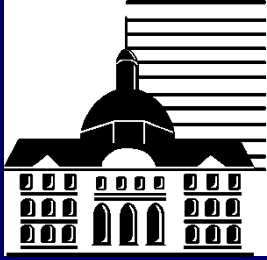


Radiochirurgie des métastases cérébrales

Jean-Jacques MAZERON

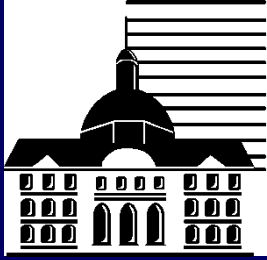
**Groupe hospitalier Pitié-Salpêtrière,
47-83, bvd de l'hôpital, 75651 Paris cedex 13 – France
jean-jacques.mazeron@psl.aphp.fr**



Introduction

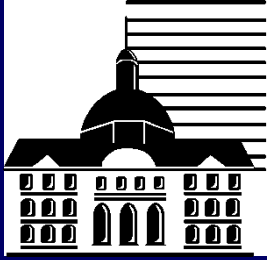
Avantages de la radiochirurgie

- **Même survie que chirurgie + radiothérapie panencéphalique**
- **Hospitalisation courte, pas d'anesthésie générale**
- **Possible dans les régions inopérables**
- **Possible chez les patients âgés**
- **Taux de mortalité < 1%**
- **Peu d'effets secondaires**
- **Peut être répétée**



Principes

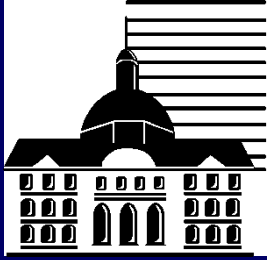
- **Définition de la cible très précise (IRM)**
- **Dosimétrie 3D**
- **Dose très forte dans la métastase**
- **Dose faible dans les tissus sains (pas ou peu d'alopecie +++)**



Radiochirurgie des métastases cérébrales

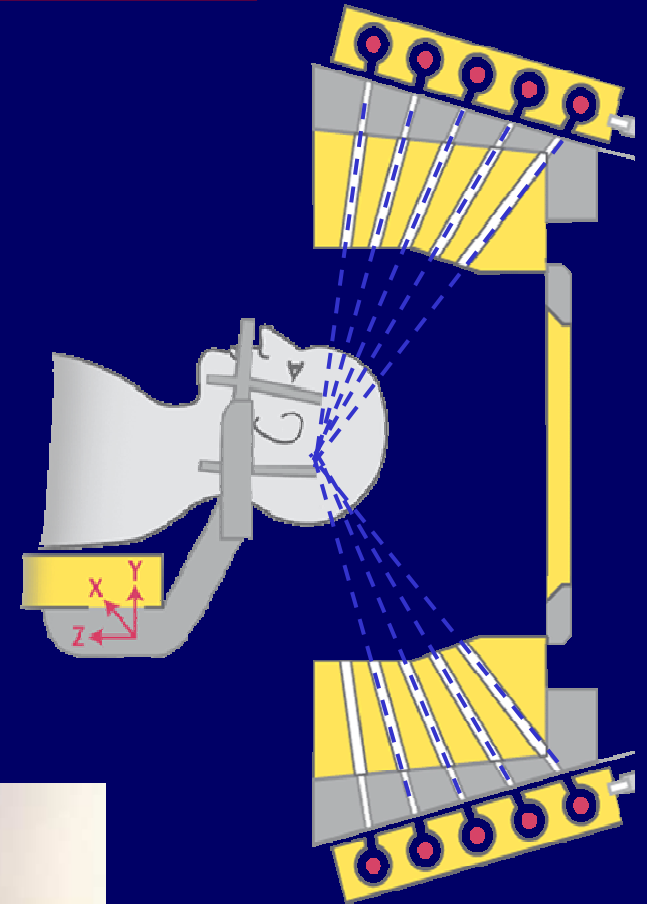
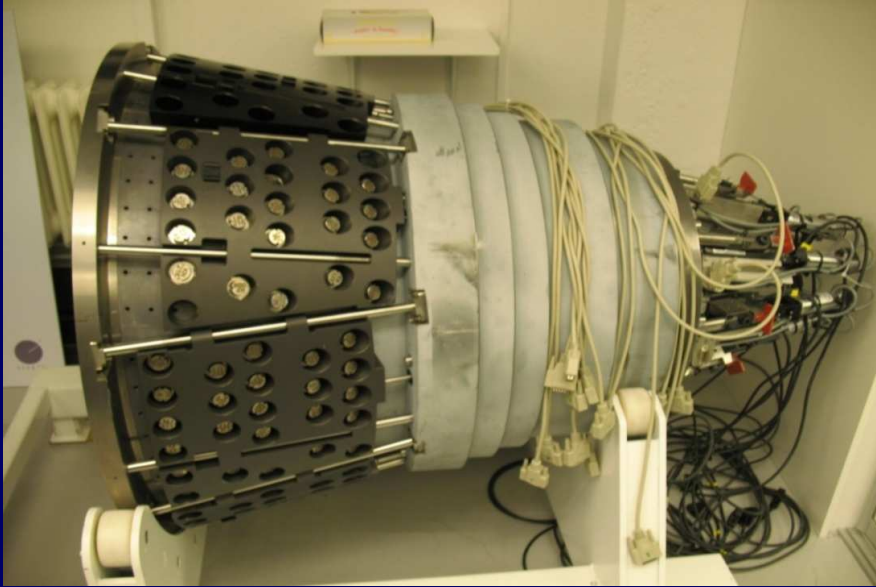
Appareils

- **Gamma Unit**
- **Accélérateurs linéaires**



Radiochirurgie des métastases cérébrales

Gamma Unit

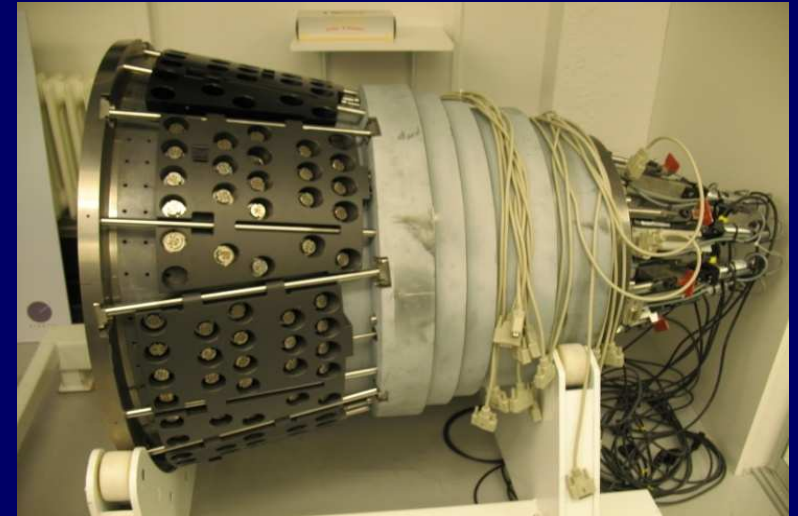
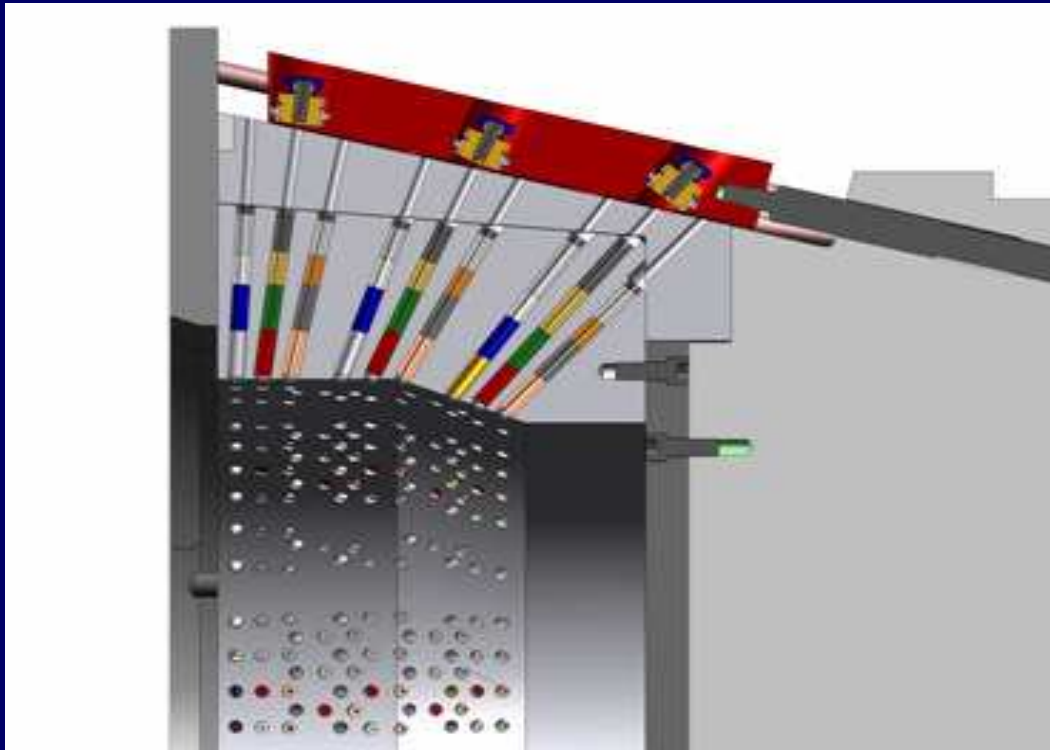




Radiochirurgie des métastases cérébrales

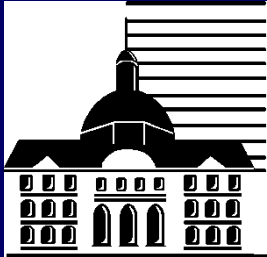
Gamma Knife® Perfexion™

192 sources de Co^{60} réparties sur 8 secteurs
3 dimensions de collimateurs : 4, 8 ou 16 mm
576 collimateurs



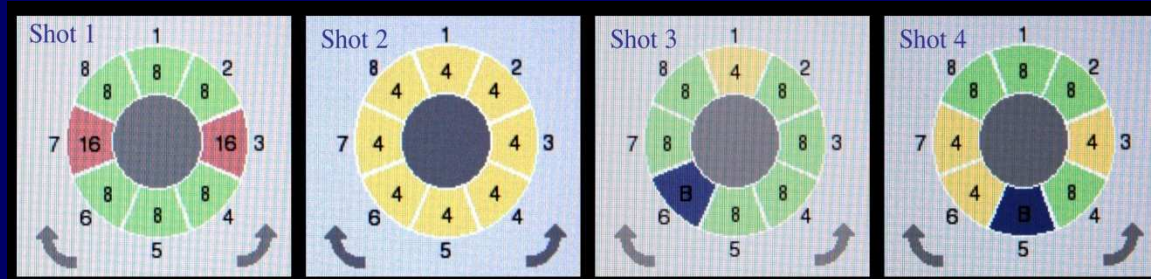
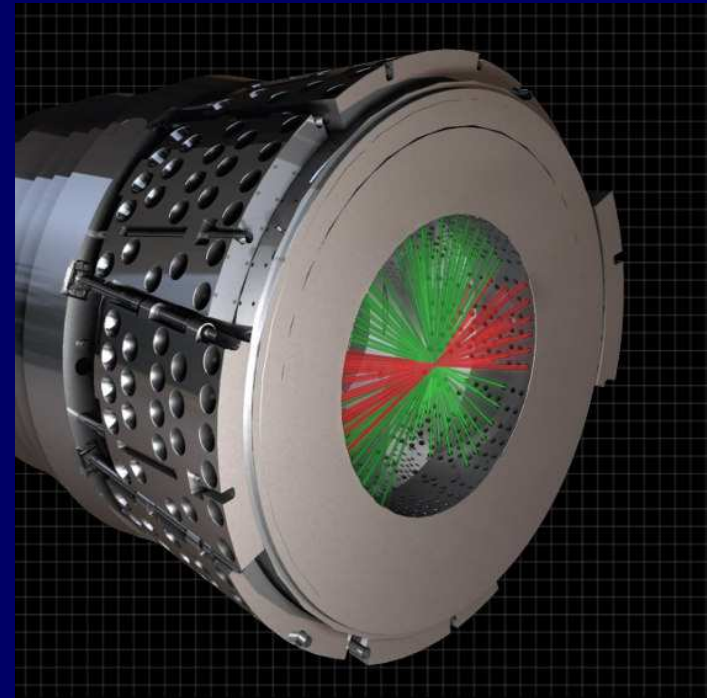
5 positions pour les secteurs

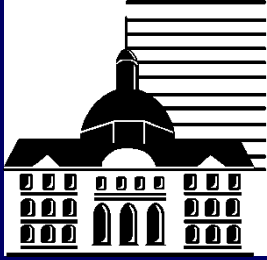
- Sécurité
- 8 mm
- Secteur bloqué
- 4 mm
- 16 mm



Radiochirurgie des métastases cérébrales

Gamma Knife® Perfexion™

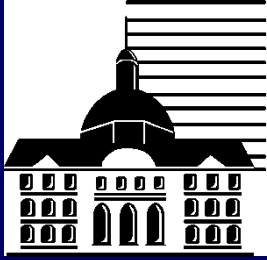




Radiochirurgie des métastases cérébrales

Novalis Tx



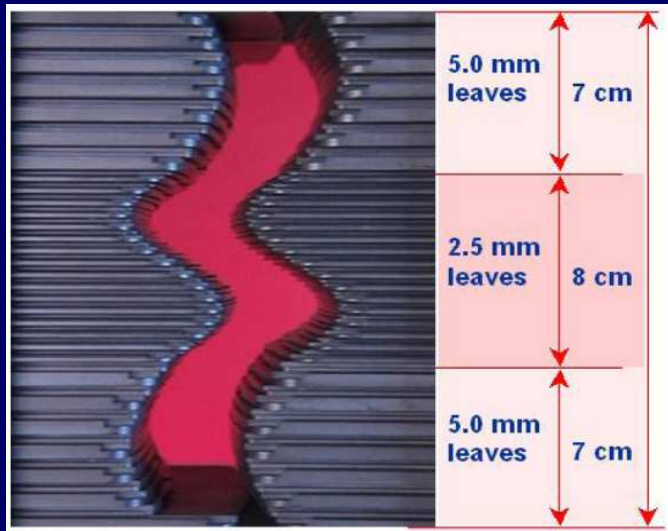


Radiochirurgie des métastases cérébrales

Novalis Tx

– Collaboration Varian et Brainlab

- De 6 à 25 MV (3 au choix)
- Jusqu'à 1000 UM/min
- Collimateur HD120 lames



Champ max : 22 x 40 cm²





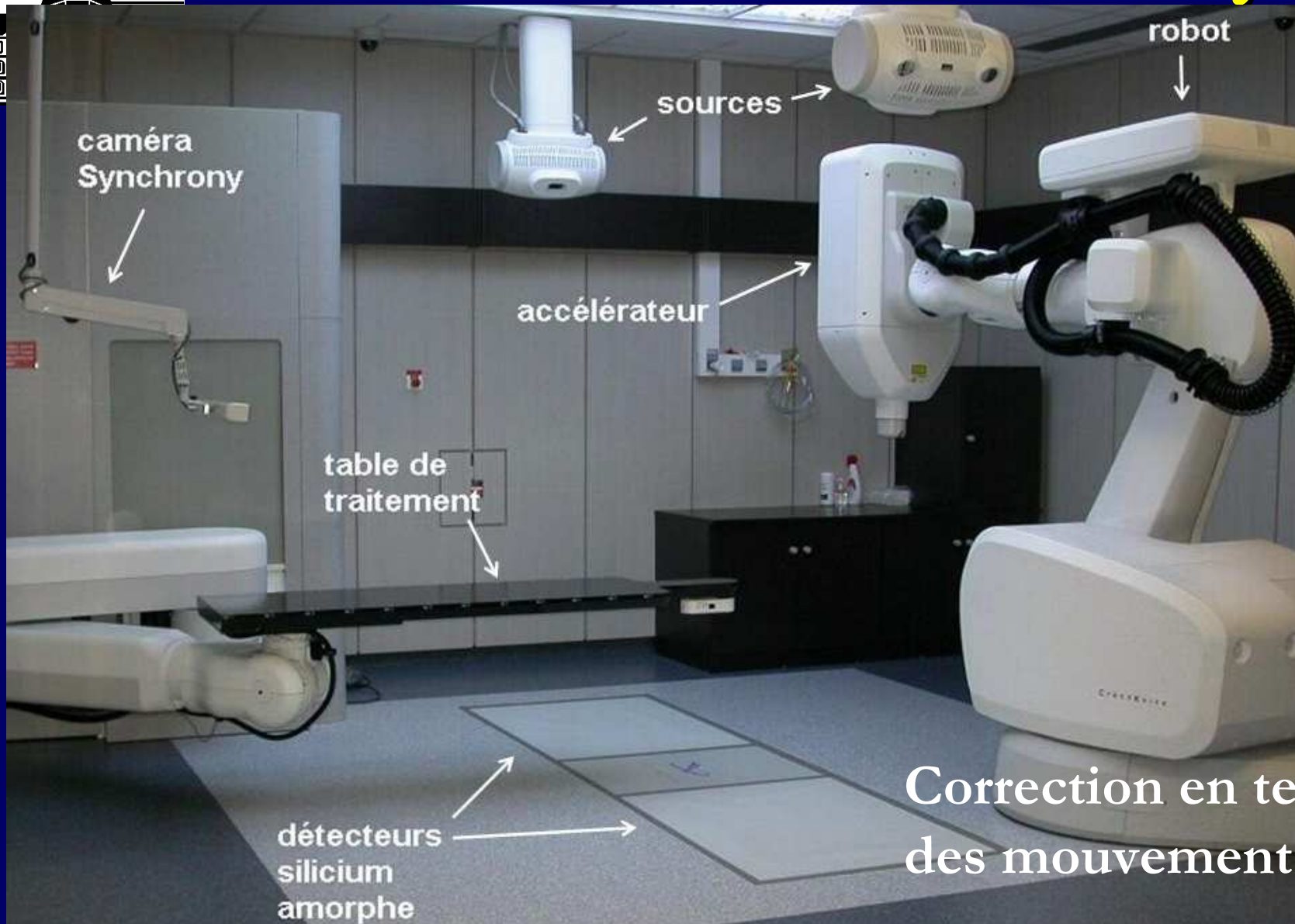
Radiochirurgie des métastases cérébrales



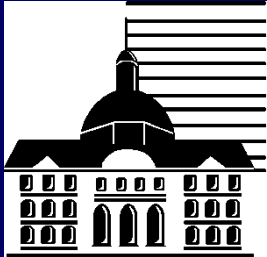
- Pas de cadre invasif : précision de repositionnement sub millimétrique
- Images kV pour positionnement du patient + vérification durant la séance
- Table à 6° de liberté

Radiochirurgie des métastases cérébrales

Cyberknife



Correction en temps réel
des mouvements du patient



Radiochirurgie des métastases cérébrales

Cyberknife

- 1 seule énergie : 6 MV ($d_{\max}=15$ mm)
- Débit : de 600 à 1000 UM/min (selon modèles)
- Pas de filtre égalisateur
- 12 collimateurs
 - ϕ 5 à 60 mm @ 80 cm
 - Iris variable

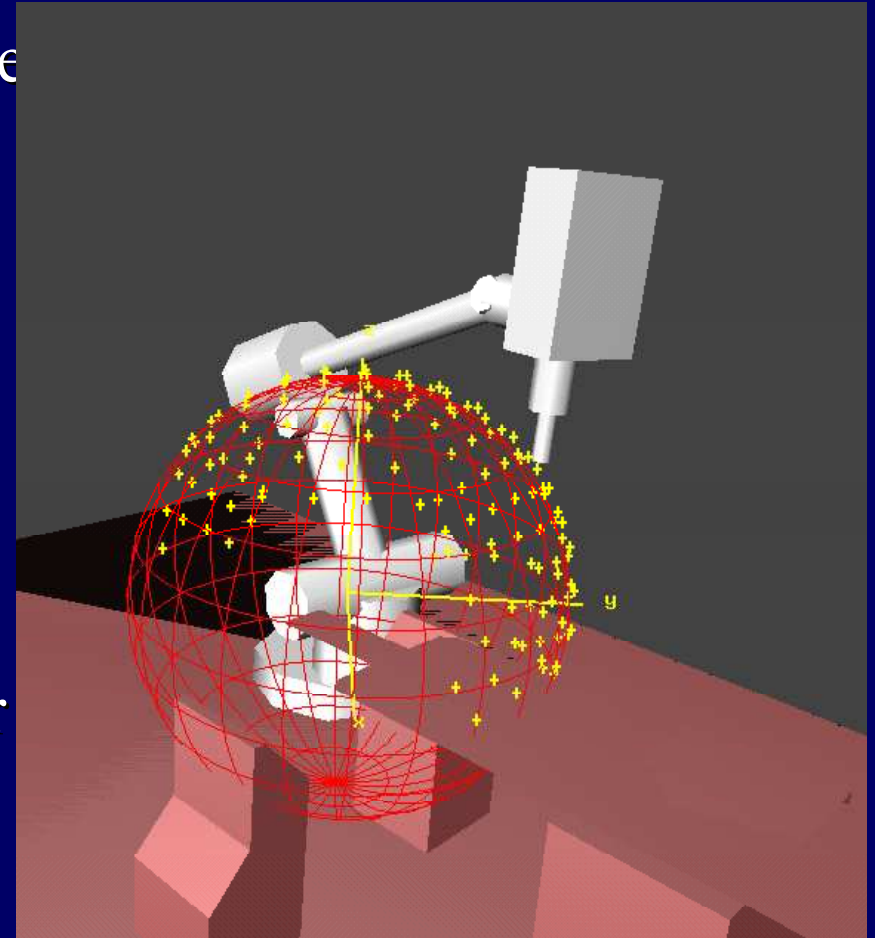




Radiochirurgie des métastases cérébrales

Cyberknife

- Passage automatique du bras par certains points de position dans l'espace (nœuds) selon un trajet préétabli et systématiquement suivi
- + 100 nœuds et 12 directions possibles par nœuds
- + de 1200 faisceaux potentiels
- Précision mécanique : 0.12 mm
- Précision globale $< 1\text{mm}$ (0.5 mm pour cibles fixes et 0.7 mm pour cibles mobiles)

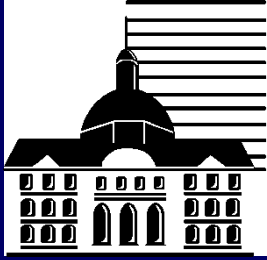




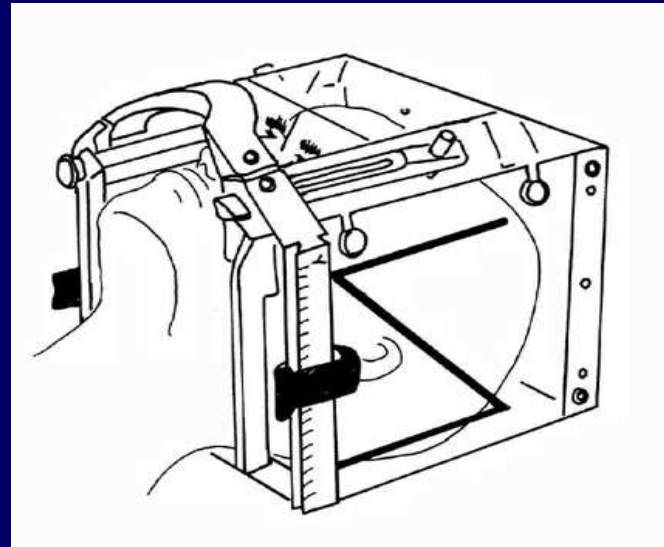
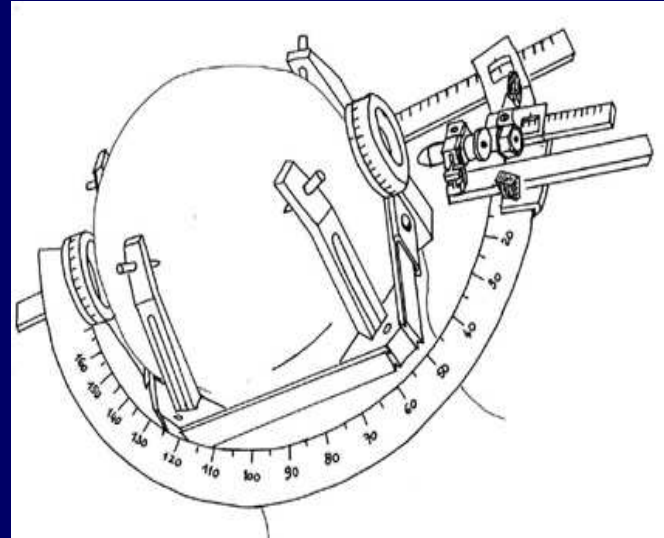
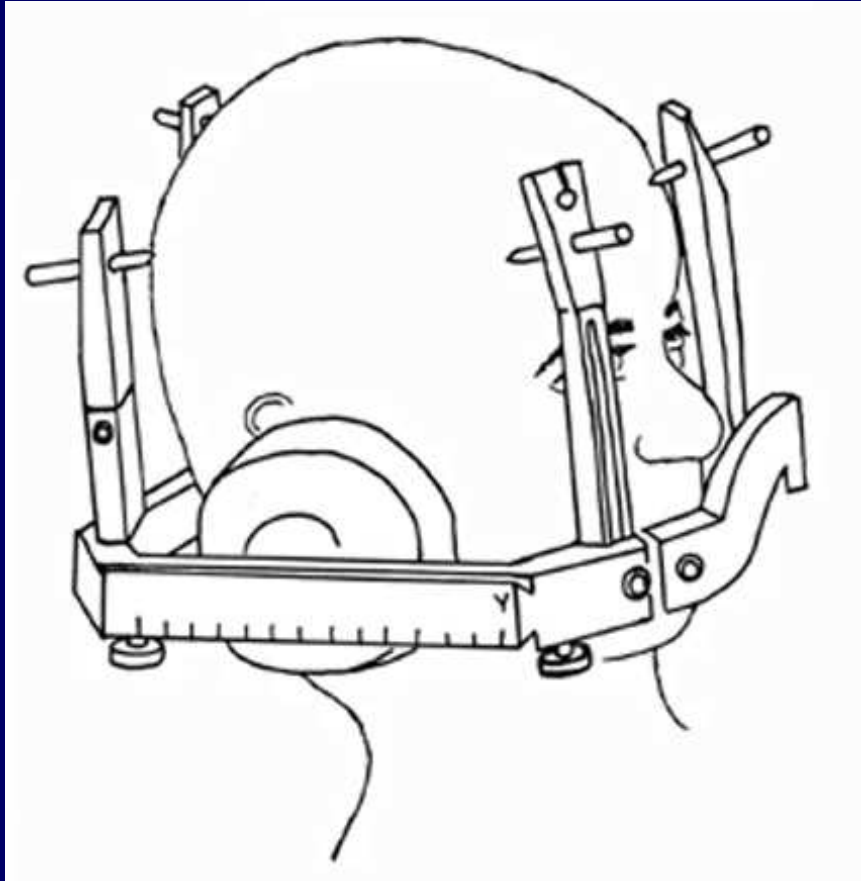
Radiochirurgie des métastases cérébrales

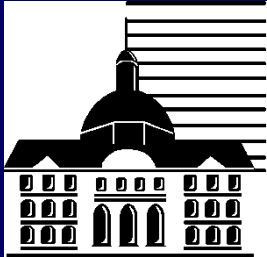
Technique

8.00 h	Installation du cadre de Leksell sous anesthésie locale
8.30 h	TDM-IRM
9 .00 h	Contourage, dosimétrie
15 .00 h	Traitement
16 .00 h	Ablation du cadre

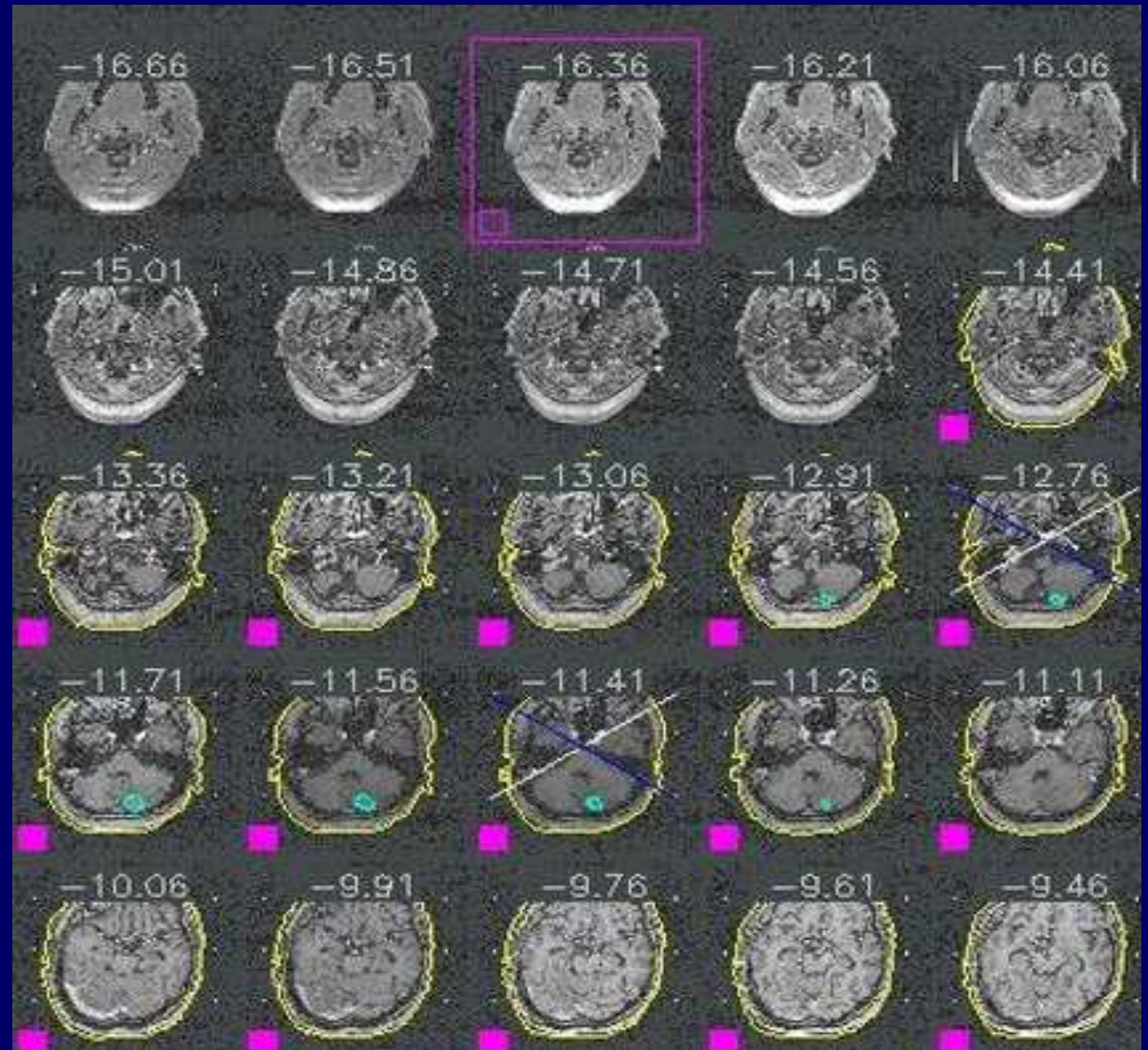
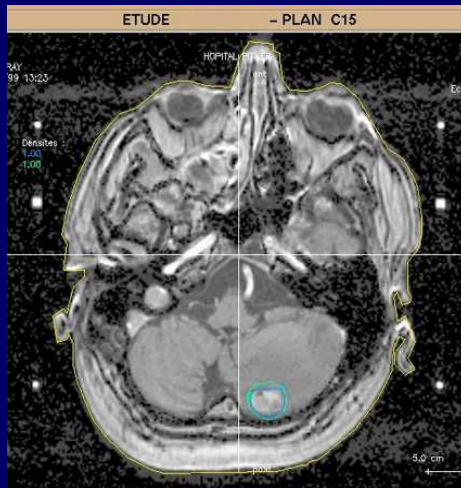
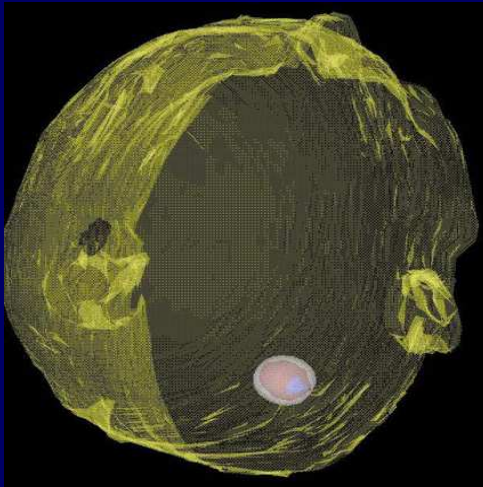


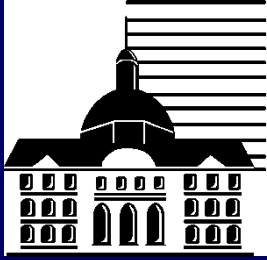
Radiochirurgie des métastases cérébrales



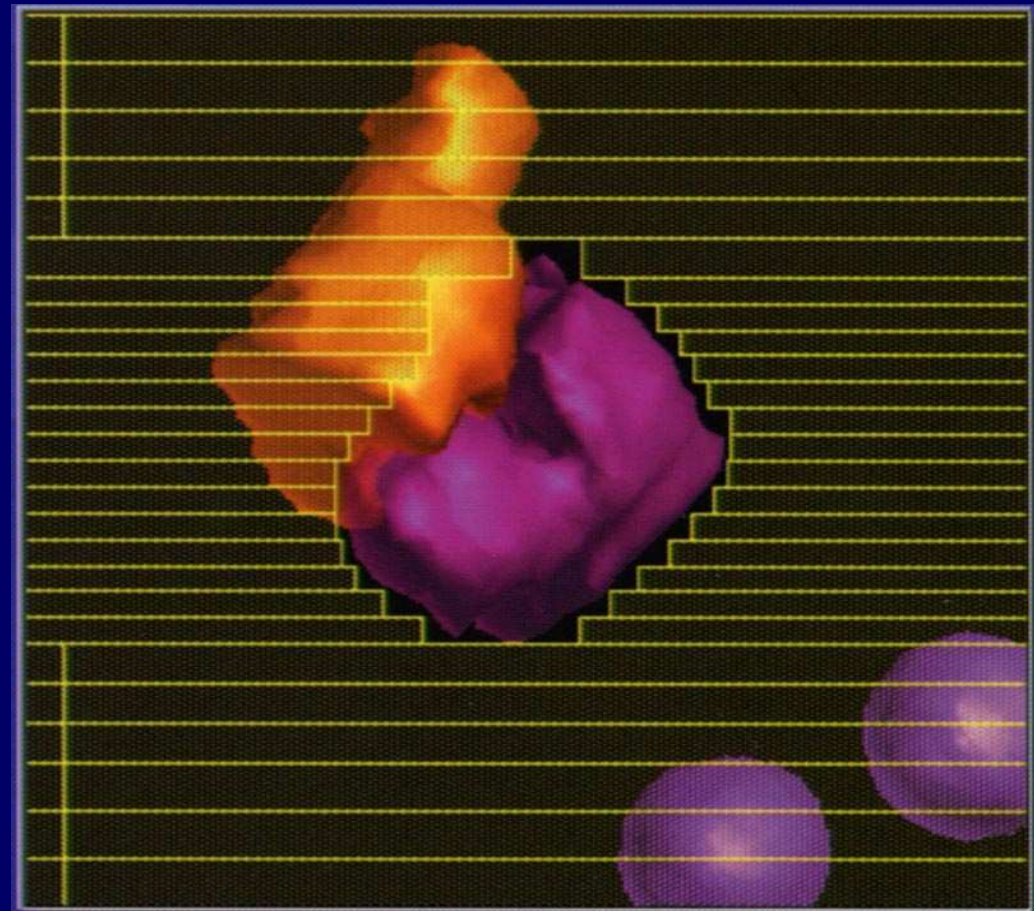
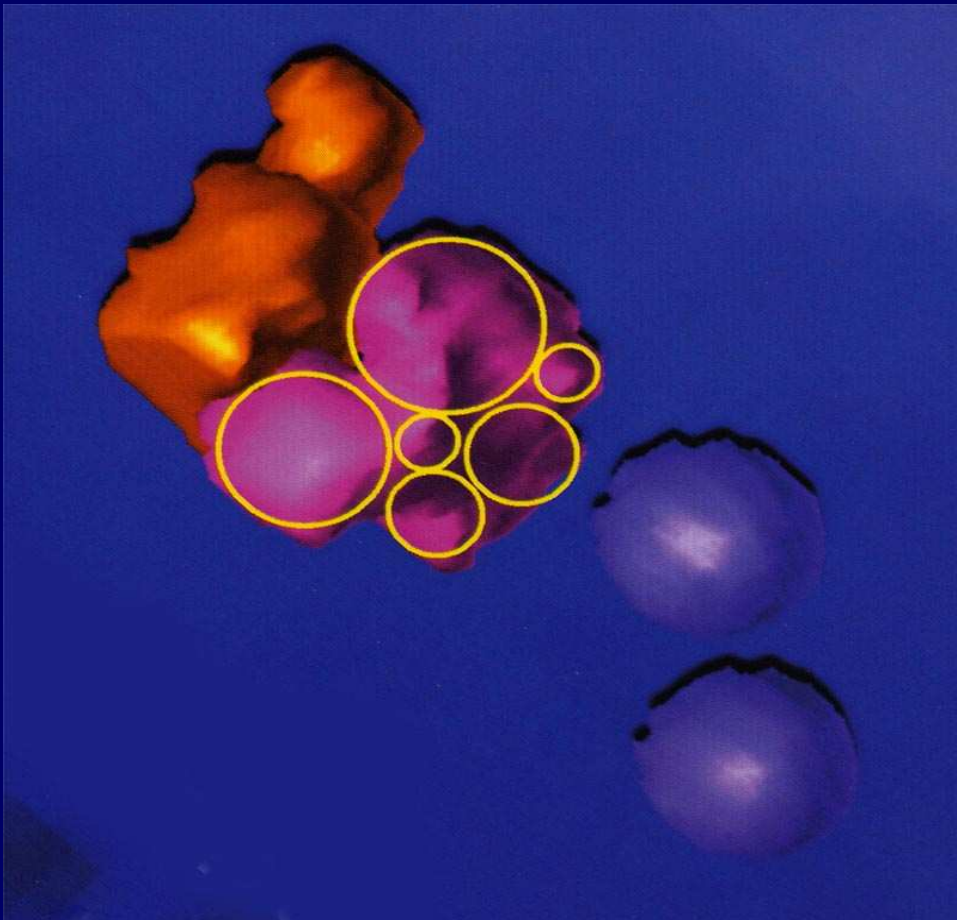


Radiochirurgie des métastases cérébrales

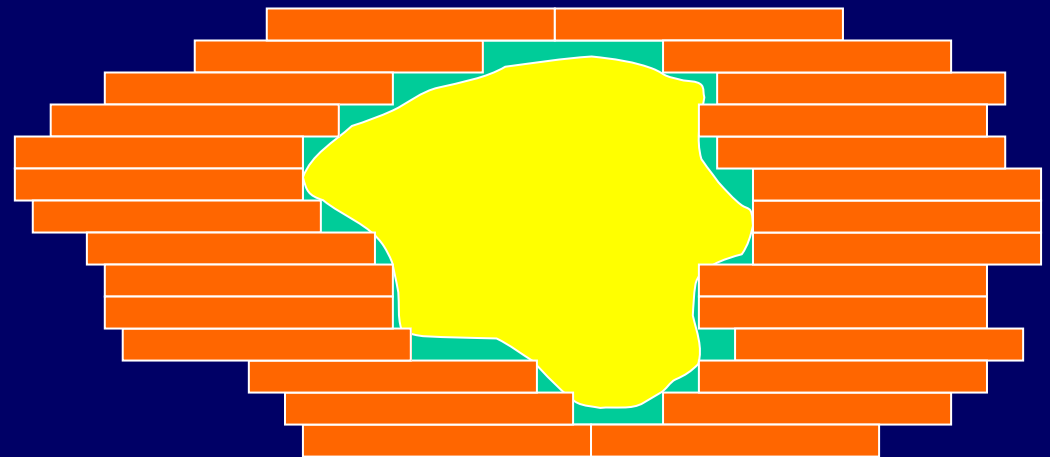
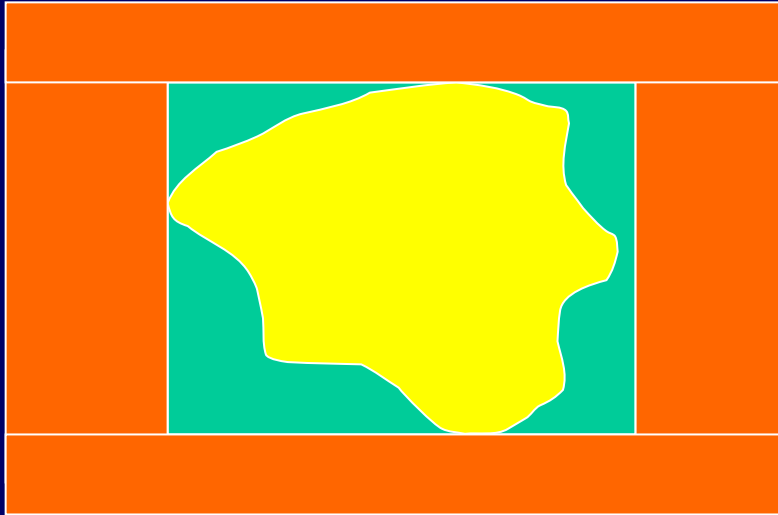


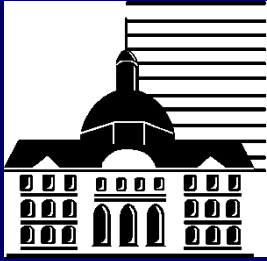


Radiochirurgie des métastases cérébrales

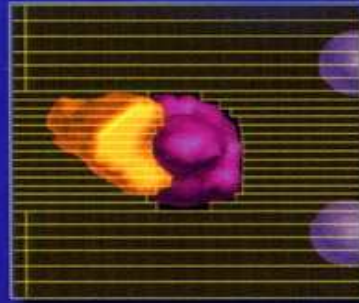
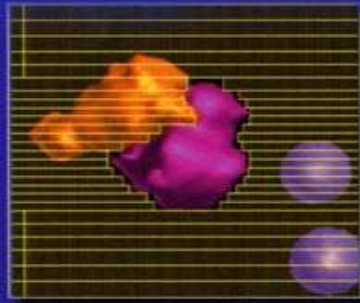
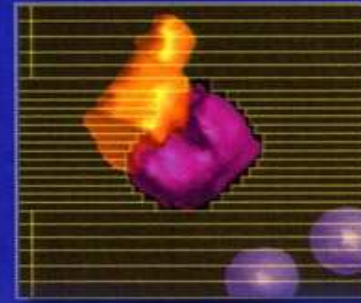
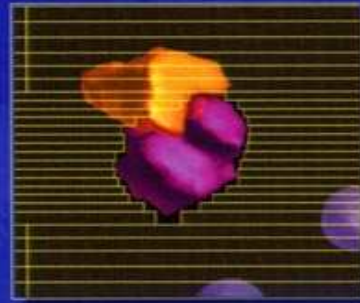
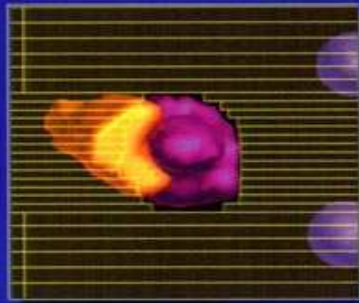
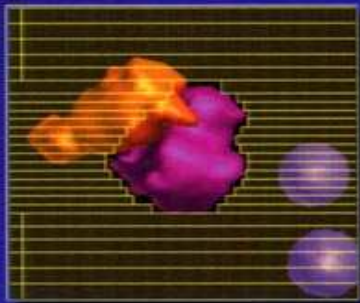


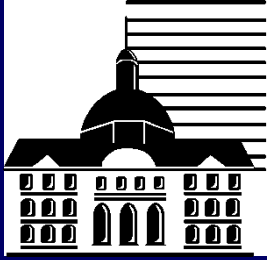
Radiochirurgie des métastases cérébrales





Radiochirurgie des métastases cérébrales

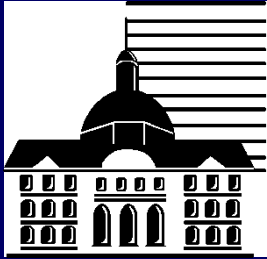




Radiochirurgie des métastases cérébrales

Indications

- **Radiochirurgie exclusive**
- **Radiothérapie panencéphalique + radiochirurgie**
- **Radiochirurgie de rattrapage**



Radiochirurgie des métastases cérébrales

Doses

- **RTOG (IJROBP 1996;34:647-54)**

GTV

$\leq 20\text{mm}$ 24 Gy

21-30 mm 18 Gy

31-40 mm, 15 Gy

- **Salpêtrière**

Gamma Knife : PTV = GTV 16 Gy minimum

Accélérateur linéaire

Isocentre: 20 Gy

CTV = GTV + 1 mm margin 14 Gy



Radiochirurgie des métastases cérébrales

Réponse

Inévaluable : 31%

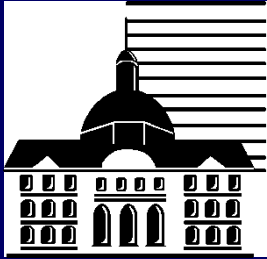
Réponse complète : 26%

Réponse partielle : 27%

Stabilisation : 34%

Evolution : 13%

87%



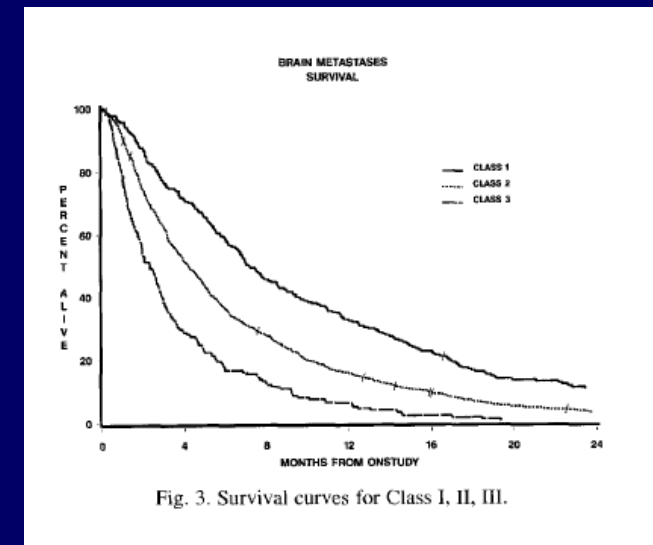
Radiochirurgie des métastases cérébrales

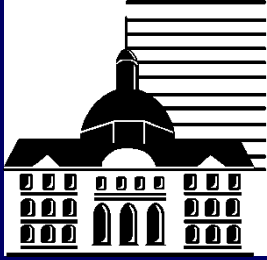
RPA (Recursive Partitioning Analysis)

Class 1: age < 65 yr, systemic or local disease controlled, IK > 70

Class 2: other

Class 3: IK < 70





Radiochirurgie des métastases cérébrales

SIR (Score Index for Radiosurgery in Brain Metastases)

	0	1	2
age	≥ 60	51-59	≤ 50
IK	≤ 50	60-70	> 70
disease	Progression	Stable ou PR	CR or no visible disease
Volume	$> 13 \text{ cm}^3$	5-13 cm^3	$< 5 \text{ cm}^3$
Number	3 et +	2	1

Class 1 : 0-3; Class 2 : 4-7; Class 3 : 8-10

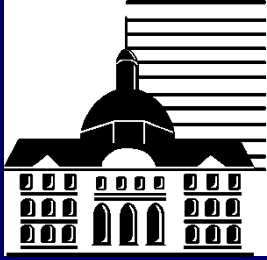
Weltman et al IJROBP 2000; 46:1155-61



Radiochirurgie des métastases cérébrales

GPA (Diagnosis-Specific Graded Prognostic Assessment. Sperduto et al. JCO 2012)

Non-small-cell and small-cell lung cancer		GPA Scoring Criteria			Patient	
Prognostic Factor	0	0.5	1.0	Score		
Age, years	> 60	50-60	< 50	___		
KPS	< 70	70-80	90-100	___		
ECM	Present	—	Absent	___		
No. of BM	> 3	2-3	1	___		
Sum total				___		
Median survival (months) by GPA: 0-1.0 = 3.0; 1.5-2.0 = 5.5; 2.5-3.0 = 9.4; 3.5-4.0 = 14.8						
Melanoma		GPA Scoring Criteria			Patient	
Prognostic Factor	0	1.0	2.0	Score		
KPS	< 70	70-80	90-100	___		
No. of BM	> 3	2-3	1	___		
Sum total				___		
Median survival (months) by GPA: 0-1.0 = 3.4; 1.5-2.0 = 4.7; 2.5-3.0 = 8.8; 3.5-4.0 = 13.2						
Breast cancer		GPA Scoring Criteria				Patient
Prognostic Factor	0	0.5	1.0	1.5	2.0	Score
KPS	≤ 50	60	70-80	90-100	n/a	___
Subtype	Basal	n/a	LumA	HER2	LumB	___
Age, years	≥ 60	< 60	n/a	n/a	n/a	___
Sum total						___
Median survival (months) by GPA: 0-1.0 = 3.4; 1.5-2.0 = 7.7; 2.5-3.0 = 15.1; 3.5-4.0 = 25.3						
Renal cell carcinoma		GPA Scoring Criteria			Patient	
Prognostic Factor	0	1.0	2.0	Score		
KPS	< 70	70-80	90-100	___		
No. of BM	> 3	2-3	1	___		
Sum total				___		
Median survival (months) by GPA: 0-1.0 = 3.3; 1.5-2.0 = 7.3; 2.5-3.0 = 11.3; 3.5-4.0 = 14.8						
GI cancers		GPA Scoring Criteria				Patient
Prognostic Factor	0	1	2	3	4	Score
KPS	< 70	70	80	90	100	___
Median survival (months) by GPA: 0-1.0 = 3.1; 2.0 = 4.4; 3.0 = 6.9; 4.0 = 13.5						

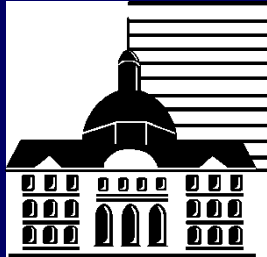


Radiochirurgie des métastases cérébrales

Rôle de la dose minimale et du diamètre tumoral

Pas de progression à 1 an (Goodman/Sneed)

- ≥ 18 Gy : 88% (359)
15-17.9 Gy : 75% (142)
< 15 Gy : 29% (17)
- ≤ 1 cm : 92% (228)
1.1-2 cm : 83% (154)
2.1-3 cm : 69% (85)
> 3 cm : 37% (24)

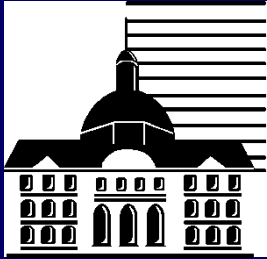


Radiochirurgie des métastases cérébrales

Facteurs pronostiques (Goodman et al. IJROBP 2001;50: 139-46)

Subgroup	No. of lesions	No. of events	Median FFP (months)	6-month FFP probability (95% CI)	1-year FFP probability (95% CI)	log-rank <i>p</i> -value
Primary site						
Breast	80	7	NR	92% (82–97%)	92% (82–97%)	0.040
Kidney	38	3	NR	94% (77–98%)	90% (71–97%)	
Lung	187	31	NR	91% (85–95%)	78% (68–85%)	
Melanoma	160	23	25.4	87% (79–93%)	74% (62–84%)	
Type of RS						
RS alone	135	22	NR	92% (84–96%)	81% (70–88%)	0.37
RS as boost	178	15	NR	94% (88–97%)	87% (77–92%)	
RS for recurrence	205	29	NR	89% (82–93%)	79% (70–86%)	
Treatment period						
1991–1994	205	34	25.4	87% (80–92%)	75% (64–83%)	0.009
1995–1997	313	32	NR	94% (89–96%)	86% (80–90%)	
Pattern of enhancement						
Homogeneous	306	23	NR	95% (91–97%)	90% (84–93%)	< 0.001
Heterogeneous	168	30	25.4	86% (78–91%)	76% (64–84%)	
Ring	44	13	26.0	84% (67–92%)	57% (35–74%)	
Percent necrosis						
None	306	23	NR	95% (91–97%)	90% (84–93%)	< 0.001
< 50%	166	31	25.4	87% (80–92%)	75% (64–84%)	
≥ 50%	46	12	NR	79% (61–90%)	57% (35–74%)	
All lesions	518	66	NR	91% (88–94%)	82% (77–86%)	—

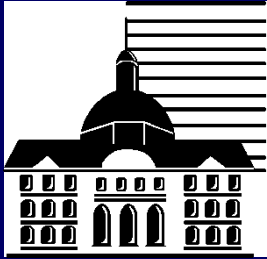
Abbreviations: FFP = freedom from progression; CI = confidence interval; NR = not reached; RS = radiosurgery.



Radiochirurgie des métastases cérébrales

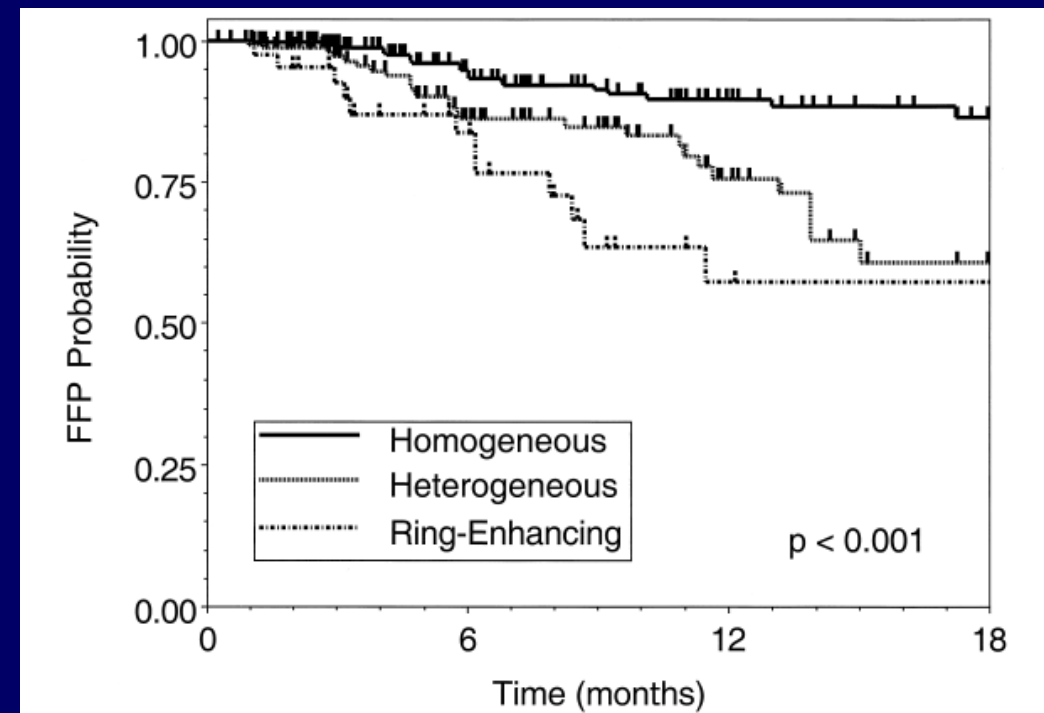
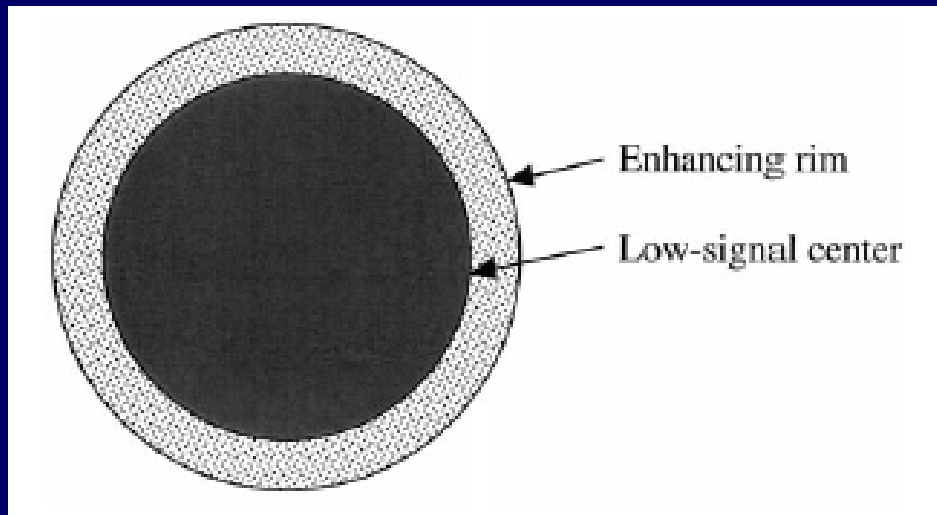
Rôle de la technique (RTOG 9508, Lancet 2004;363:1665-72)

- **Taux de réponse :**
Accélérateur linéaire : 73%
Gamma Knife : 64%
- **Taux de contrôle local :**
accélérateur linéaire : 85%
Gamma Knife : 87%



Radiochirurgie des métastases cérébrales

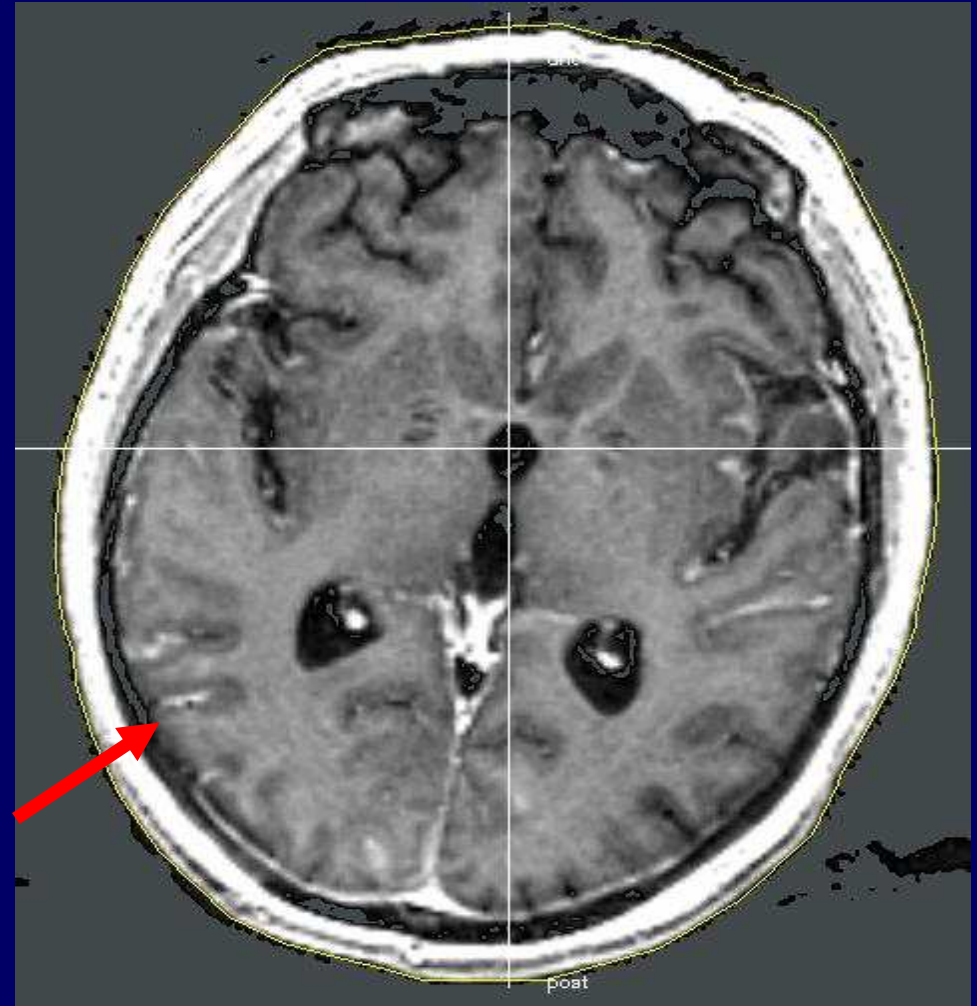
Rôle de la nécrose (Goodman et al. IJROBP 2001;50:139-46)

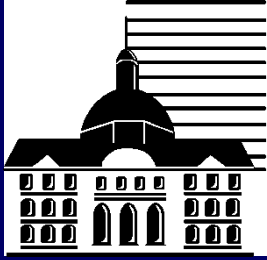




Radiochirurgie des métastases cérébrales

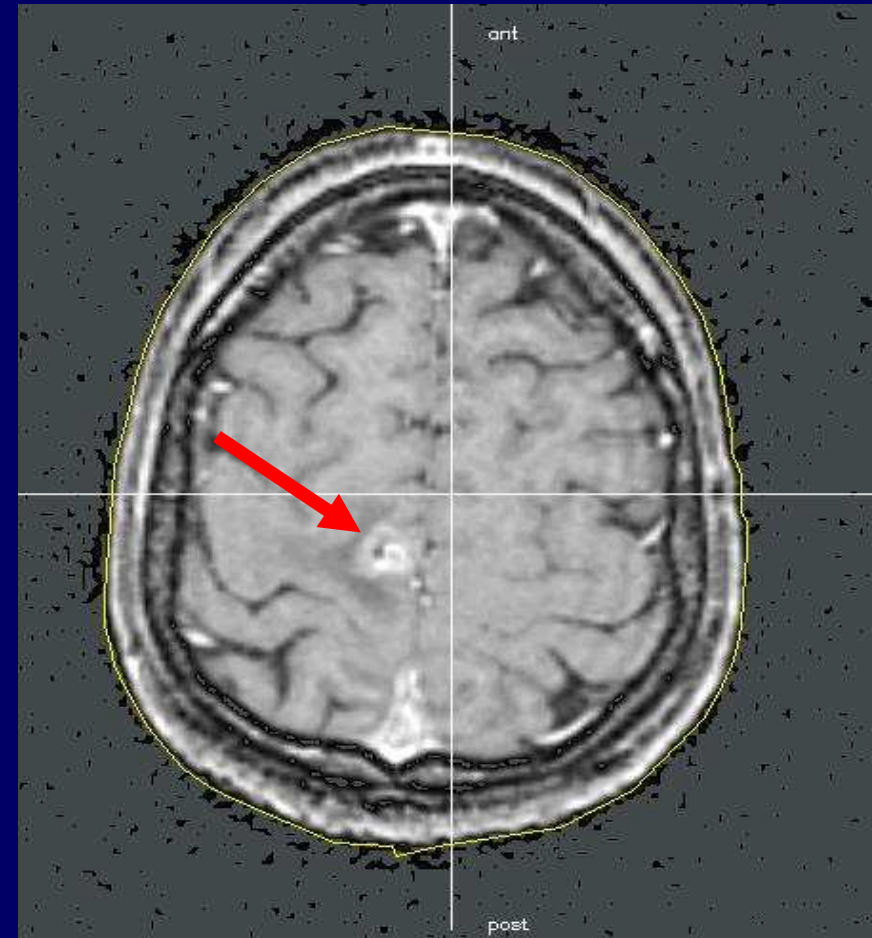
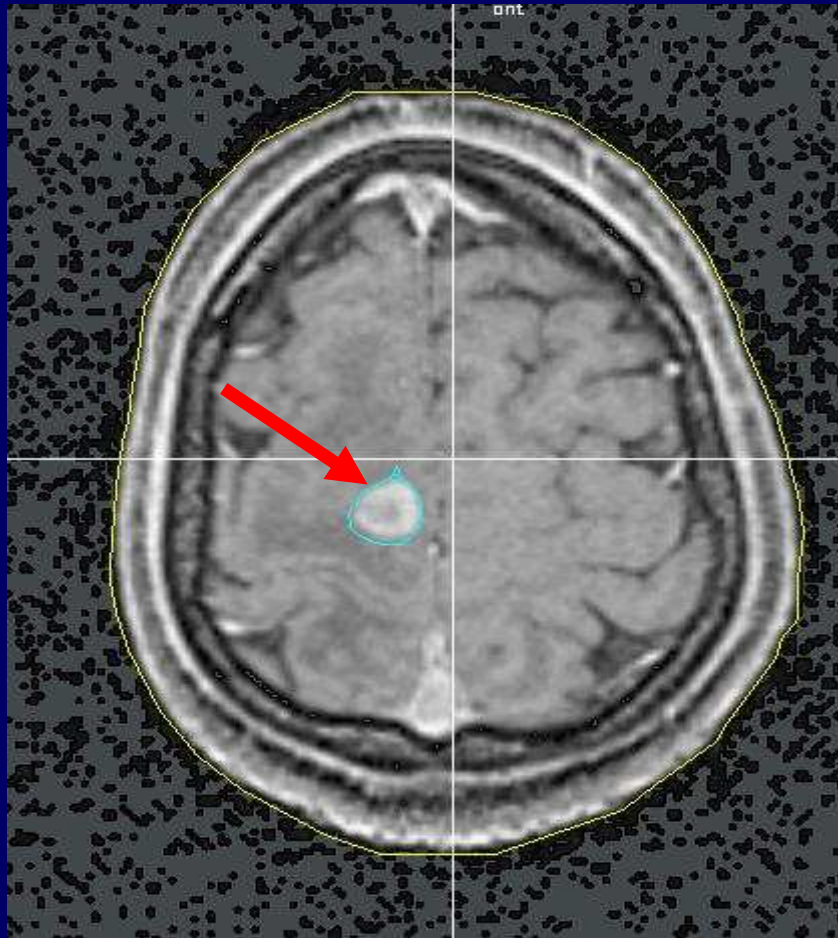
Adénocarcinome du sein (4 mois)

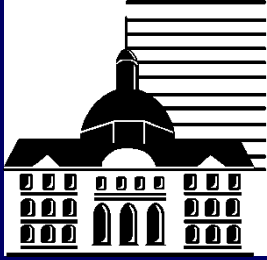




Radiochirurgie des métastases cérébrales

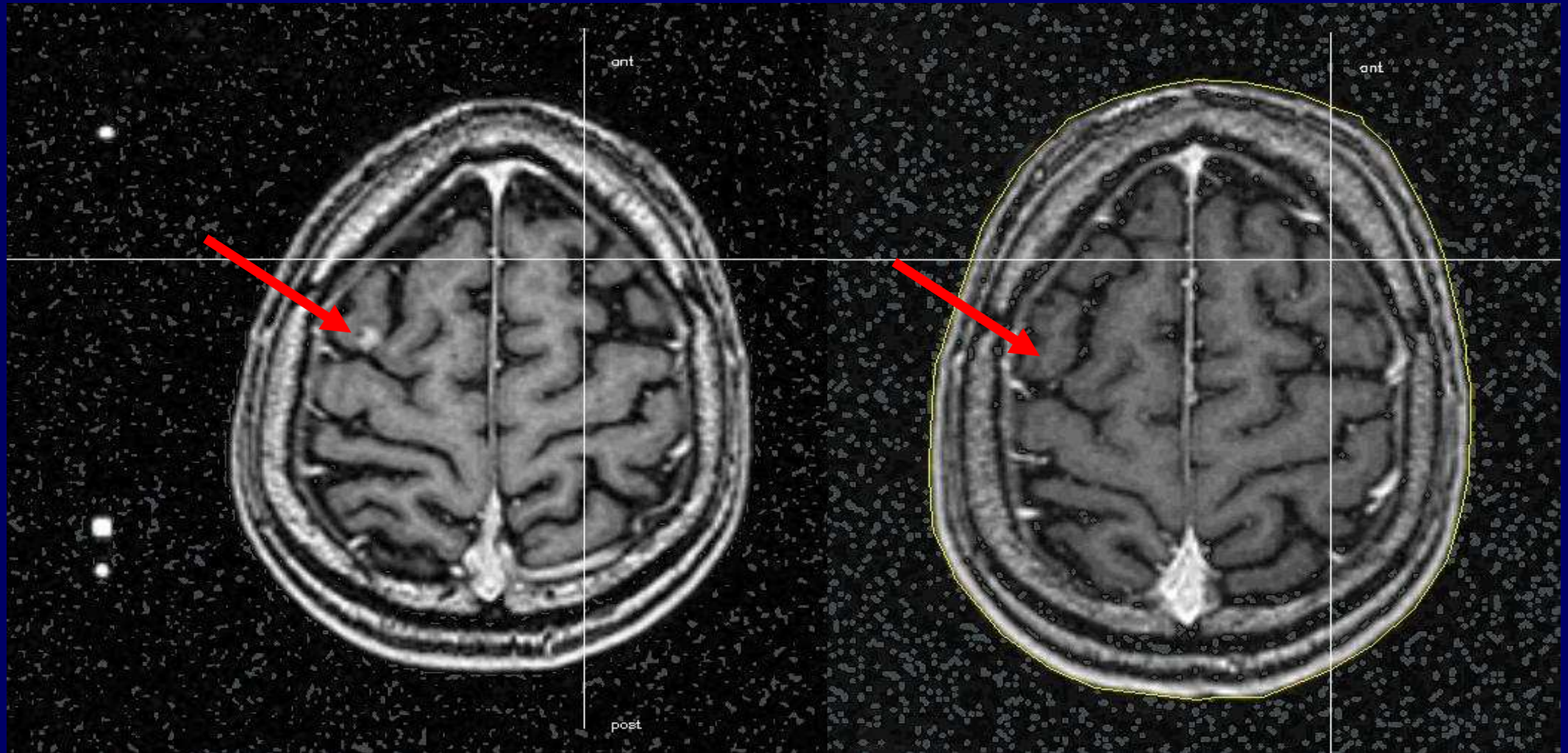
Adénocarcinome bronchique (3 mois)

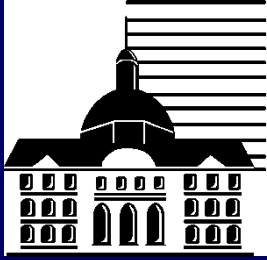




Radiochirurgie des métastases cérébrales

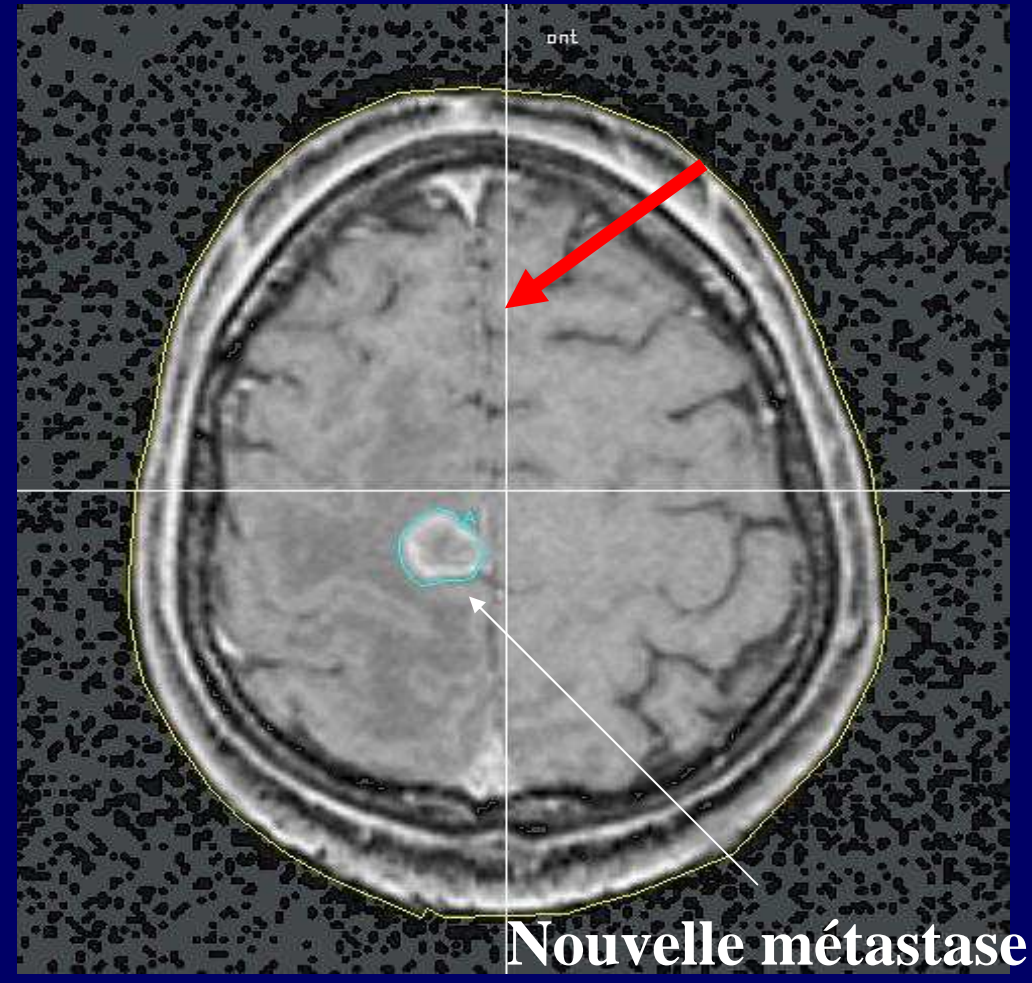
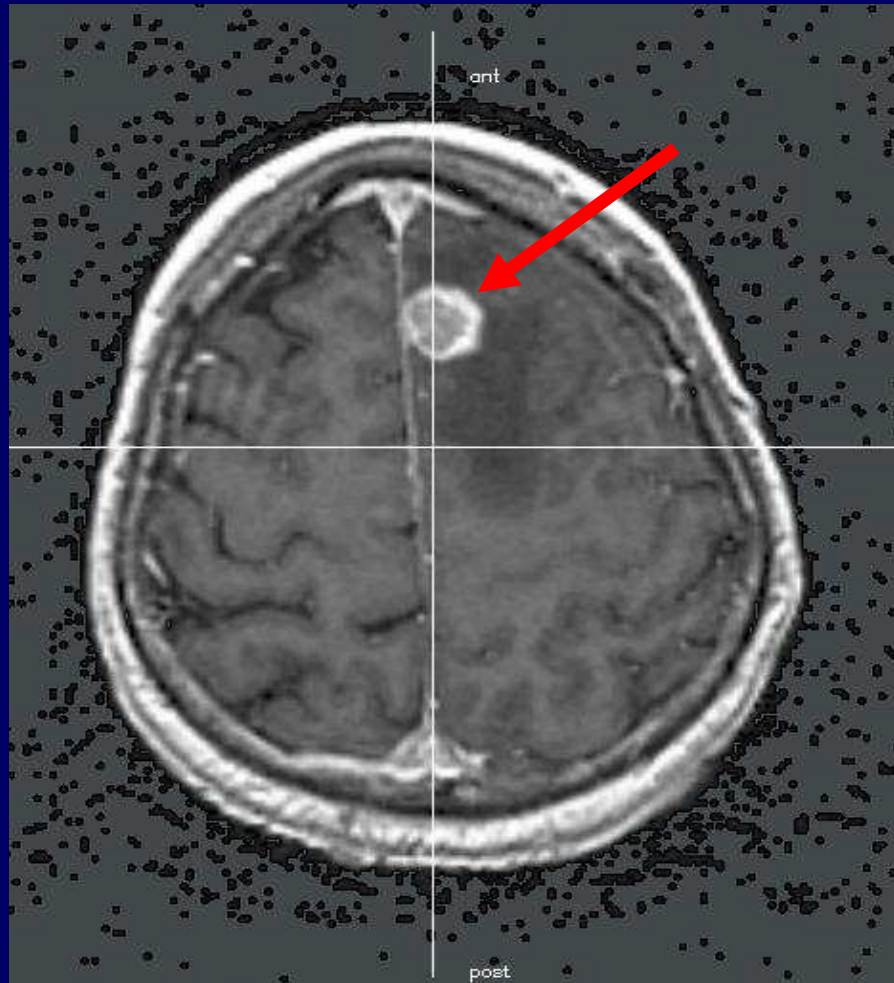
Carcinome bronchique (8 mois)

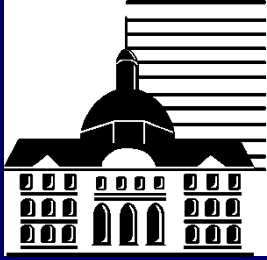




Radiochirurgie des métastases cérébrales

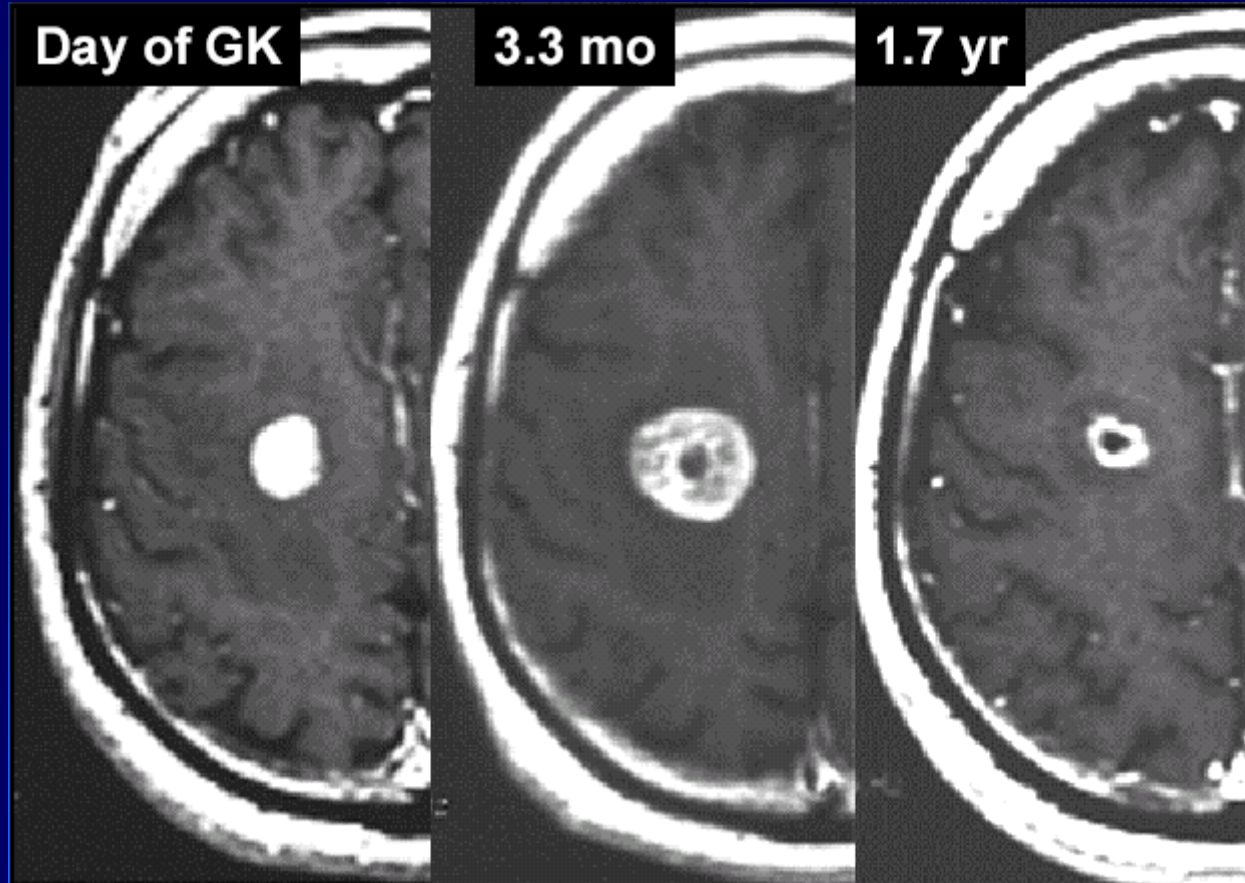
Adénocarcinome bronchique (7 mois)

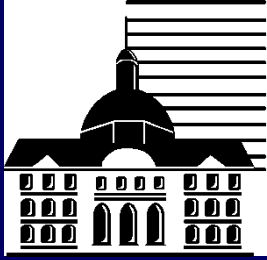




Radiochirurgie des métastases cérébrales

Nécrose





Radiochirurgie des métastases cérébrales

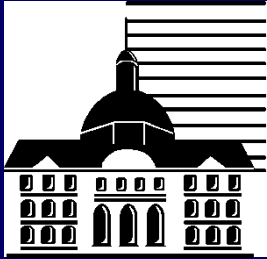
Revue de la littérature

Décès neurologique : 5-34%

Complications : 4-19%

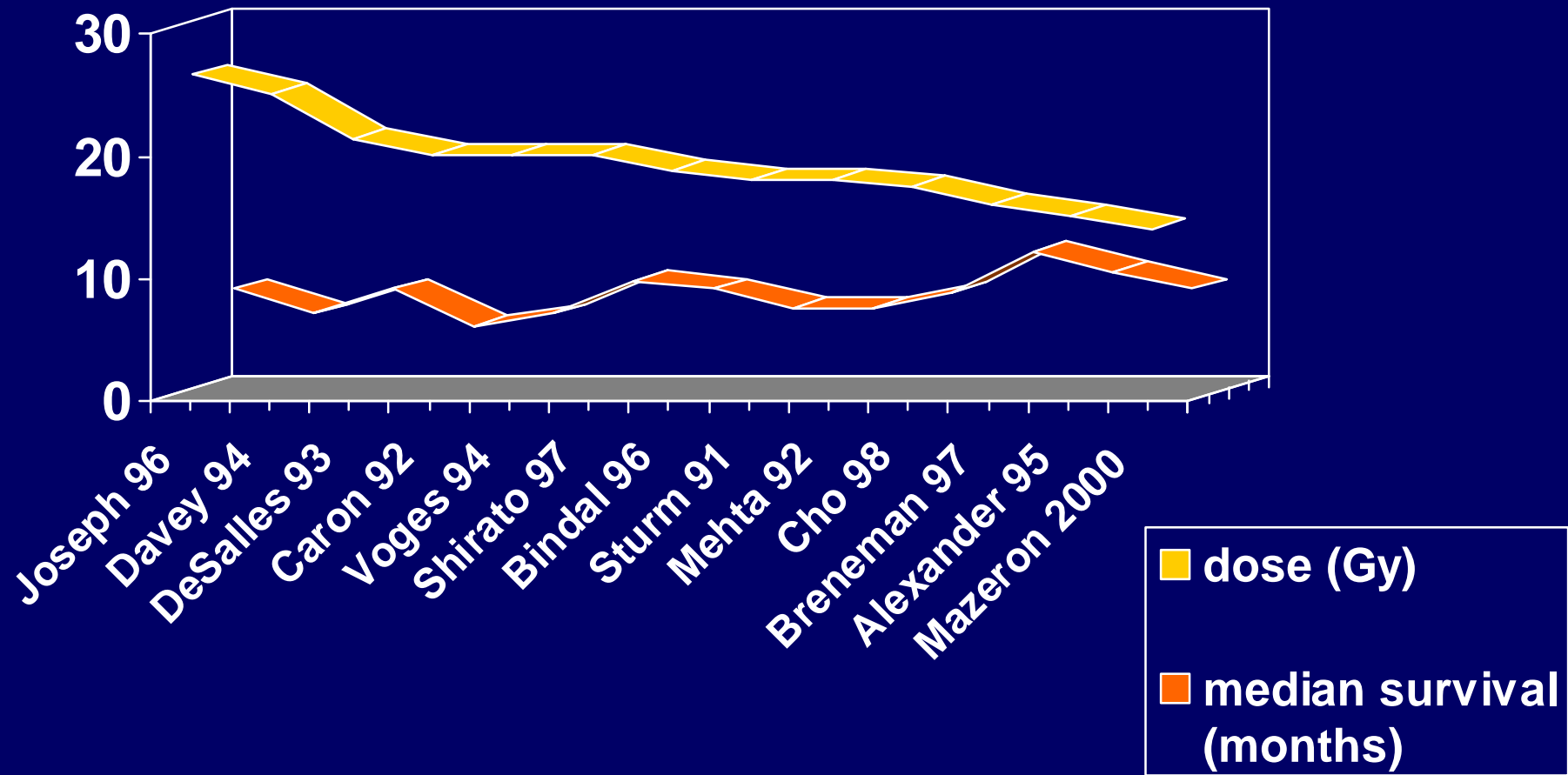
Taux de contrôle local : 47-100%

Survie médiane : 6-12 mois



Radiochirurgie des métastases cérébrales

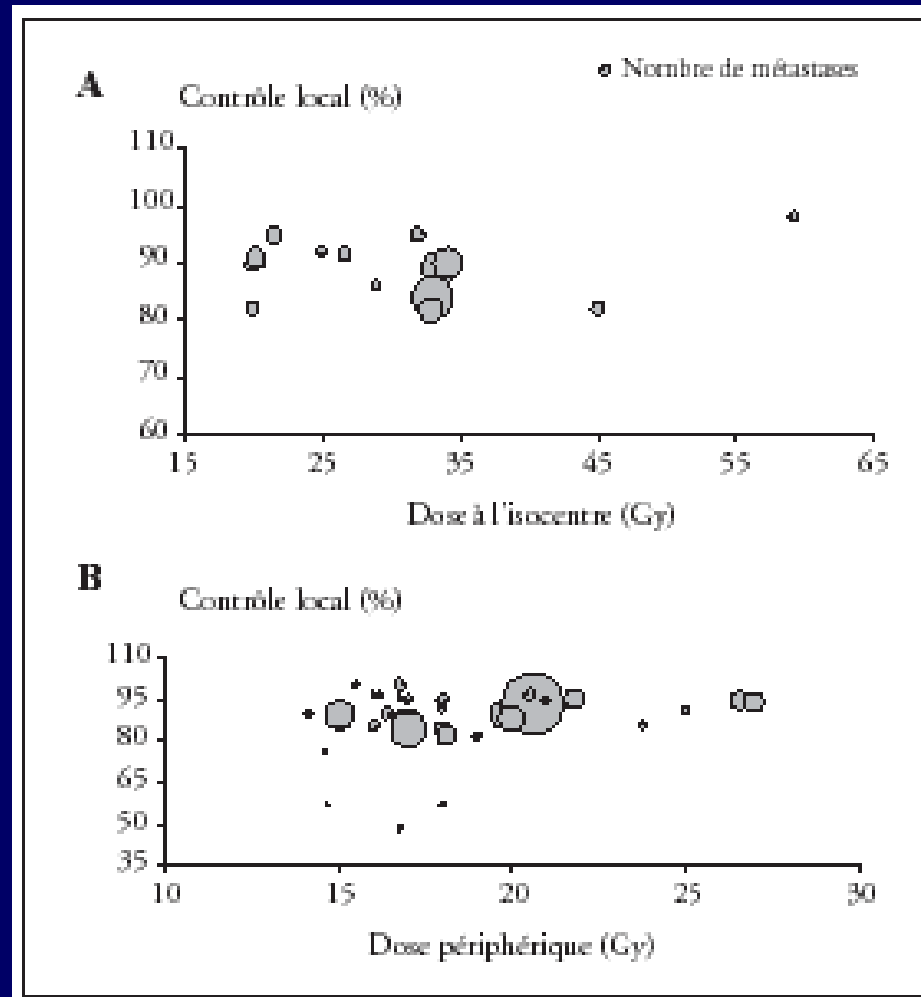
Role of the dose





Radiochirurgie des métastases cérébrales

Rôle de la dose (Noël G et al. Bull cancer 2004;91:81-93)





Radiochirurgie des métastases cérébrales

Rôle de la dose minimale (Noël G et al. Radiother Oncol 2003;68:16-21)

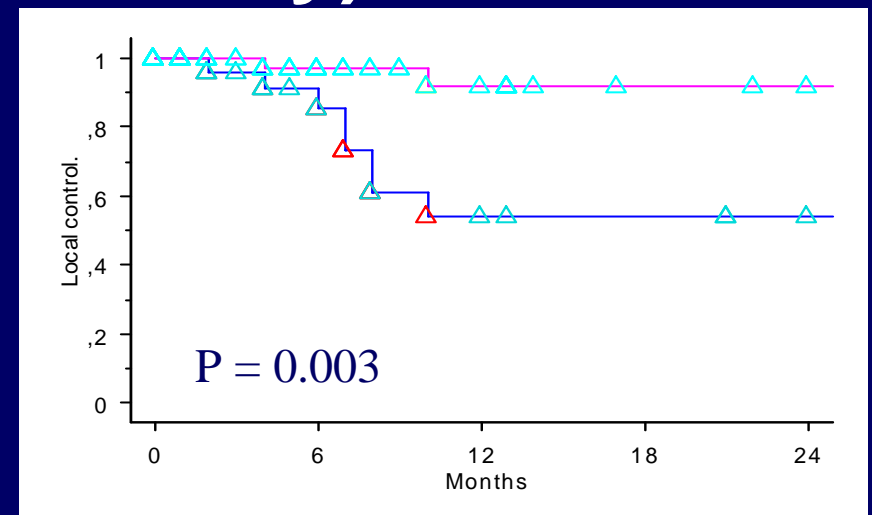
CTV = GTV + 1 mm (dose minimale = \pm 16 Gy)

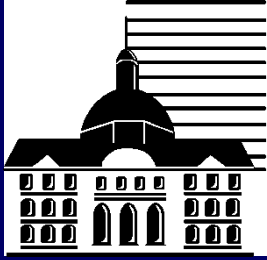
6 échecs / 188 (3%)

CTV = GTV (dose minimale = 14 Gy):

10 échecs / 109 (9%)

P = 0.027





Radiochirurgie des métastases cérébrales

Rôle de la dose minimale

153 patients

Radiochirurgie avec ou sans une marge de 2 mm

Pas d'amélioration du taux de contrôle local mais plus de complications parenchymateuses ($p = 0.02$).

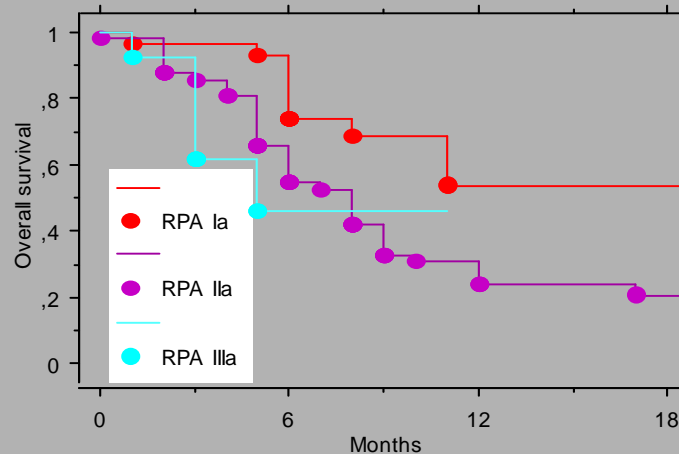
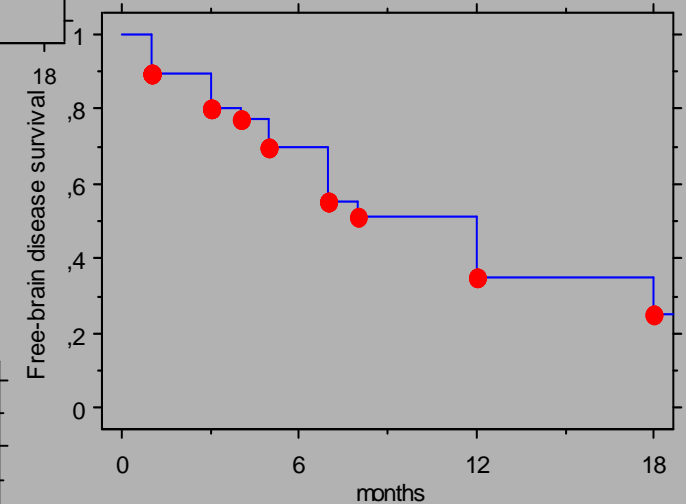
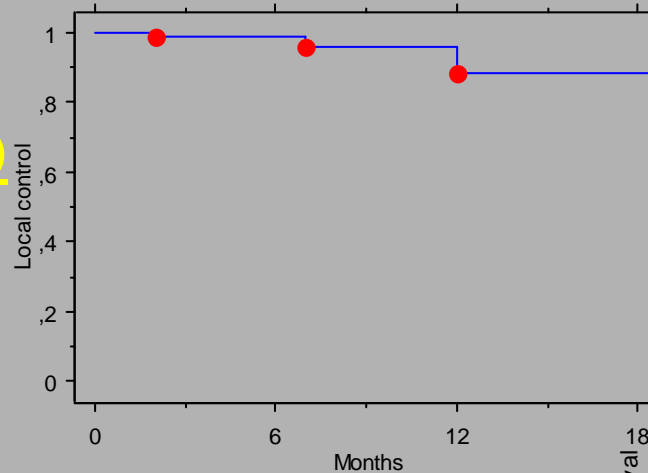
Procédure non recommandée par les auteurs

Nataf F et al. IJROBP 2008;70:766-72



Radiochirurgie des métastases cérébrales

- Elderly (53 pts – 105 meta.)
- Local control
 - Overall: 97%
 - 6 months: 98%
 - 1 year: 88%
- Free-brain disease survival
 - median: 12 months
 - 6 months: 69%
 - 1 year: 47%
- Overall survival
 - Median: 11 months
 - 6 months: 65%
 - 1 year: 36%

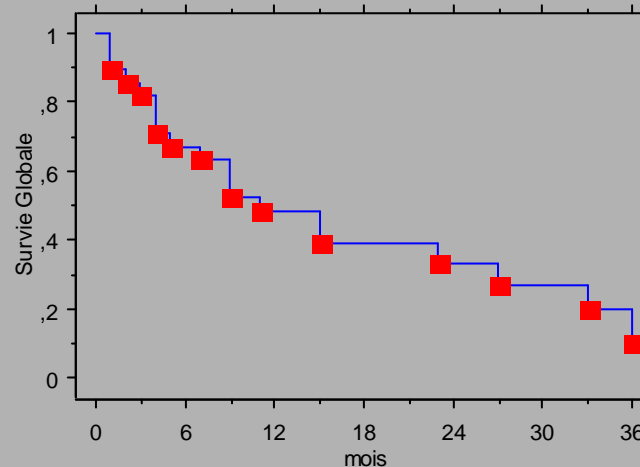
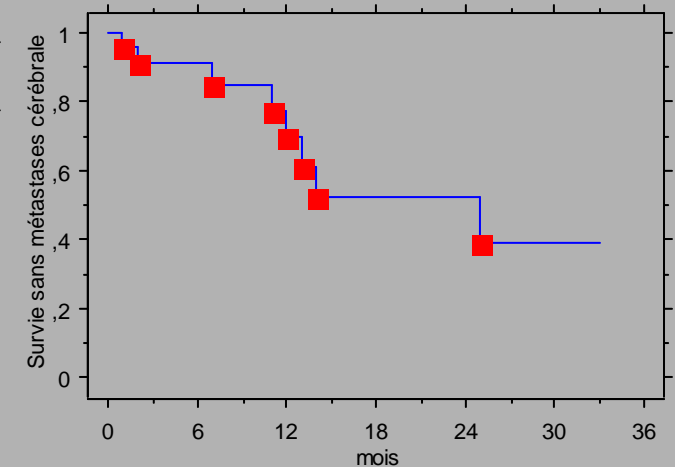
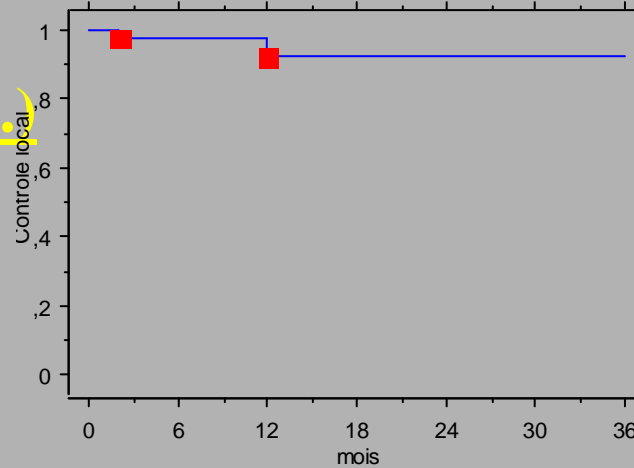


Noël G et al.
IJROBP
2005;63:1555-61



Radiochirurgie des métastases cérébrales

- Kydney (28 pts – 65 meta.)
- Local control
 - Overall: 97%
 - 6 months: 98%
 - 1 year: 93%
- Free-brain disease survival
 - median: 25 months
 - 6 months: 91%
 - 1 year: 75%
- Overall survival
 - Median: 11 months
 - 6 months: 67%
 - 1 year: 48%

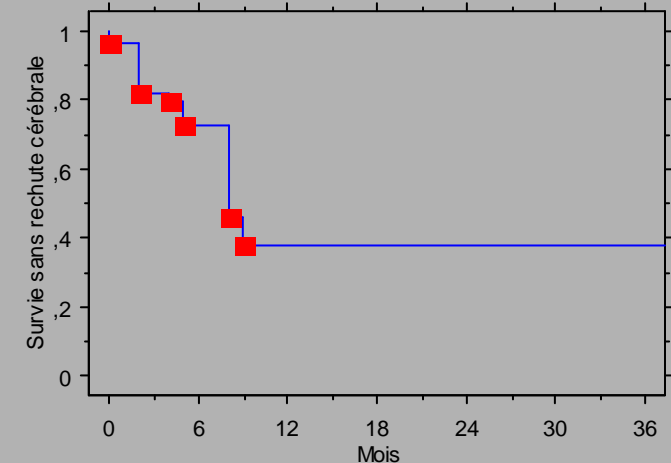
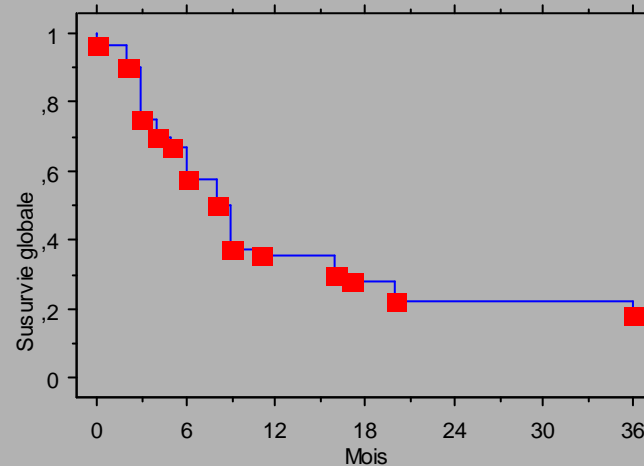
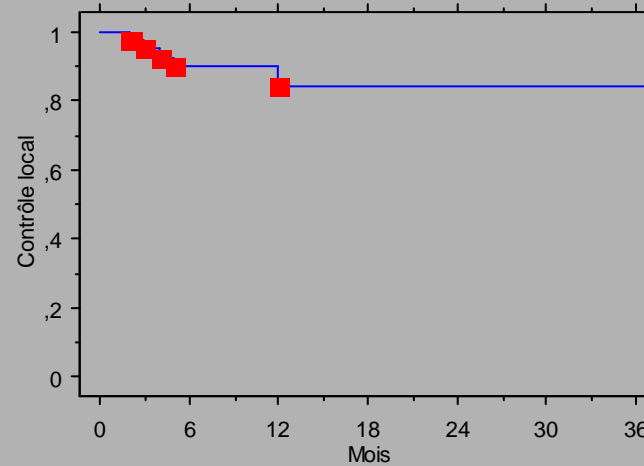


Noël G et al. Urol
Oncol.
2004;22:25-31



Radiochirurgie des métastases cérébrales

- Melanoma (25 pts – 61 meta.)
- Local control
 - Overall: 90%
 - 6 months: 95%
 - 1 year: 90%
- Free-brain disease survival
 - median: 8 months
 - 6 months: 68%
 - 1 year: 38%
- Overall survival
 - Median: 8 months
 - 6 months: 53%
 - 1 year: 29%

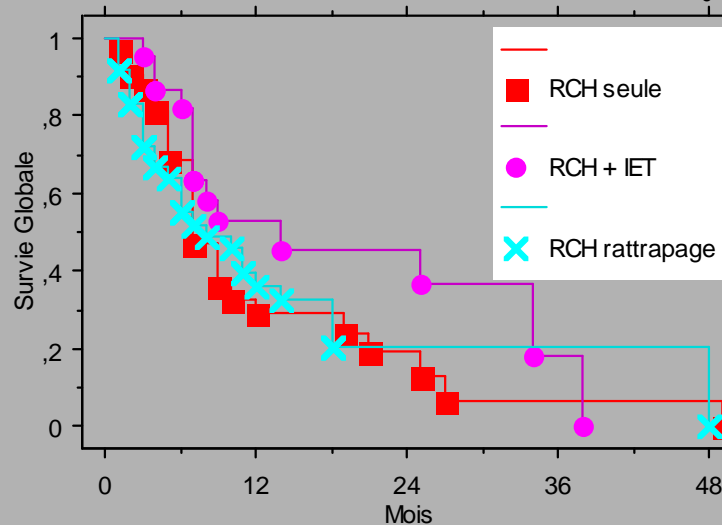
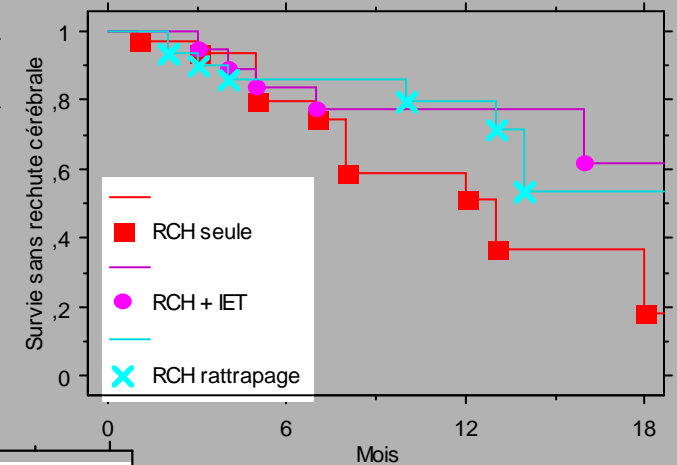
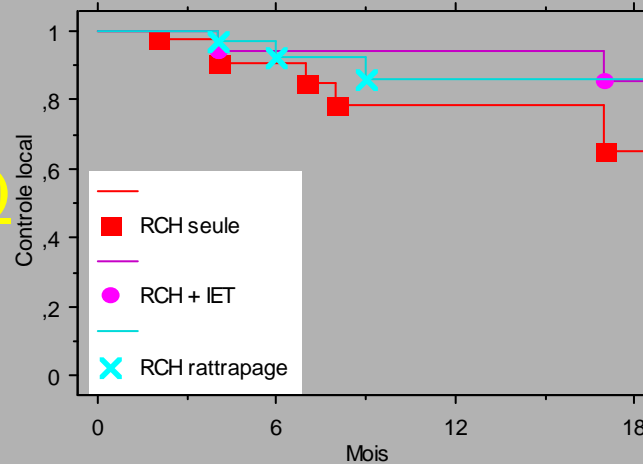


Noël G et al.
Stereotact Funct
Neurosurg.
2002;79:245-55

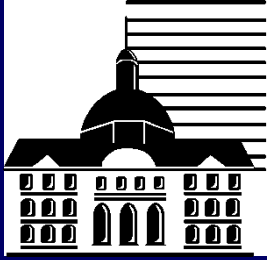


Radiochirurgie des métastases cérébrales

- Lung (92 pts – 145 meta.)
- Local control
 - Overall: 86-92-95%
 - 1 year: 90-94-92%
 - 2 years: 78-94-86%
- Free-brain disease survival
 - median: 13-24-NR months
 - 1 year: 51-77-79%
- Overall survival
 - Median: 7-14-8 months
 - 1 year: 29-53-36%
 - 2 years: 18-45-20%

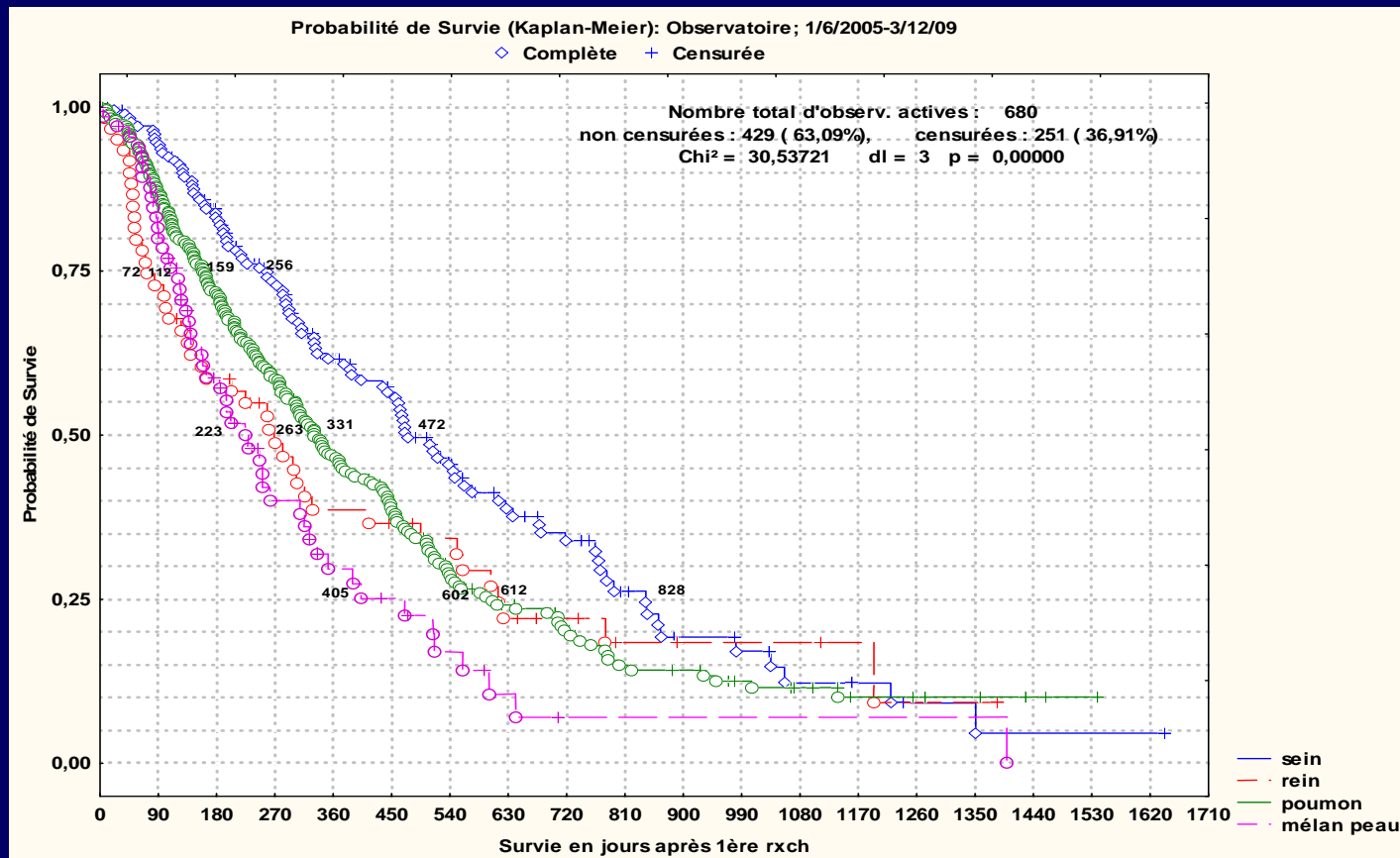


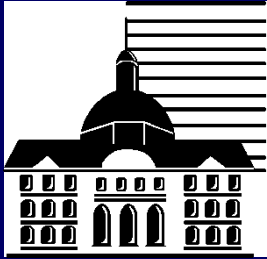
Noël G et al.
Lung Cancer.
2003;41:333-43



Radiochirurgie des métastases cérébrales

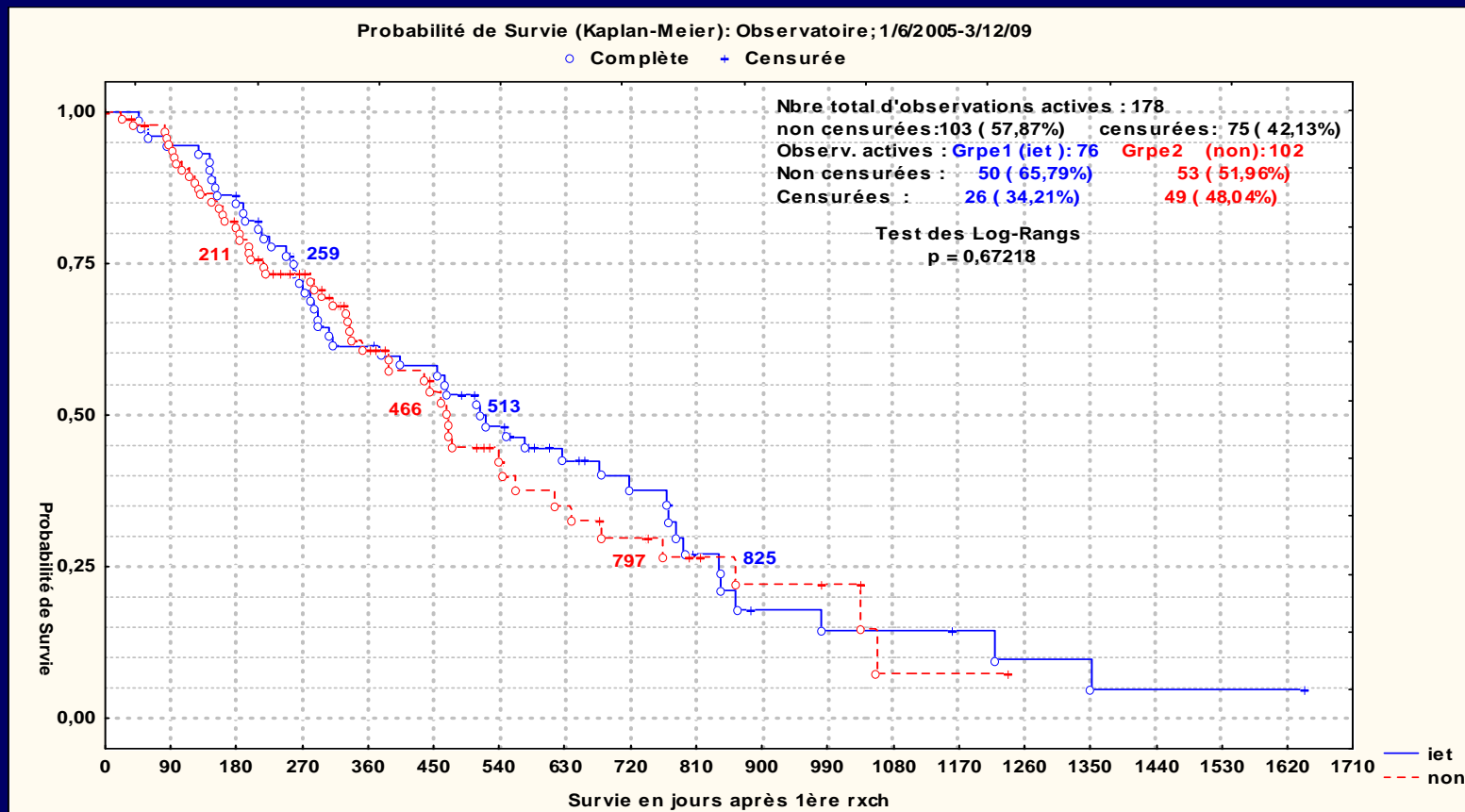
Survie en fonction du cancer primitif





Radiochirurgie des métastases cérébrales

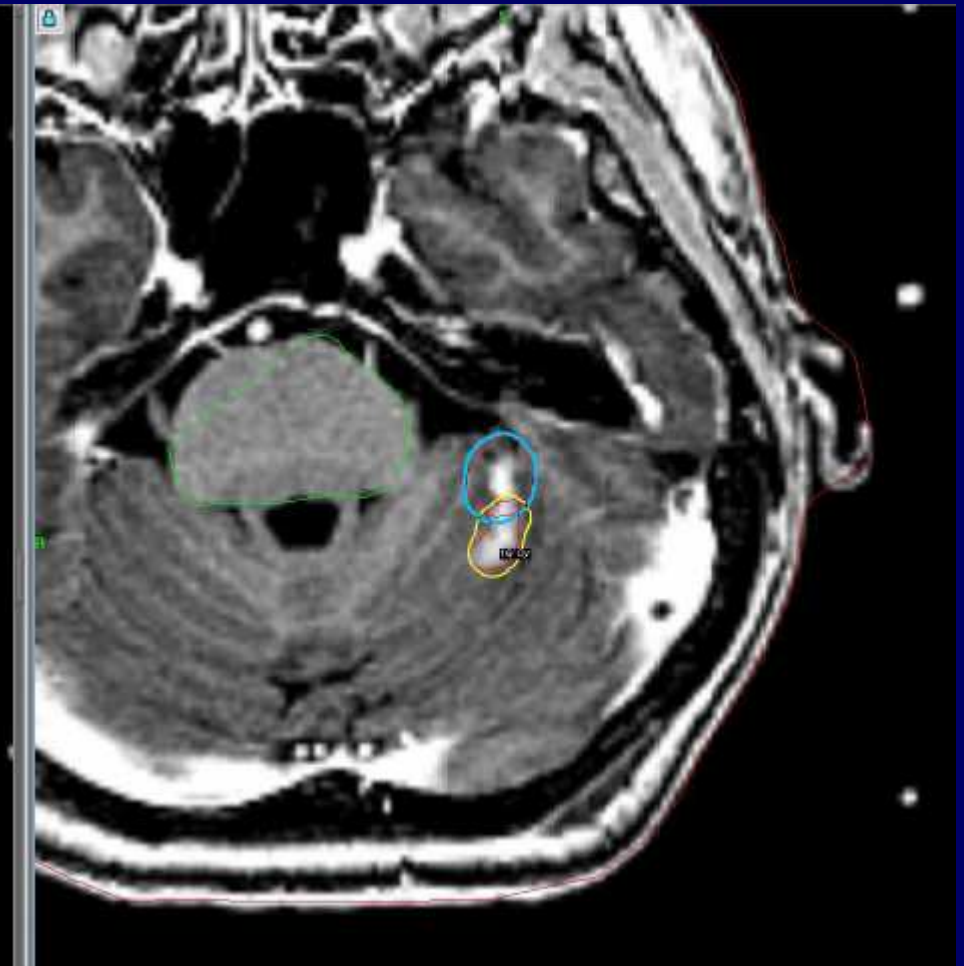
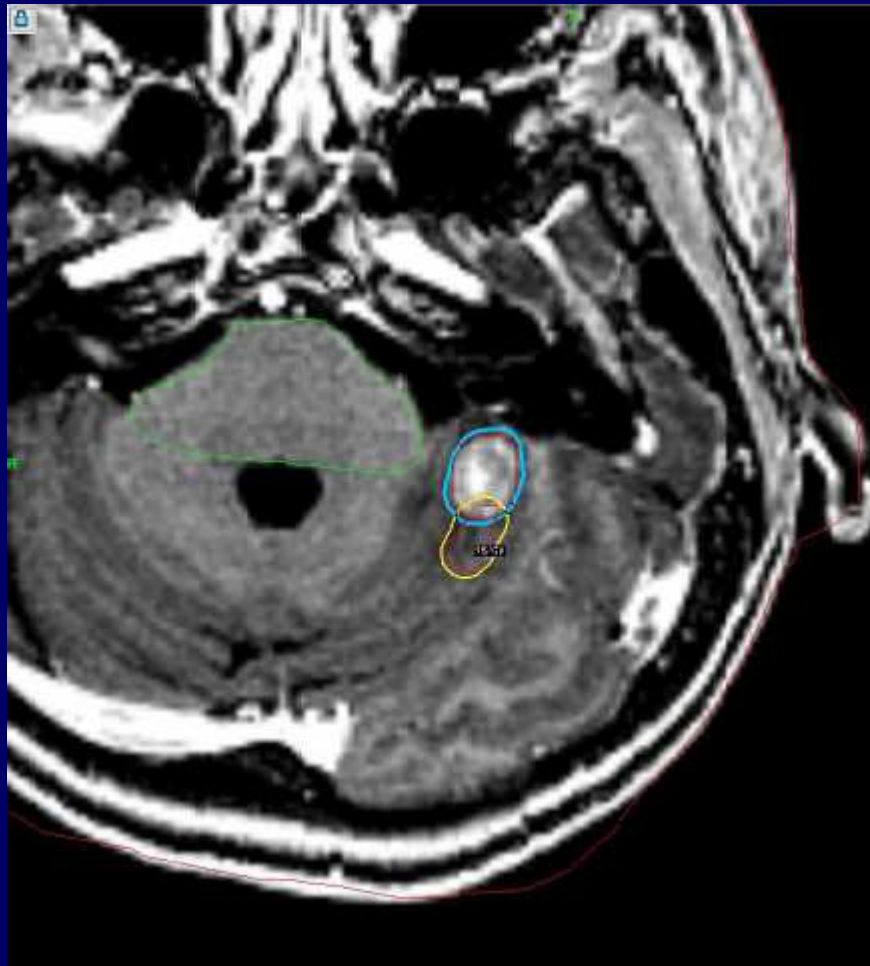
Survie (cancer du sein : radiochirurgie +/- radiothérapie panencéphalique)

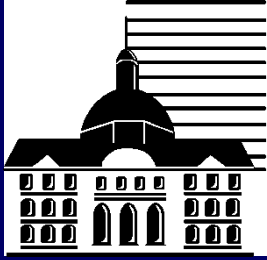




Radiochirurgie des métastases cérébrales

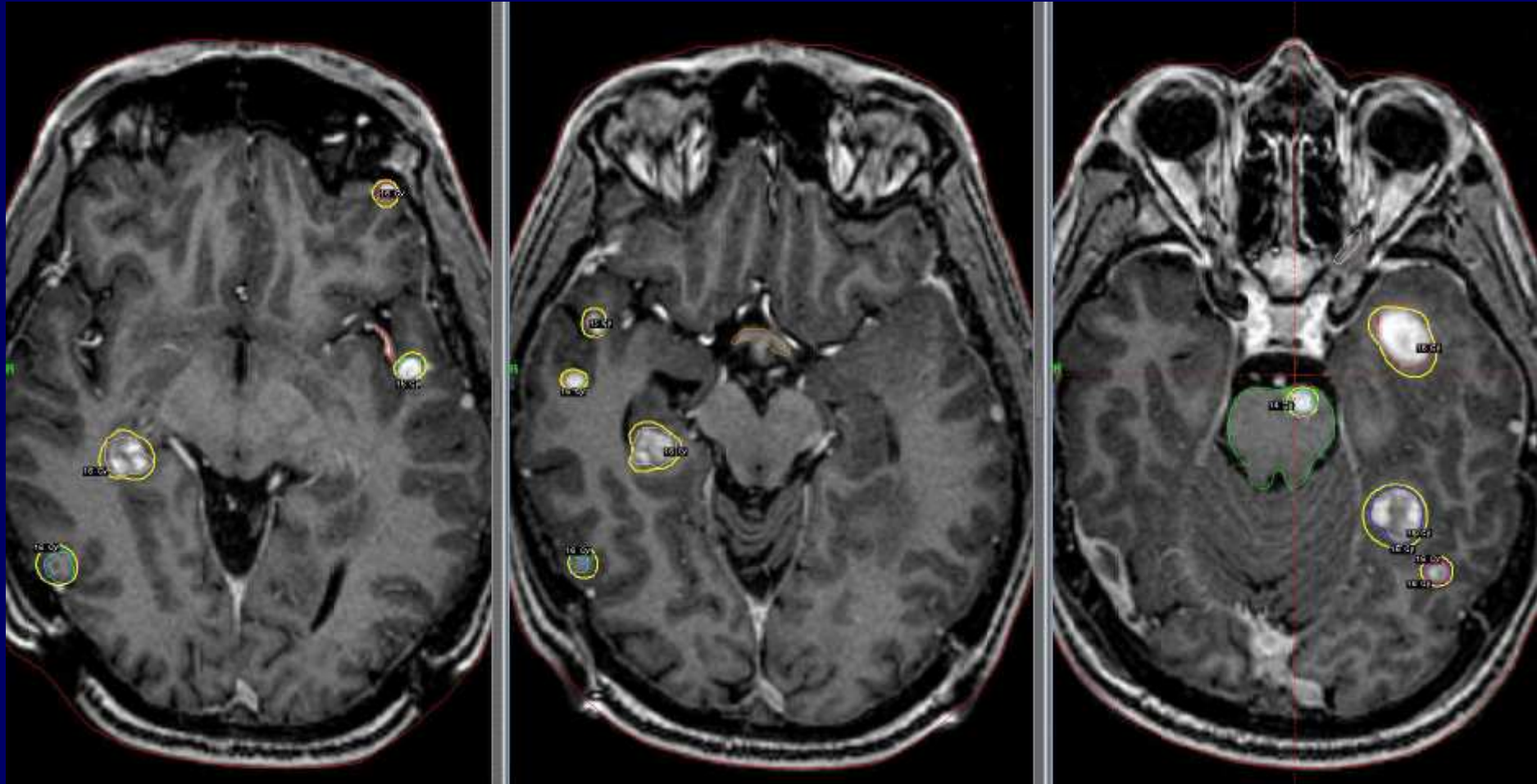
Retraitement par radiochirurgie

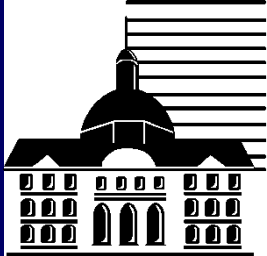




Radiochirurgie des métastases cérébrales

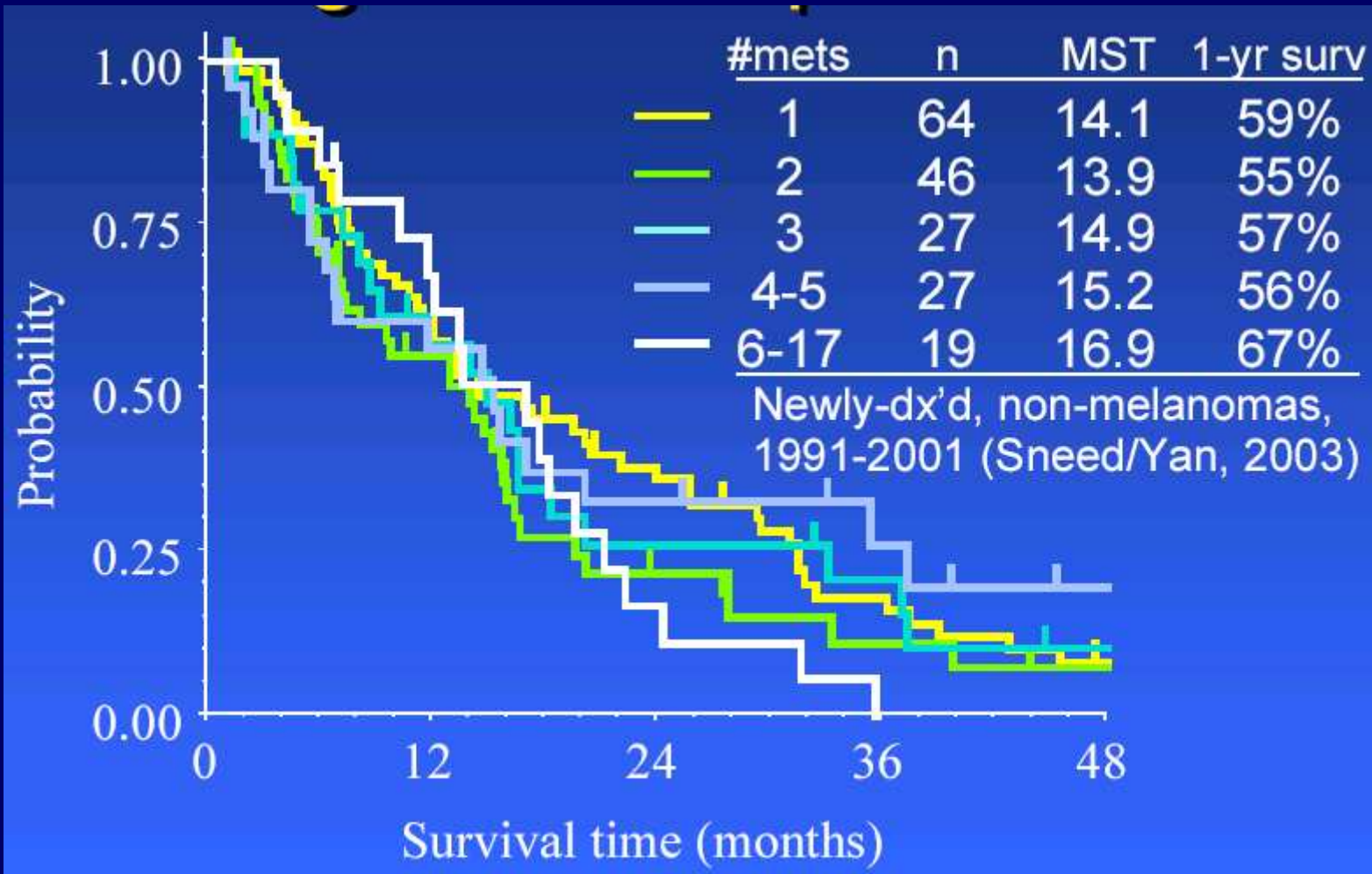
Métastases multiples

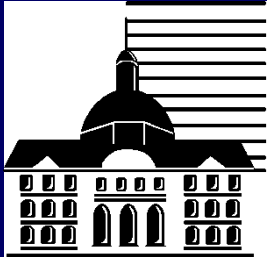




Radiochirurgie des métastases cérébrales

Métastases multiples



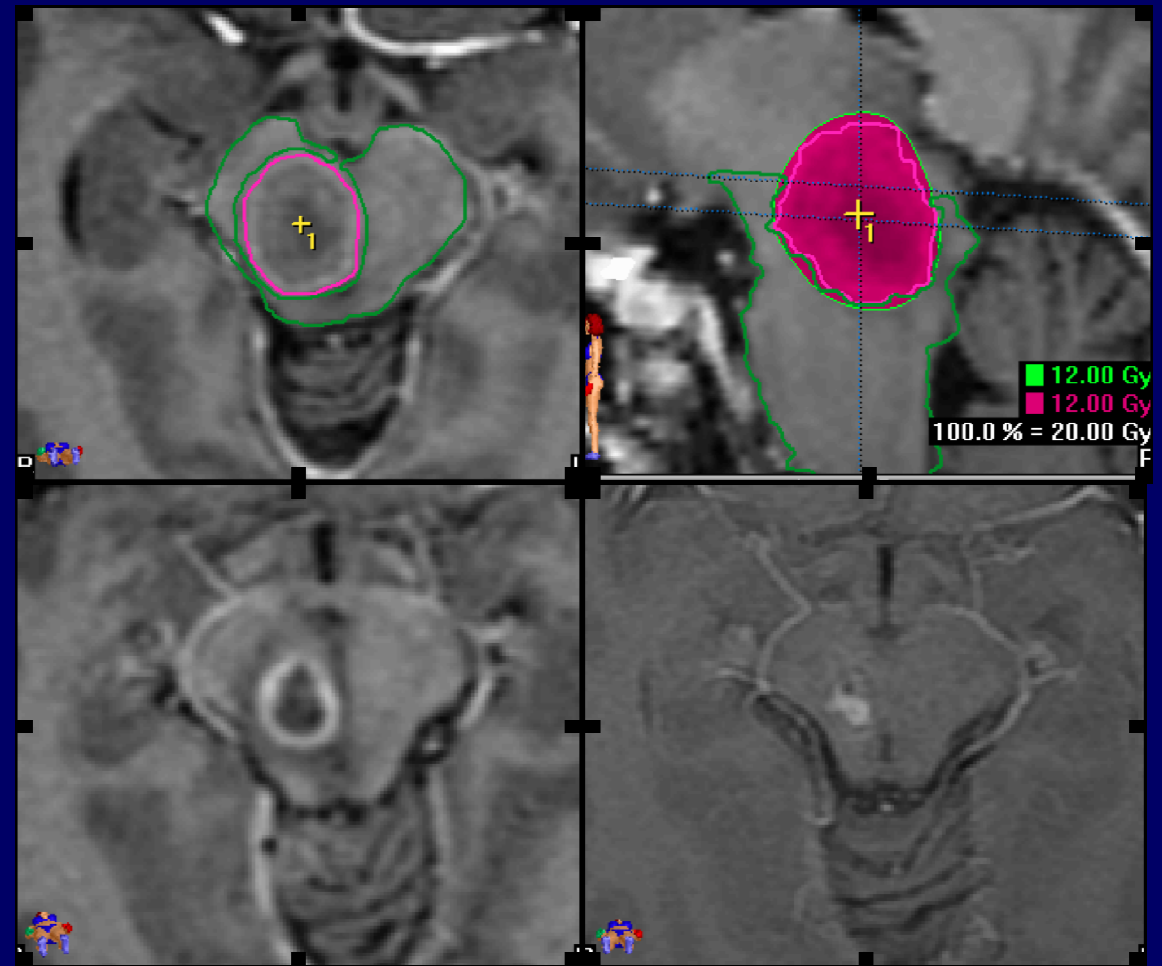


Radiochirurgie des métastases cérébrales

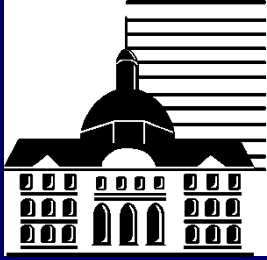
Métastases du tronc cérébral

51-year-old female with lung cancer
metastases located in the pons and mesencephalic
area (3D SPGR)

- (a) delineation in axial plane
- (b) dosimetric planning in sagittal plane
- (c) 6 months after radiosurgery
- (d) at 19-month follow-up.



a	b
c	d



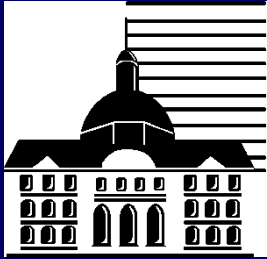
Métastases du tronc cérébral

30 patients

Dose médiane : 13,4 Gy

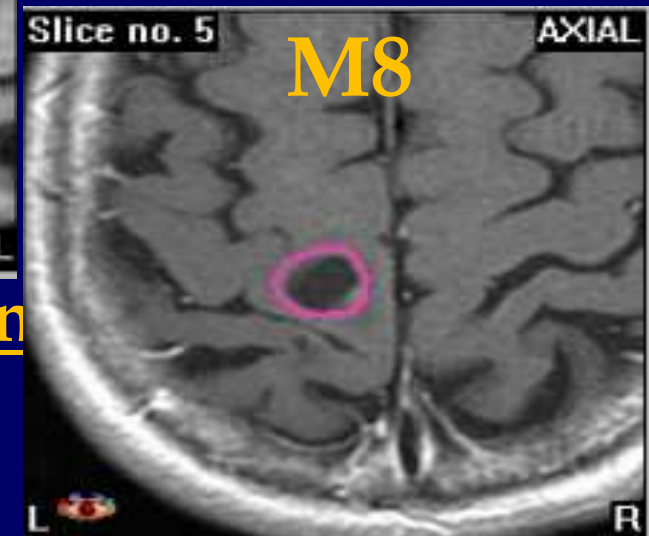
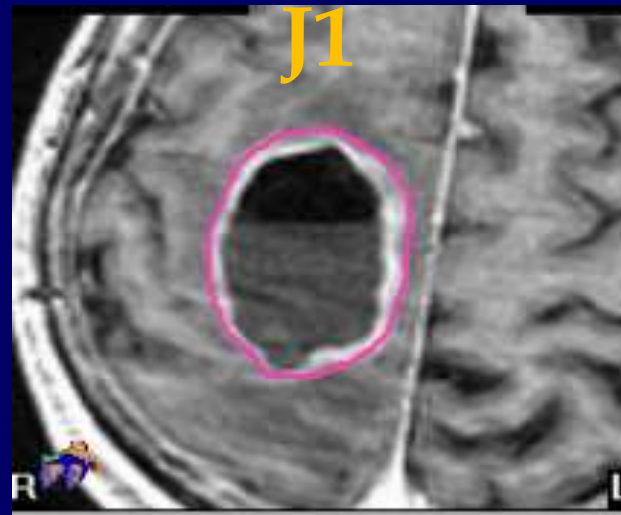
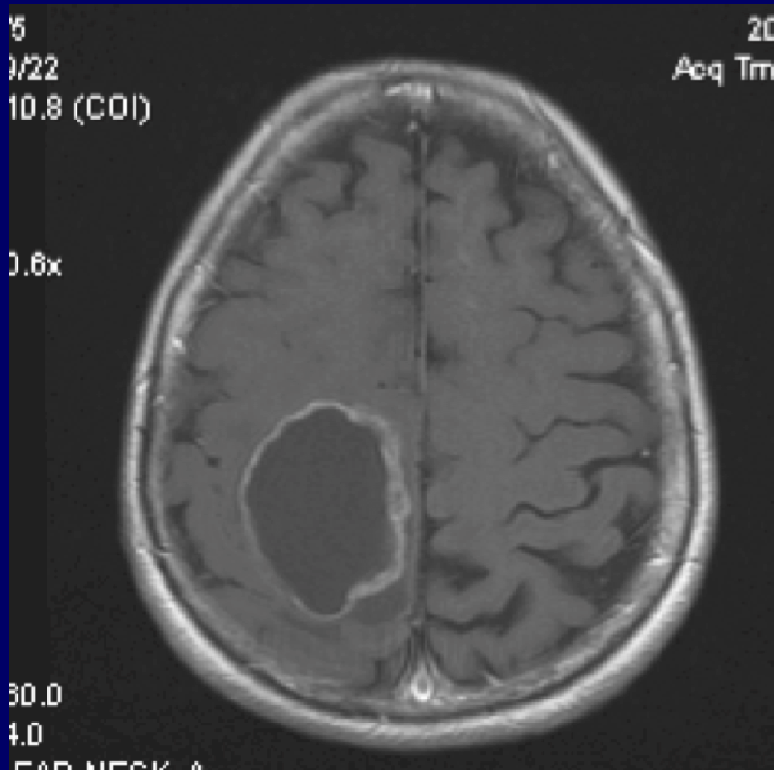
Taux de contrôle local (12 mois) : 80 %

Pas d'effets secondaires de grades 3-4



Radiochirurgie des métastases cérébrales

J0

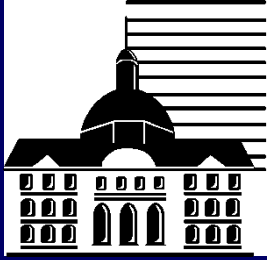


J0 V=55cc

J1 V=33 cc

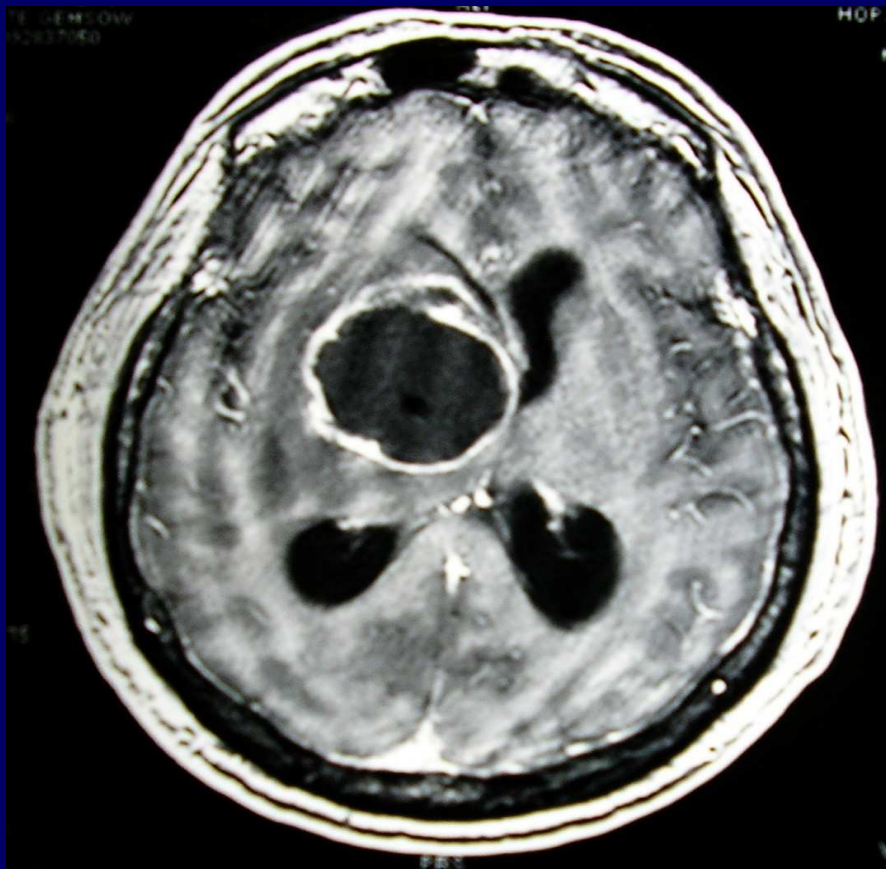
M8 V=2,7cc

F, 75 ans, cancer du poumon, hémiparésie, ponction
stéréotaxique et RC

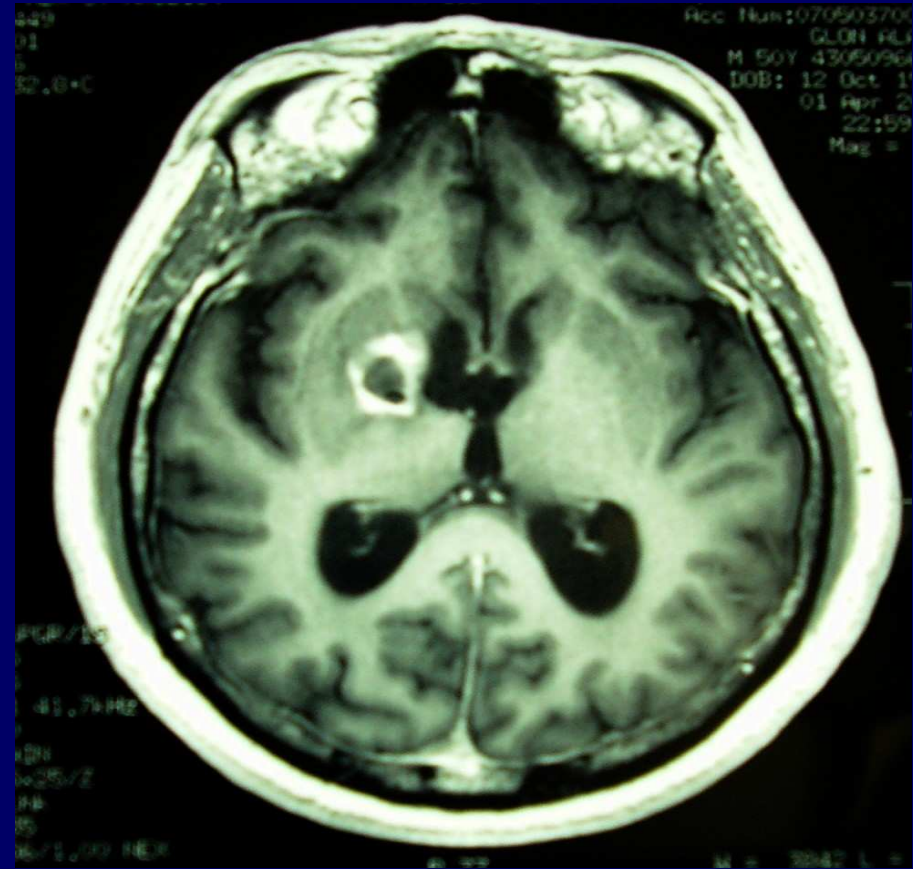


Radiochirurgie des métastases cérébrales

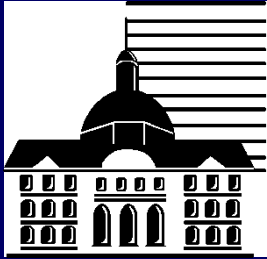
Homme, 55 ans, cancer du poumon, métastase profonde, ponction
40cc (J0) + RS (J 1-3)



J0

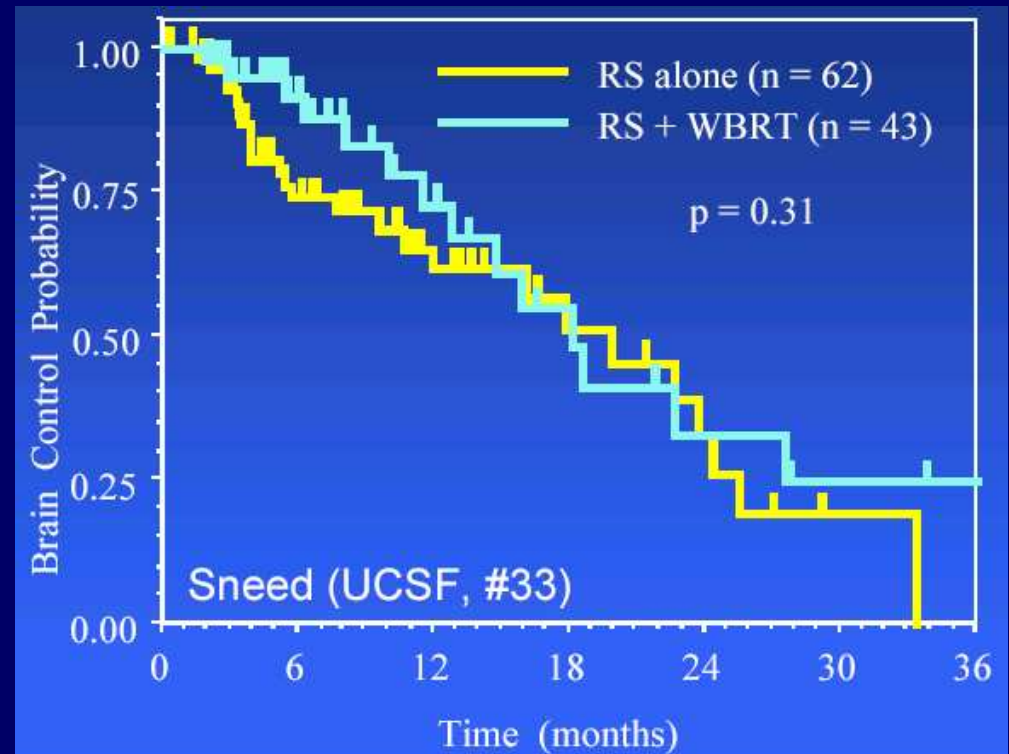
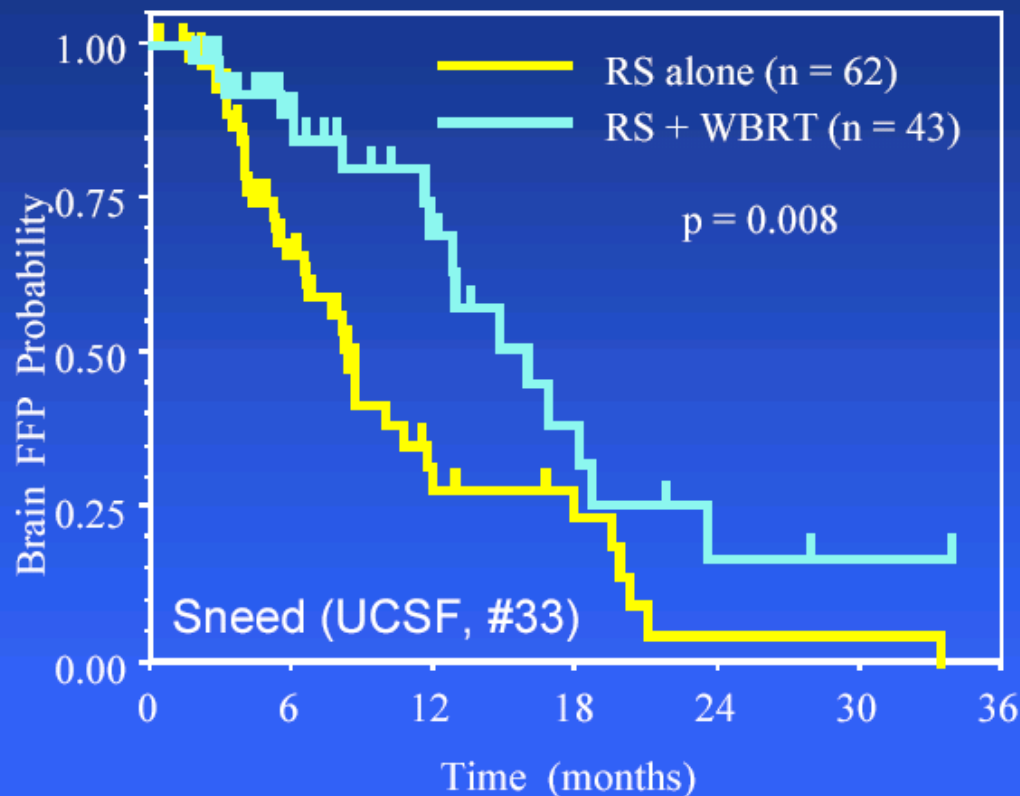


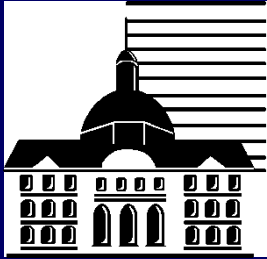
M6



Radiochirurgie des métastases cérébrales

Role de la radiothérapie panencéphalique





Radiochirurgie des métastases cérébrales

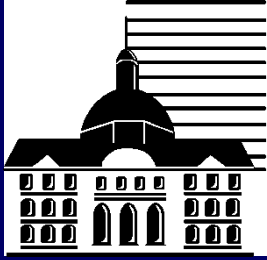
Radiochirurgie contre radiothérapie panencéphalique et radiochirurgie

Phase III trial (*Aoyama et al. JAMA 2006*) 132 patients

The median survival time and the 1-year actuarial survival rate were 7.5 months and 38.5% (95% confidence interval, 26.7%-50.3%) in the WBRT + SRS group and 8.0 months and 28.4% (95% confidence interval, 17.6%-39.2%) for SRS alone ($P = .42$).

The 12-month brain tumor recurrence rate was 46.8% in the WBRT + SRS group and 76.4% for SRS alone group ($P < .001$). Salvage brain treatment was less frequently required in the WBRT + SRS group ($n = 10$) than with SRS alone ($n = 29$) ($P < .001$).

Death was attributed to neurologic causes in 22.8% of patients in the WBRT + SRS group and in 19.3% of those treated with SRS alone ($p = 0.64$).



Radiochirurgie des métastases cérébrales

Radiochirurgie contre radiothérapie panencéphalique et radiochirurgie

Essai randomisé de Houston (Lancet Oncol 2009)

Radiochirurgie +/- 30 Gy/10 fractions/12 jours

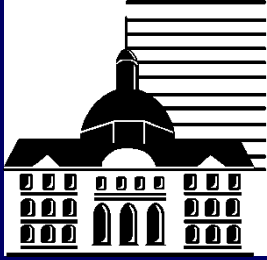
Avec la radiothérapie panencéphalique :

Meilleur taux de contrôle local

Plus de séquelles cognitives (49 % contre 23 % à 4 mois)

Médiane de survie plus courte (5,6 contre 15,2 mois)

Survie à 1 an : 19 % contre 61 % (p = 0,003)



Radiochirurgie des métastases cérébrales

Radiochirurgie contre radiothérapie panencéphalique et radiochirurgie

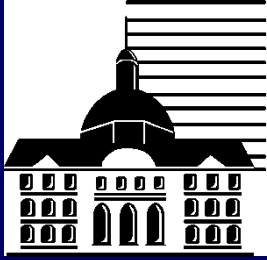
EORTC 22952-6001 (J Clin Oncol. 2011;134-41)

1 à 3 métastases \leq 3 cm

Chirurgie ou radiochirurgie +/- 30 Gy/10 fractions/12 jours

359 patients

Radiothérapie panencéphalique : même survie médiane (9,5 contre 10 mois), même survie jusqu'à dépendance fonctionnelle, mais moins de rechutes et de décès de cause neurologique



Radiochirurgie des métastases cérébrales

Radiochirurgie contre chirurgie + radiothérapie panencéphalique

Essai randomisé (Muacevic et al., J Neurooncol. 2008;87:299-307.)

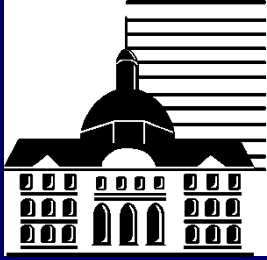
64 patients

Moins de toxicité pendant les 6 premiers mois

Rechutes cérébrales : $p = 0,04$ (0,4 après rattrapage radiochirurgical)

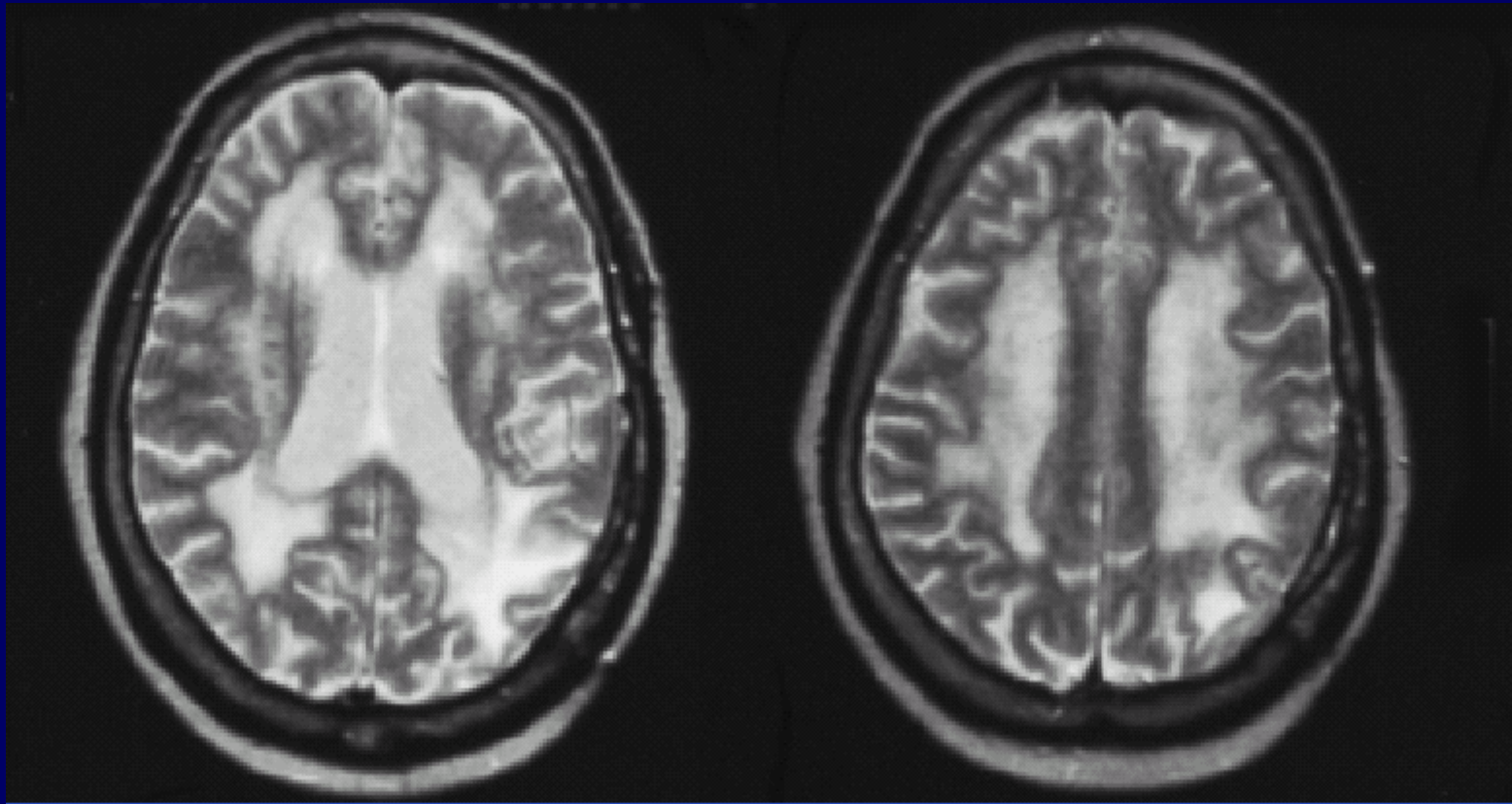
Décès de cause neurologique : $p = 0.3$

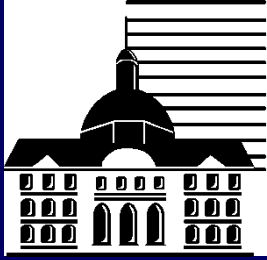
Survie : $p = 0.8$



Radiochirurgie des métastases cérébrales

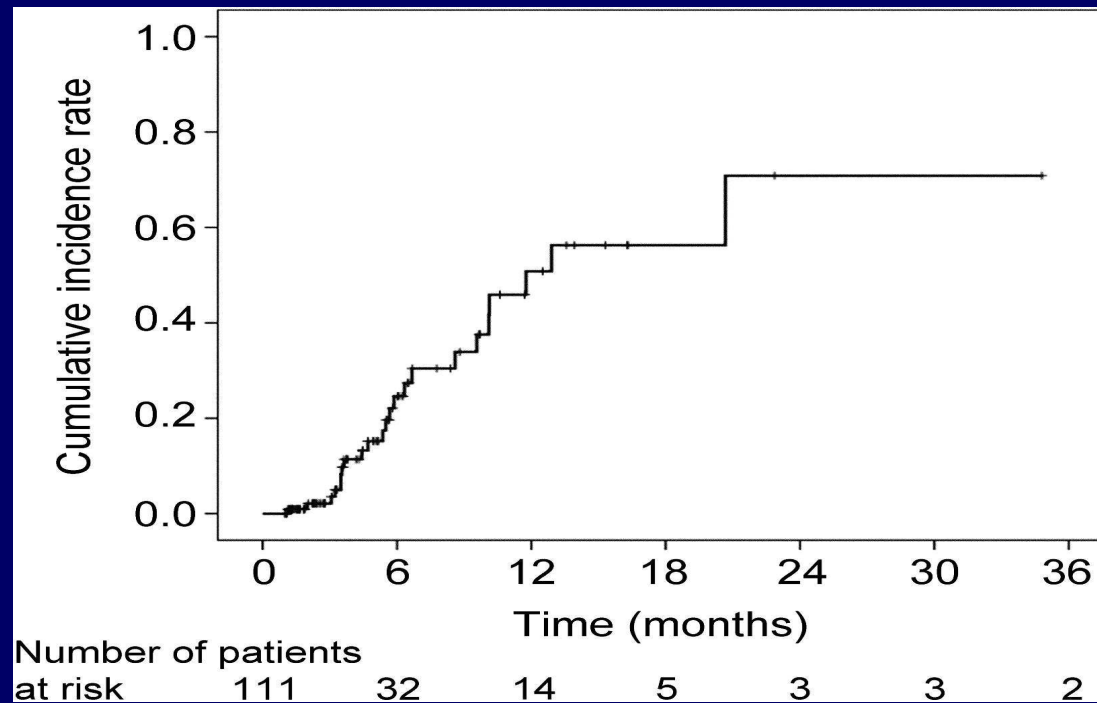
Leucoencéphalite (1 an après 30 Gy /
10 fractions / 12 jours)

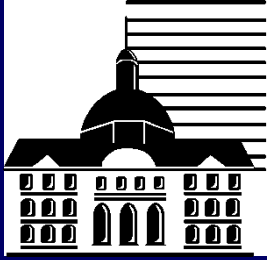




Radiochirurgie des métastases cérébrales

Cumulative incidence rate of leukoencephalopathy after the completion of whole-brain radiation therapy (EBI et al. IJROBP 2013;85:1212-7).





Radiochirurgie des métastases cérébrales

Radiothérapie panencéphalique avec ou sans radiochirurgie

- Essai de phase III (Konziolka et al., IJROBP 1999 ;45:427-434.)

14 patients 30 Gy/12 fr

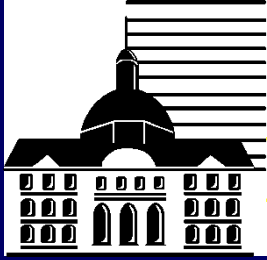
13 patients 30 Gy/12 fractions + radiochirurgie

Médiane de rechute : 6 mois contre 36 ($p = 0.0005$)

Rechutes : 100% contre 8% ($p = 0.05$)

Médiane de survie : 7,5 mois contre 11 ($p = 0.26$)

- 27 patients seulement (essai stoppé après analyse intermédiaire)



Radiochirurgie des métastases cérébrales

Radiothérapie panencéphalique avec ou sans radiochirurgie

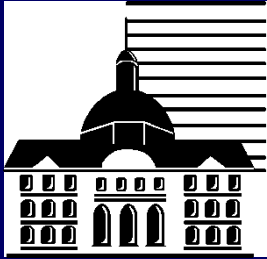
Essai de phase III (RTOG 95-08, Lancet 2004;363:1665-72)

333 patients 37.5 Gy/15 fractions \pm radiochirurgie

Avec la radiochirurgie

Meilleure autonomie fonctionnelle

Meilleure médiane de survie globale si métastase unique



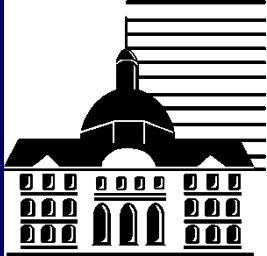
Radiochirurgie des métastases cérébrales

Doses équivalentes

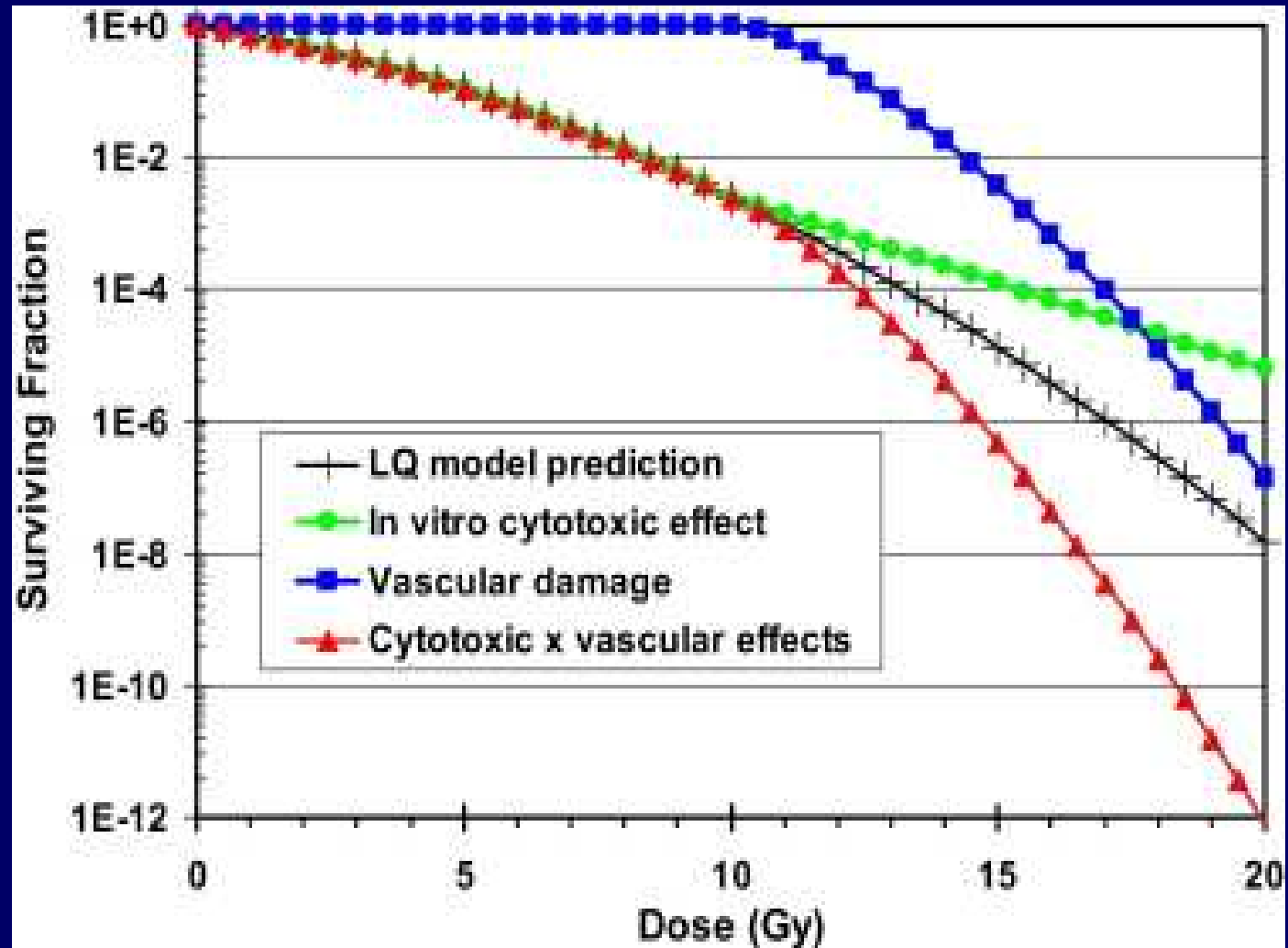
	2 Gy / fraction		6 Gy / fraction	
Radiosurgery doses	$\alpha / \beta = 2$	$\alpha / \beta = 10$	$\alpha / \beta = 2$	$\alpha / \beta = 10$
10 Gy	30	16.7	15	12.5
20 Gy	110	50	55	37.5
30 Gy	240	110	120	75

Effets tardifs : $\alpha / \beta = 2$

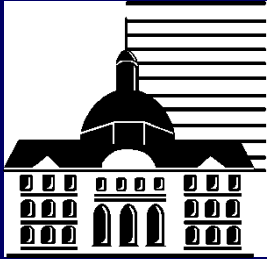
Effets précoces (carcinome épidermoïde) : $\alpha / \beta = 10$



Radiochirurgie des métastases cérébrales

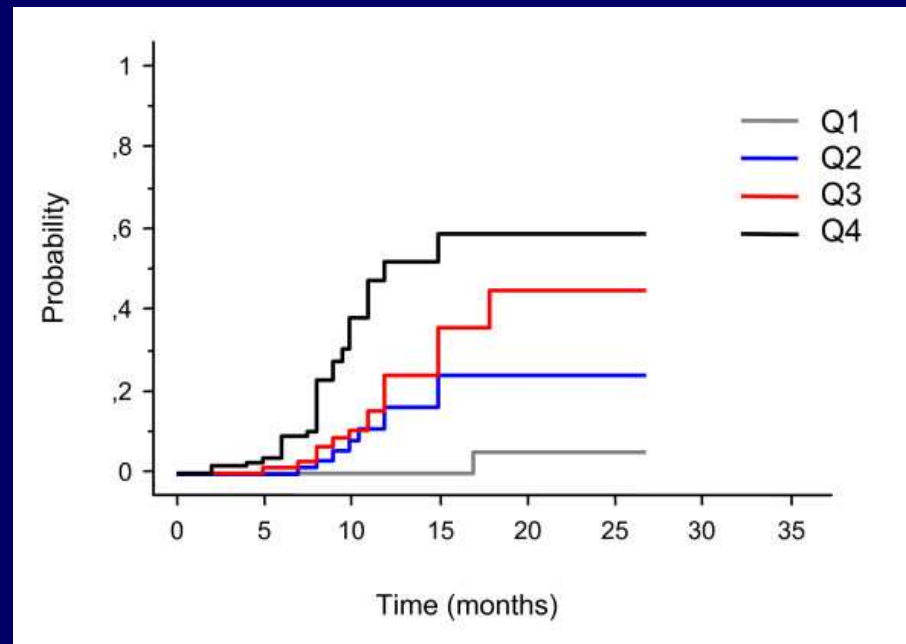


Kirkpatrick JP, et al. Semin Radiat Oncol. 2008;18:240-3.

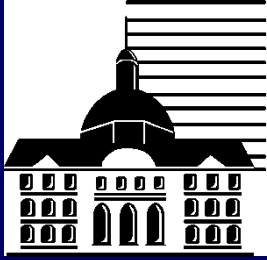


Radiochirurgie des métastases cérébrales

Rôle du V12Gy



Minniti G et al. Radiat Oncol. 201;6:48.

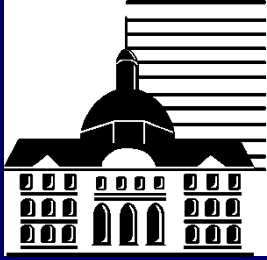


Radiochirurgie des métastases cérébrales

La radiothérapie en conditions stéréotaxiques hypofractionnée

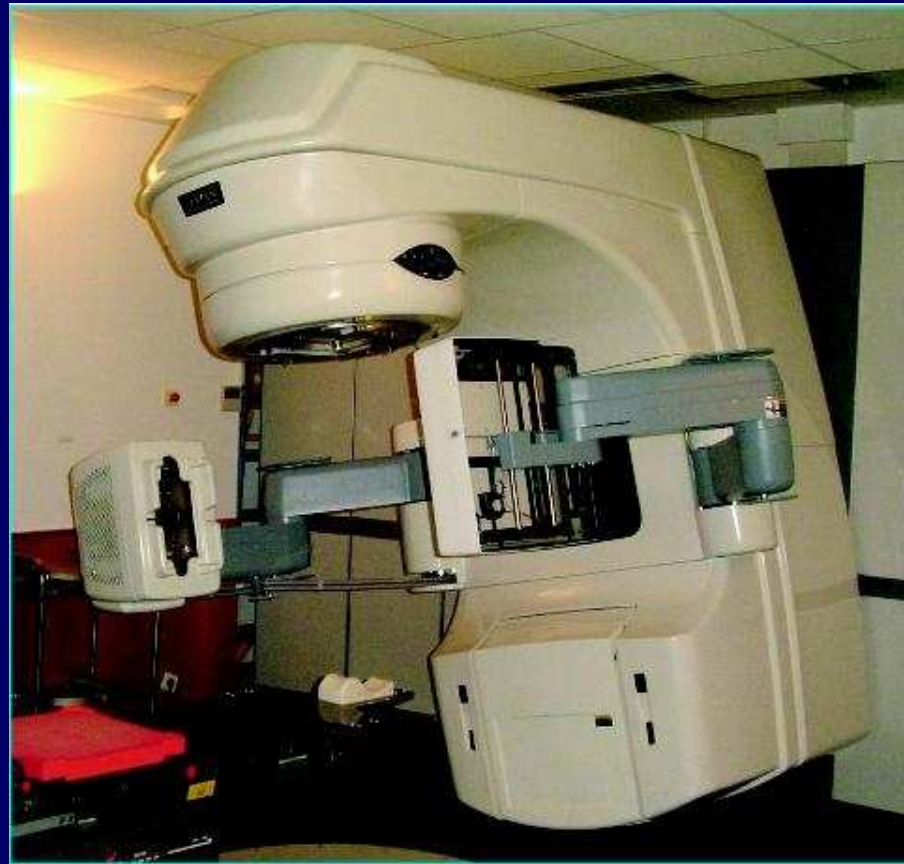
Séquence :

1. **Masque**
2. **Imagerie (IRM + TDM)**
3. **Dosimétrie en trois dimensions**
4. **3 séances de 11 Gy en utilisant le système de repositionnement**
5. **Tumeurs de 3 à 6 cm**



Radiochirurgie des métastases cérébrales

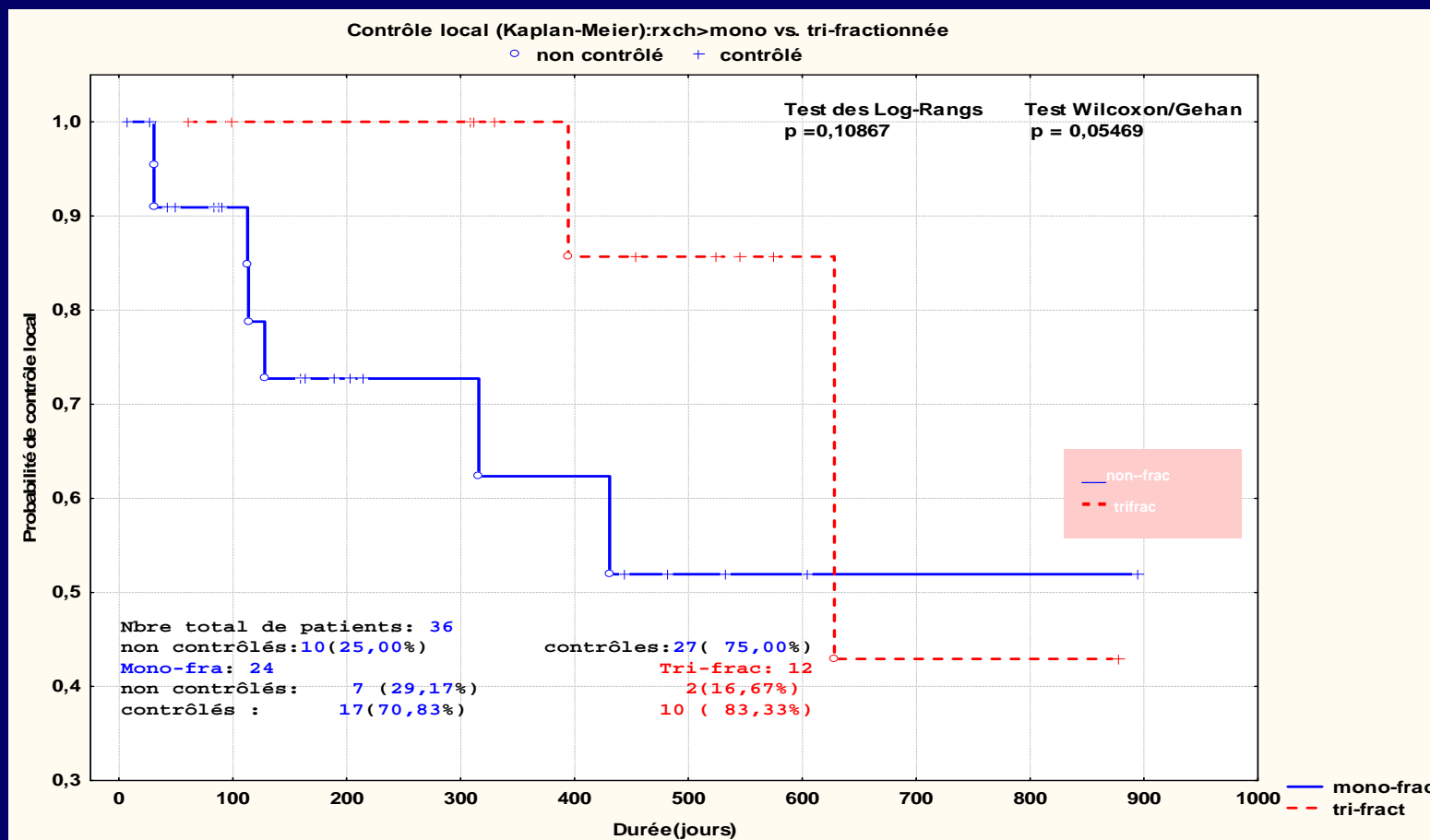
Imagerie embarquée (OBI – cone beam)

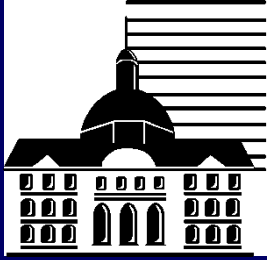




Radiochirurgie des métastases cérébrales

Radiothérapie trifractionnée





Radiochirurgie des métastases cérébrales

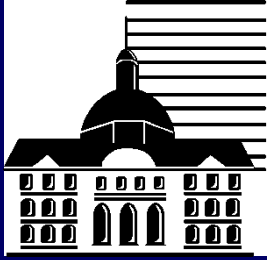
Indications typiques

Une, deux ou trois métastases

Diamètre ≤ 3 cm

Bon indice de Karnofsky

Maladie extra-cérébrale contrôlée



Traitement Pitié Salpêtrière

- **Pas de radiothérapie panencéphalique systématique**
- **Dose de 16 Gy minimum à la périphérie du GTV**
- **Marge de 1 mm (accélérateur)**
- **Isodose 70 % couvrant le CTV (accélérateur) ou isodose 50 % couvrant le GTV (Gamma Knife)**



Radiochirurgie des métastases cérébrales

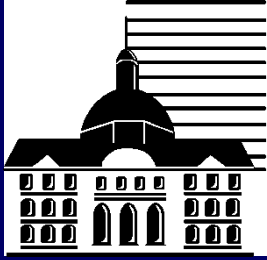
Conclusions

Hospitalisation courte

Pas d'anesthésie générale

Taux de contrôle local élevé

**Peu d'effets secondaires (pas
ou peu d'alopécie)**



Conclusion

**Peut être associée à la radiothérapie
panencéphalique, la chirurgie et/ou la
chimiothérapie**

Peut être répétée

Peut être délivrée en rattrapage



Conclusions

Quel rôle pour la chirurgie ?

Quel rôle pour la radiothérapie panencéphalique ?

Peut-on élargir les indications (plus de métastases, métastases plus grosses) ?

Merci de votre attention !

