text{Aire de section transversale maximale de la lésion T2}}{\text{Aire de section transversale maximale de la lésion T1}}$$

Diagnostic différentiel RL/RN

	RL	RN	Sensibilité	Spécificité
IRM T1	LQ<0,3	LQ>0,6	8%	91%
IRM perfusion	rCBV>2,1	rCBV<2,1	100%	95%

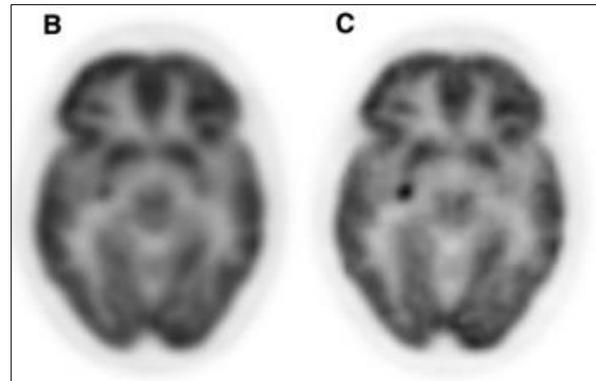
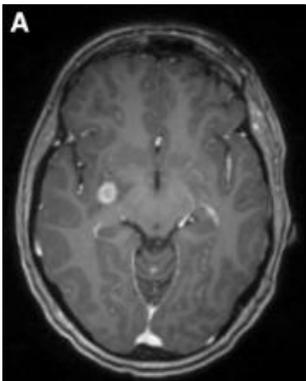


« rCBV »



Diagnostic différentiel RL/RN

	RL	RN	Sensibilité	Spécificité
IRM T1	LQ<0,3	LQ>0,6	8%	91%
IRM perfusion	rCBV<2,1	rCBV>2,1	100%	95%
TEP 18F-FDG	Indice>0,19	Indice<0,19	95%	100%
TEP F-DOPA	Ratio SUVmax >1,6	Ratio SUVmax <1,6	90%	92%



« indice rétentionnel »

$$\frac{R4h - R1h}{R1h} > 0,19$$

Diagnostic différentiel RL/RN

	RL	RN	Sensibilité	Spécificité
IRM T1	LQ<0,3	LQ>0,6	8%	91%
IRM perfusion	rCBV<2,1	rCBV>2,1	100%	95%
TEP 18F-FDG	Indice<0,19	Indice>0,19	95%	100%



- Artefact
- rCBV: seuil machine dépendant

- Résolution spatiale
- Corrélation anatomique scanner

TEP-MR?

Diagnostic différentiel RL/RN

2021-2022
N=23 (dt 12M+)
Suspicion RL/RN à l'IRMmp



30 min post injection FDG:

- MRAC (T1 atténuation)
- PET acquisition 1
- FLAIR
- SWI/Diffusion/carte ADC
- Inj Gado: perfusion/rCBV, SeqT1 3D

4h post injection FDG:

- MRAC (T1 atténuation gado+)
- PET acquisition 2

Évaluation
qualitative

Évaluation semi-
quantitative



Gold standard

- anatomoP (18%)
- Stabilité/régression 3-6 mois

Diagnostic différentiel RL/RN

2021-2022
N=23 (dt 12M+)
Suspicion RL/RN à l'IRMmp



30 min post injection FDG:

- MRAC (T1 atténuation)
- PET acquisition 1
- FLAIR
- SWI/Diffusion/carte ADC
- Inj Gado: perfusion/rCBV, SeqT1 3D

4h post injection FDG:

- MRAC (T1 atténuation gado+)
- PET acquisition 2

Évaluation qualitative

Évaluation semi-quantitative

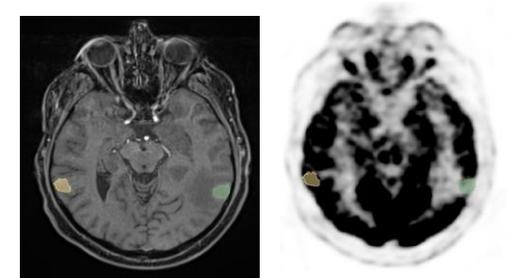


Gold standard

- anatomoP (18%)
- Stabilité/régression 3-6 mois

« indice rétentionnel de Horky »

$$\frac{R4h - R1h}{R1h}$$



Diagnostic différentiel RL/RN

	Évaluation qualitative	Évaluation semi-quantitative	
		ROI 1	ROI 2
Sensibilité	86 %	89 %	100 %
Spécificité	75 %	100 %	100 %





Gestion des
toxicités