Iodine 125 Plaque Radiotherapy

For Recurrent Retinoblastoma with Localized Vitreous Seeding after Chemoreduction

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I^{125} Plaque for Recurrent RB with Localized Vitreous Seeding after Chemoreduction

Introduction

- RB management is complex and individualized
- ***Enucleation*** remains the most popular non conservative technique
- ***Chemoreduction*** is currently the most popular conservative technique

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Enucleation **Non Enucleation**

= *Chemoreduction* followed by

- **Focal therapy**
  - ✓ ***Thermotherapy***
  - ✓ ***Cryotherapy***
  - ✓ ***Plaque radiotherapy***
- **External beam radiation**

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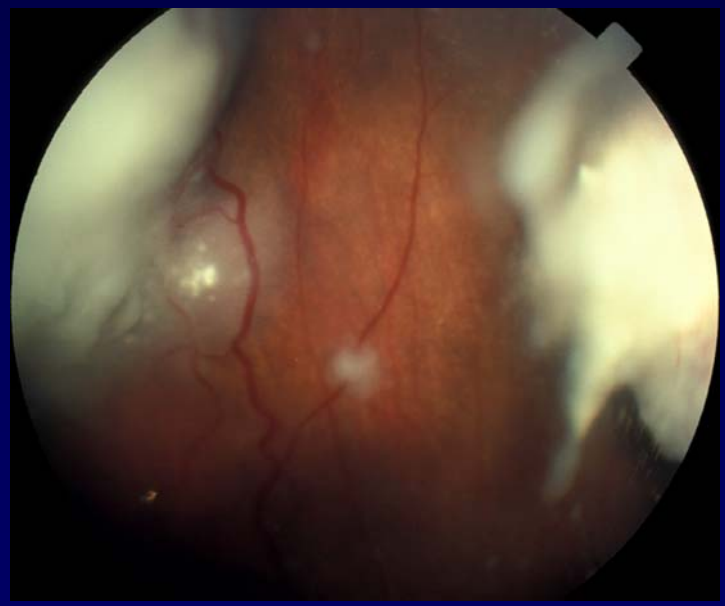
Introduction

- **Recurrent vitreous seeding after chemoreduction**



↯ ***Usually requires external beam radiotherapy or enucleation***

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I^{125} Plaque for Recurrent RB with Localized Vitreous Seeding after Chemoreduction

Material	Energy	Half-life	Depth
• *γ-radiation*			
✓ Cobalt-60	1.500 keV	5.2 years	up to 10 mm
✓ Iridium-192	450 keV	74 days	up to 10 mm
✓ Palladium-103	20 keV	17 days	up to 10 mm
✓ Iodine-125	30 keV	60 days	up to 10 mm
• *β-radiation*			
✓ Ruthénium-106	30 keV	1 year	up to 5 mm
✓ Strontium-90	540 keV	27 years	up to 3 mm

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Iodine-125 - Advantages

- Lower-energy γ-rays
- Gold foil shielded plaque
- Seeds placement ➔ Isodoses conformation
- Custom-designed plaque
- Rapid dose fall-off
  - ✓ HVL in water = 20 mm

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Iodine-125 - Disadvantages

- Expensive
- Short half-life
- 2-day preparation
- High tissue penetration (γ radiation)

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Purpose

- ***To report our experience with I^{125} plaque radiotherapy for recurrent localized RB vitreous seeding after chemoreduction***

- ***Tumor recurrence at treatment site***
- ***Radiation complications***
- ***Late enucleation***

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Material and Methods

- **Prospective - non comparative observational series Oct 1997 - Sept 2006**
- **First-line chemotherapy**
  - ✓ ***Carboplatin - vincristine - etoposide*** **IV**
    560mg/m² 1.5 mg/m² 150 mg/m²
  - ✓ **6 cycles (2 days) at 3 week-intervals**
- **Consolidation by focal therapy**
  - ✓ **Cryotherapy**
  - ✓ **Thermotherapy**
  - ✓ **Chemothermotherapy**

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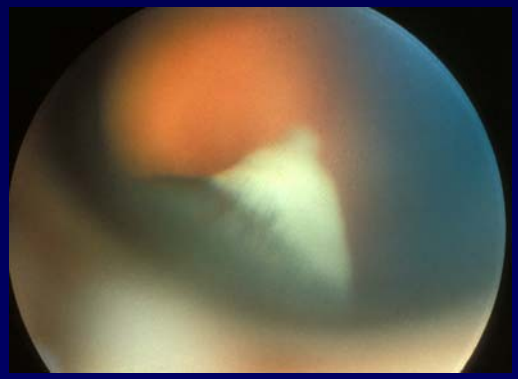
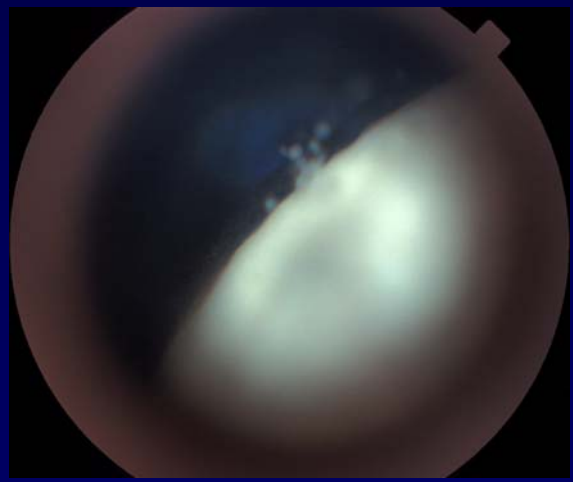
Material and Methods

- **Eligibility criteria**
  - ✓ **Recurrent vitreous seeding after chemoreduction**
    - ➢ **Isolated**
    - ➢ **With RB tumor**





  - ✓ **≤ 15 mm in basal dimensions**
  - ✓ **≤ 8 mm in thickness**

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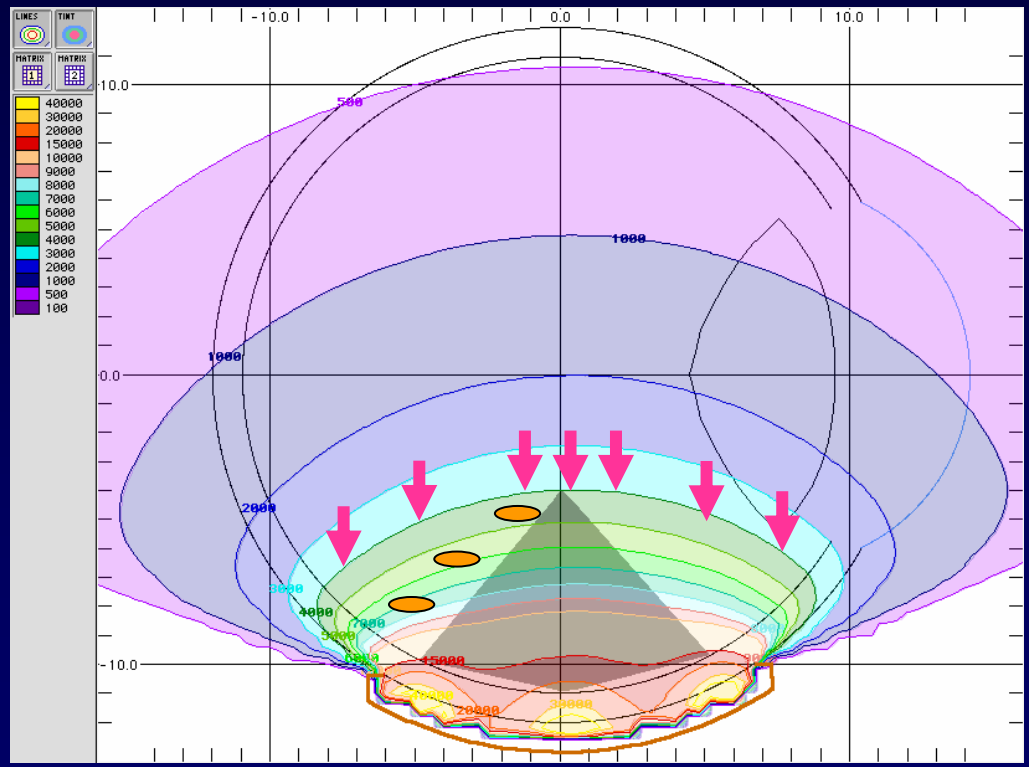
I^{125} Plaque for Recurrent RB with Localized Vitreous Seeding after Chemoreduction

Treatment planning

- Program simulator *Bebig*
- Including 1 mm-safety (diameter and thickness)
- Median dose to tumor apex (vitreous seeds) = 40Gy



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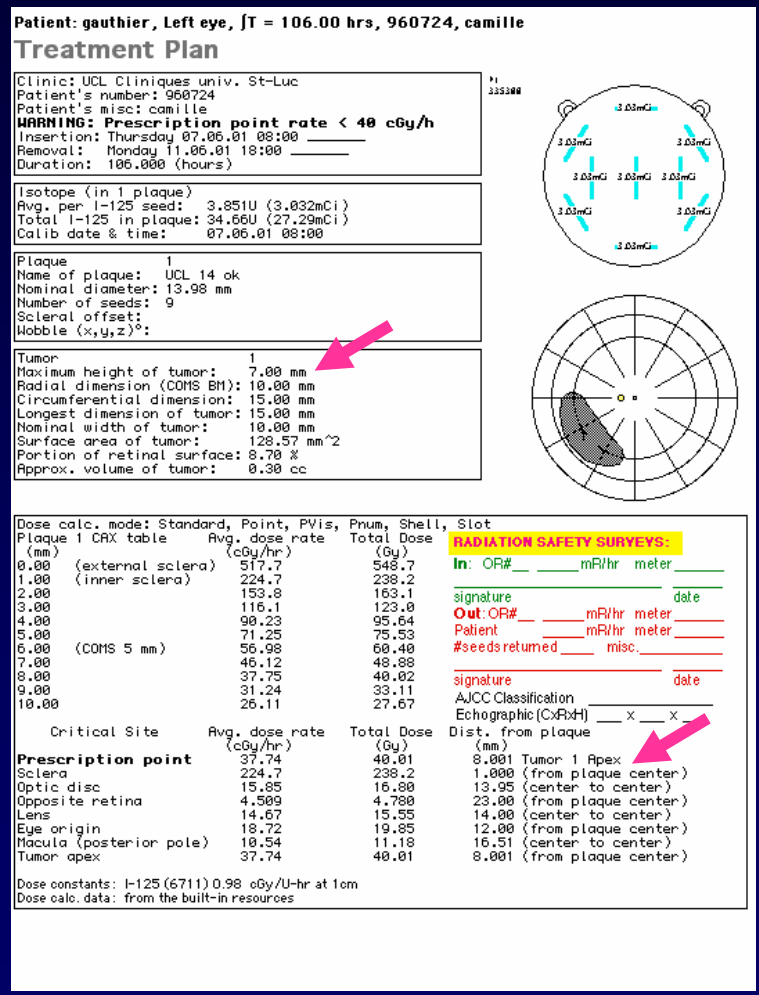
Collected Data

- **Patient features**
  - ✓ Age at plaque treatment
  - ✓ Prior treatments
    - ➢ Chemoreduction alone
    - ➢ Chemoreduction + focal therapy
  - ✓ RB laterality
- **Radiation dose**
  - ➢ Lens
  - ➢ Optic disc
  - ➢ Fovea
  - ➢ Sclera



Patient: gauthier, Left eye, ∫T = 106.00 hrs, 960724, camille

Treatment Plan

Clinic: UCL Cliniques univ. St-Luc
Patient's number: 960724
Patient's misc: camille
WARNING: Prescription point rate < 40 cGy/h
Insertion: Thursday 07.06.01 08:00 _____
Removal: Monday 11.06.01 18:00 _____
Duration: 106.000 (hours)

Isotope (in 1 plaque)
Avg. per I-125 seed: 3.851U (3.032mCi)
Total I-125 in plaque: 34.66U (27.29mCi)
Calib date & time: 07.06.01 08:00

Plaque 1
Name of plaque: UCL 14 ok
Nominal diameter: 13.98 mm
Number of seeds: 9
Scleral offset:
Wobble (x,y,z)°:

Tumor 1
Maximum height of tumor: 7.00 mm
Radial dimension (COMS BM): 10.00 mm
Circumferential dimension: 15.00 mm
Longest dimension of tumor: 15.00 mm
Nominal width of tumor: 10.00 mm
Surface area of tumor: 128.57 mm^2
Portion of retinal surface: 8.70 %
Approx. volume of tumor: 0.30 cc

Dose calc. mode: Standard, Point, PVis, Pnum, Shell, Slot

Plaque 1 CAX table (mm)		Avg. dose rate (cGy/hr)	Total Dose (Gy)
0.00	(external sclera)	517.7	548.7
1.00	(inner sclera)	224.7	238.2
2.00		153.8	163.1
3.00		116.1	123.0
4.00		90.23	95.64
5.00		71.25	75.53
6.00	(COMS 5 mm)	56.98	60.40
7.00		46.12	48.88
8.00		37.75	40.02
9.00		31.24	33.11
10.00		26.11	27.67

Critical Site	Avg. dose rate (cGy/hr)	Total Dose (Gy)	Dist. from plaque (mm)
Prescription point	37.74	40.01	8.001 Tumor 1 Apex
Sclera	224.7	238.2	1.000 (from plaque center)
Optic disc	15.85	16.80	13.95 (center to center)
Opposite retina	4.509	4.780	23.00 (from plaque center)
Lens	14.67	15.55	14.00 (center to center)
Eye origin	18.72	19.85	12.00 (from plaque center)
Macula (posterior pole)	10.54	11.18	16.51 (center to center)
Tumor apex	37.74	40.01	8.001 (from plaque center)

Dose constants: I-125 (6711) 0.98 cGy/U-hr at 1cm
Dose calc. data: from the built-in resources

RADIATION SAFETY SURVEYS:
In: OR#__ _____mR/hr meter_____
_____ _____
signature date
Out: OR#__ _____mR/hr meter_____
Patient _____mR/hr meter_____
#seeds returned ____ misc._____
_____ _____
signature date
AJCC Classification _____
Echographic (CxRxH) ___ x ___ x ___

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Tumor (vitreous seeding) Data

- +/- Retinal tumor
- Meridional location
- Largest basal dimension
- Largest thickness (depth)
- Distance to disc
- Distance to fovea
- Subretinal fluid

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Results

- **14 patients = 17 tumors**
  - ✓ Unilateral sporadic 4
  - ✓ Bilateral sporadic 10
- **Mean age** — **23 month old** (range, 4 to 59 months)
- **Mean interval post CRD** — **6 months** (range, 1 to 22 months)
- **Prior treatments**
  - ✓ Chemoreduction alone 8 *(47%)*
  - ✓ Chemoreduction + focal RX 8 *(47%)*
  - ✓ Chemoreduction + EBRT 1 *(6%)*

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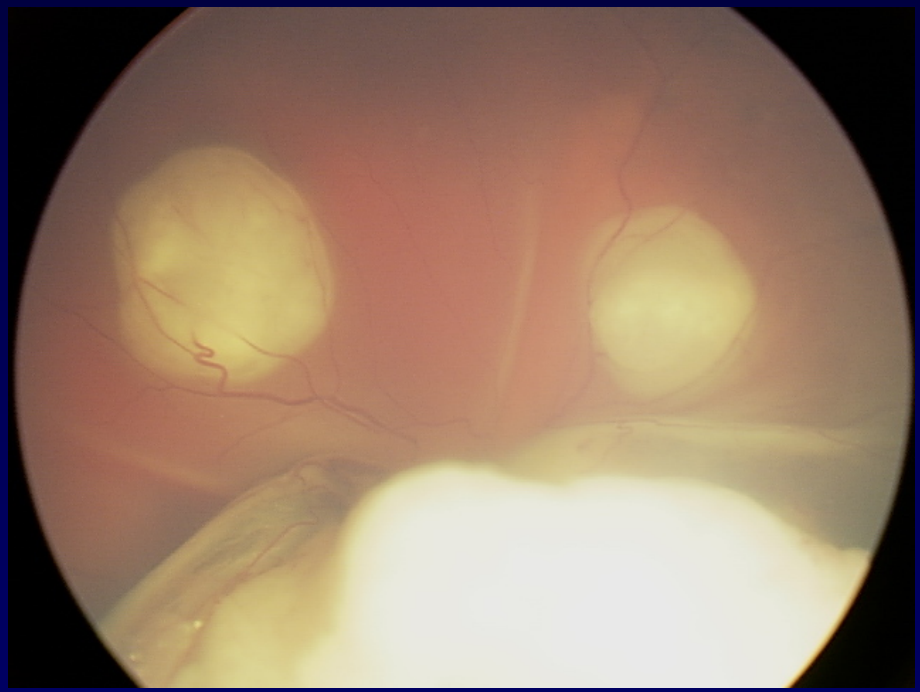

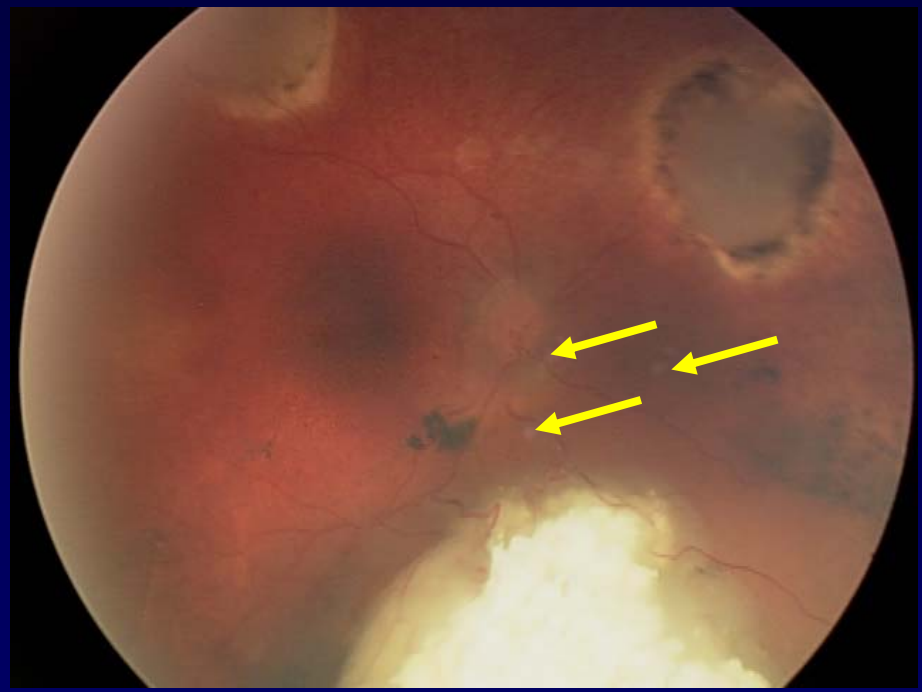

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Results

- **Mean largest basal dimension** — **12 mm** (range, 6 to 15 mm)
- **Mean greatest thickness** — **6 mm** (range, 4 to 8 mm)
- **Mean distance to disc** — **7.8 mm** (range, 0 to 18 mm)
- **Mean distance to fovea** — **8.5 mm** (range, 0 to 15 mm)

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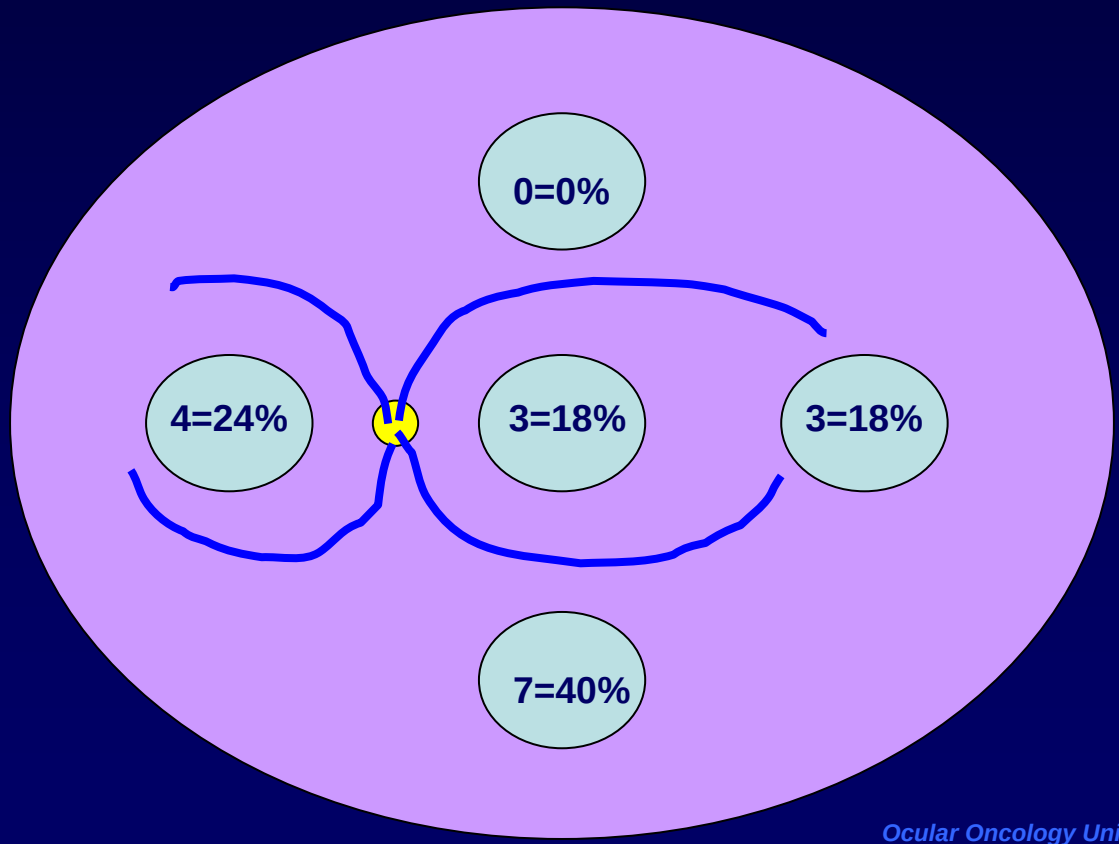
Results

- **Meridional location**



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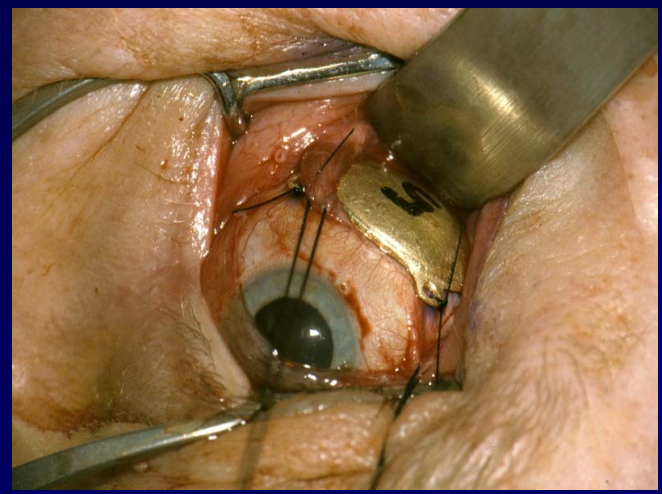
Results Mean radiation dose (Gy)

- Apex 40
- Optic disc 15 (range, 4 to 62)
- Macula 20 (range, 4 to 124)
- Lens 11 (range, 3 to 18)



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Results

- **Recurrence type**
  - ✓ Vitreous seeding alone — 4 *(24%)*
  - ✓ Vitreous seeding + retinal tumor — 13 *(76%)*

- **Retinal detachment**
  - ✓ None — 13 *(76%)*
  - ✓ ≤ 25% retinal surface — 2 *(12%)*
  - ✓ > 25% and ≤ 50% retinal surface — 2 *(12%)*

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Results

- **Total follow-up** — **48 months** *(range, 6 to 108 months)*
- **Tumor recurrence at site** — **1** ***(6%)*** *at 24 months*
- **Late enucleation** — **3** ***(18%)***
  Mean interval 12 months *(range, 2 to 24 months)*
  - ✓ **Tumor recurrence at site** — **1**
  - ✓ **Tumor recurrence at distance** — **2**
- **RB-related death** — **0**

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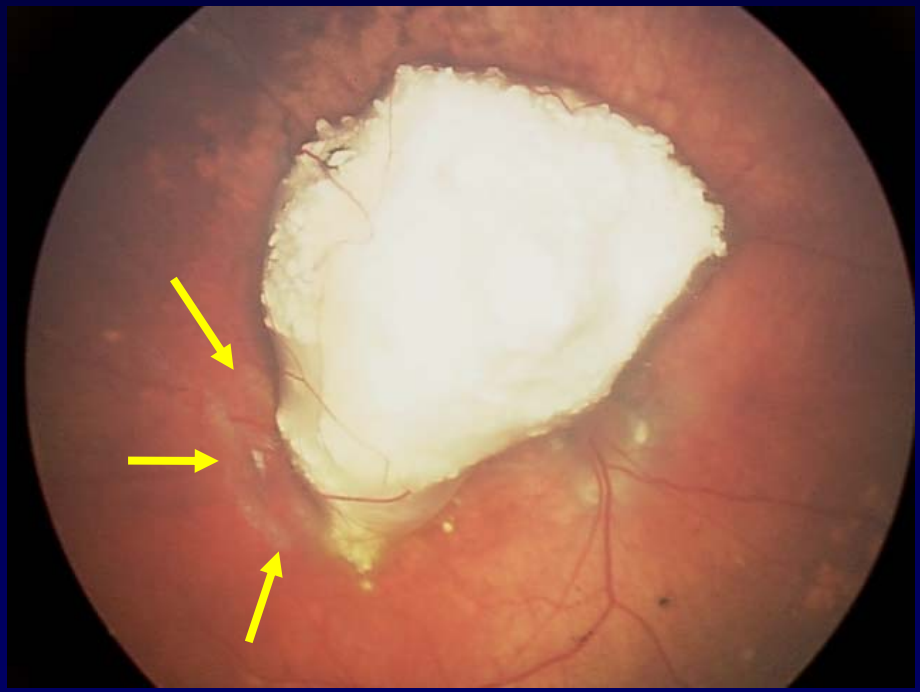

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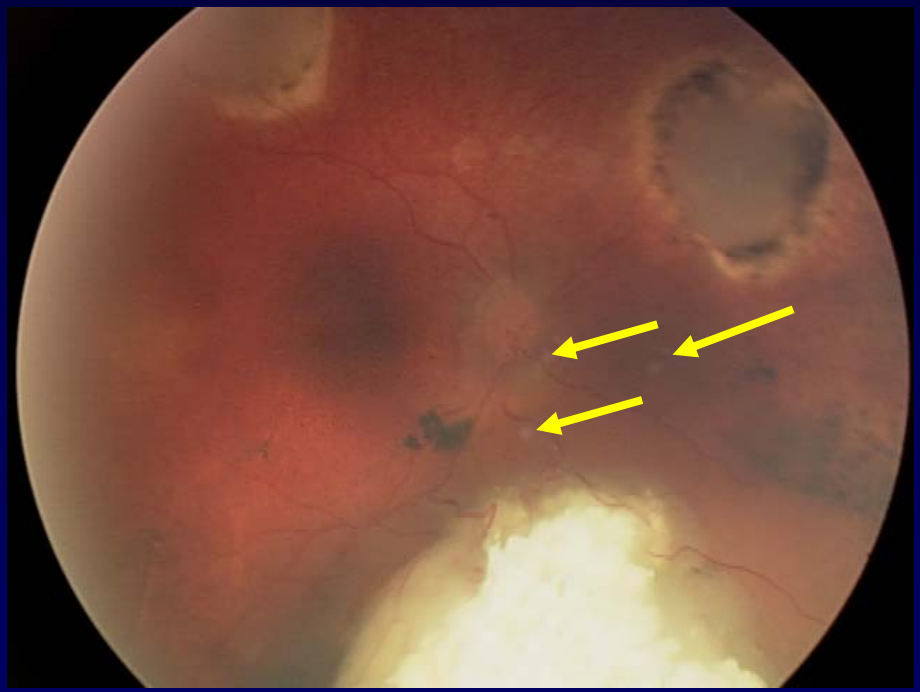

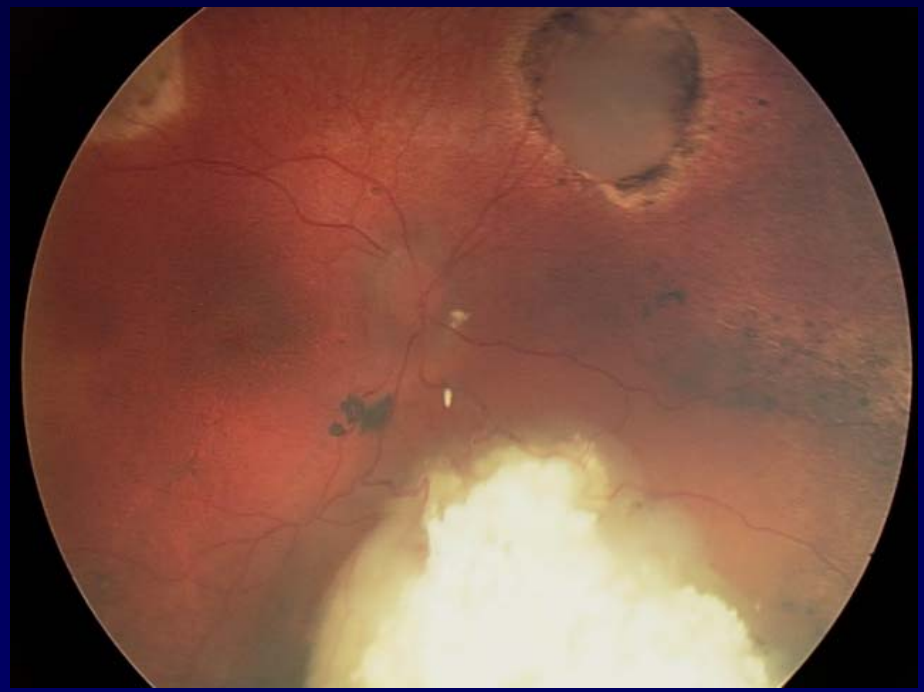

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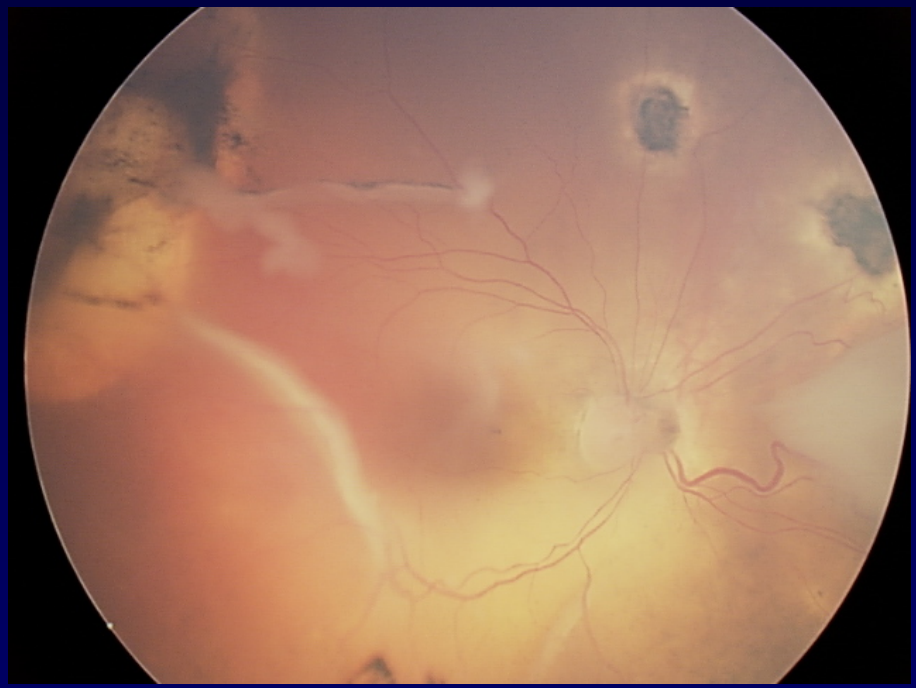

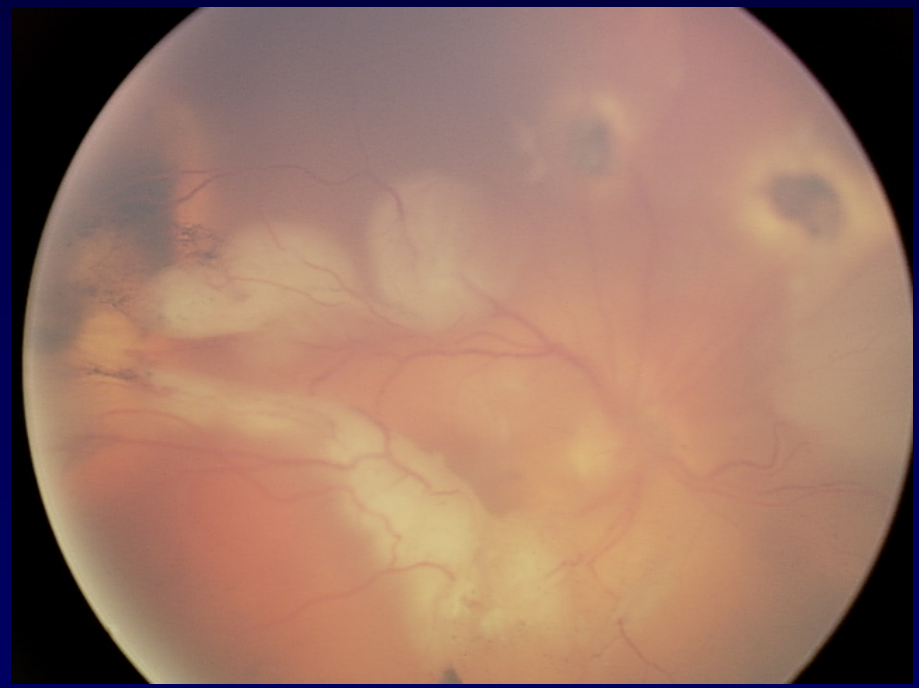

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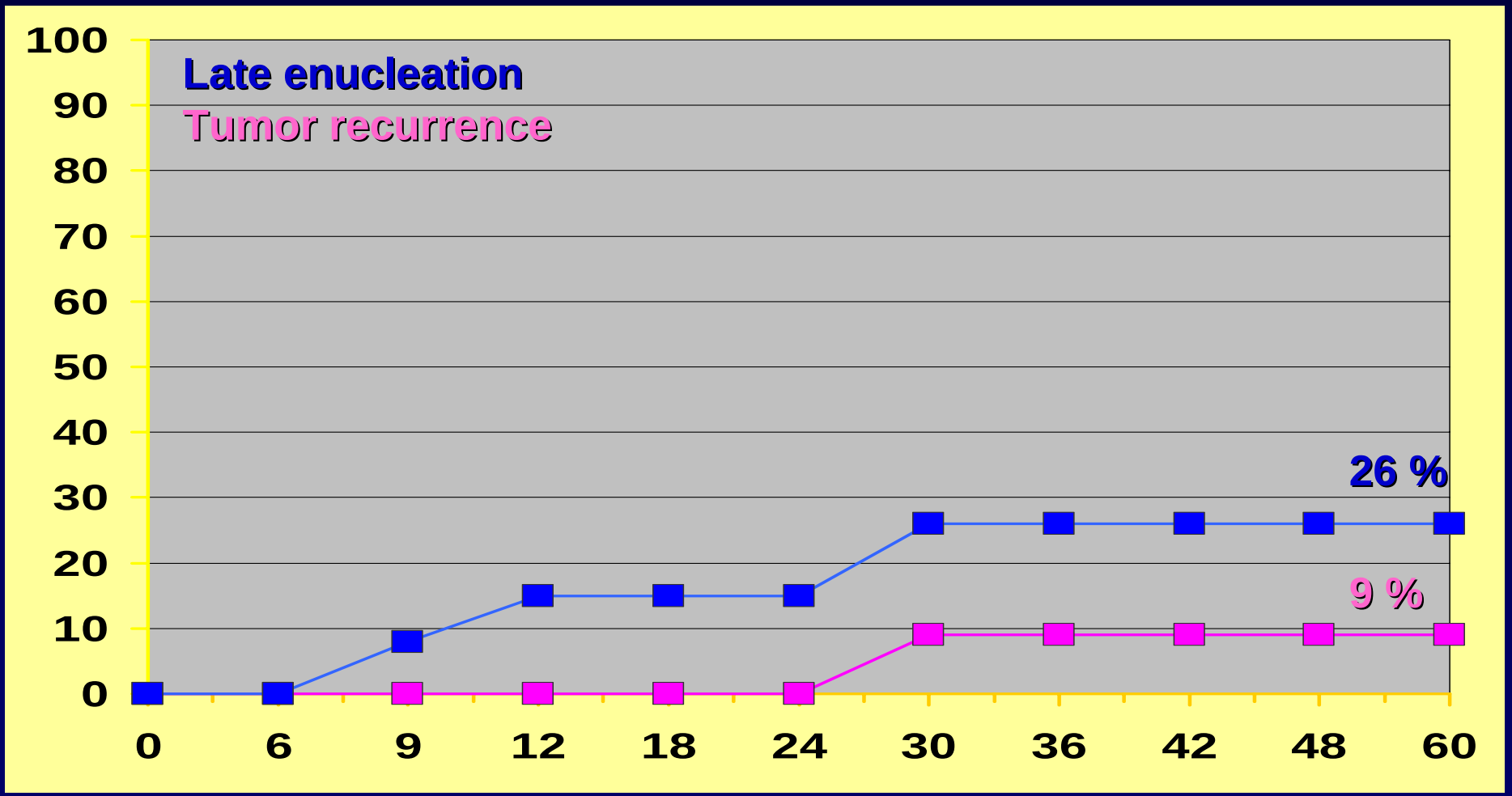
Results – Kaplan-Meier at 5 years



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Results

• Radiation retinopathy	6 *(35%)*
Mean interval	11 months
• Radiation papillopathy	1 *(6%)*
Mean interval	8 months
• Radiation cataract	6 *(35%)*
Mean interval	33 months
• Transient vitreous hemorrhage	5 *(29%)*
Mean interval	12 months
• Neovascular glaucoma	0

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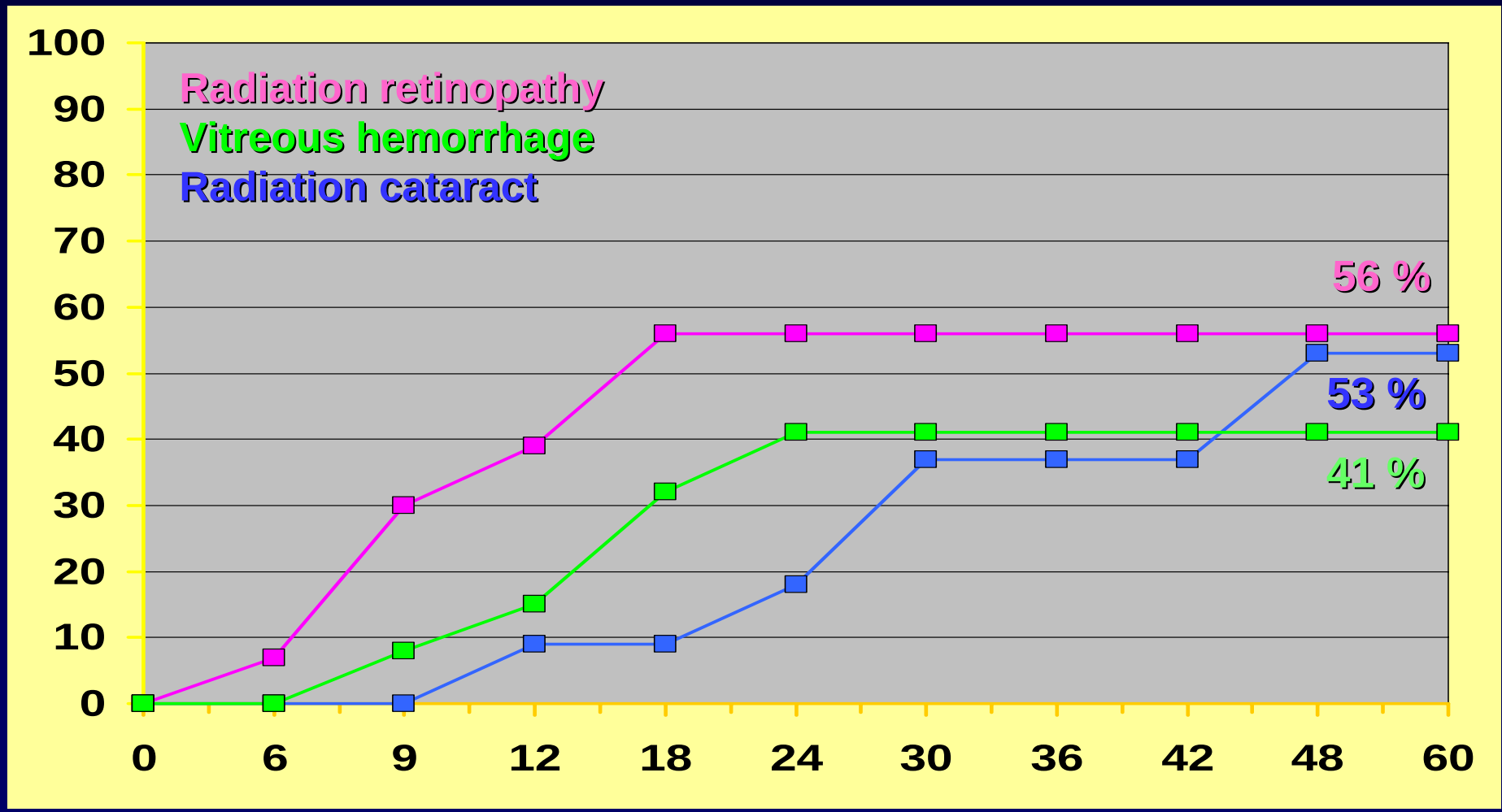
Results – Radiation Complications at 5 years (Kaplan-Meier)



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Results - Clinical Factors Predictive

(univ*ariate analysis-Cox regression)*

- **Radiation retinopathy**
  - ✓ Shorter distance to disc
  - ✓ Shorter distance to fovea
- **Radiation cataract**
  - ✓ Tumor thickness
- **Vitreous hemorrhage**
  - ✓ Shorter distance to disc

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Conclusions

1) ***I^{125} plaque radiotherapy*** **offers 94% tumor control for selected vitreous seeding that fails chemoreduction**

2) **The 5-year cumulative risks**

✓ Tumor recurrence at site	9%
✓ Late enucleation	26%
✓ Radiation retinopathy	56%
✓ Radiation cataract	53%
✓ Transient vitreous hemorrhage	41%

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Conclusions

3) Late enucleation after I^{125} plaque

related to	tumor recurrence at plaque site tumor recurrence at distance
not related to	radiation complications

4) Recurrent vitreous seeding > 15 mm in basal dimension and/or > 8 mm in thickness after chemoreudction should be considered for enucleation or EBRT

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