
EYES make World Beautiful

Retinoblastoma

Demographics, Clinical profile & Current Concepts of Management

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Preamble

- Most common Intra Ocular Malignancies in Children
- Estimated incid: 3000-4000 cases / annum
- Asia accounts for 50% of RB in the World
- 1 in 15000 - 18000 live birth
- 1500-2000 new cases/yr in India
- No racial or gender predisposition

Preamble

- Average age of Diag – 18 months
- Bil. is more common in younger <12 mths
- Unilateral @ 24 mths.
- Bil. RB 25-35% , Unilateral 65-75%

Genetics

- Newly diagnosed cases

  6% are familiar 94% Sporadic

- Bil. RB involve germinal mutation in all cases
- Unil RB only 15% involve mutation, 85% are Sporadic

Genetic Counseling

- Positive F/H
  - 40% of the sublings may develop RB
- With no F/H RB - Unilateral RB
  - If the child has RB
    (a) 1% of sublings are at risk
    (b) 8% of the offspring may develop RB
- With no F/H RB - Bilateral RB
    (a) 6% of the siblings may have a chance of RB
    (b) 40% of the offspring have a chance of RB

Preamble

- Current management modalities are restricted to very few Tertiary care centers
- Only about 10-15% pts have access

Preamble

- Survival rate
  - West 95%
  - Underdeveloped Countries <50%
- Problems
  - Late referral
  - Misdiagnosis
  - Suboptimal treatment

Ocular Oncology Service

LV Prasad Eye Institute, in assoc Apollo Cancer Inst, Hyderabad

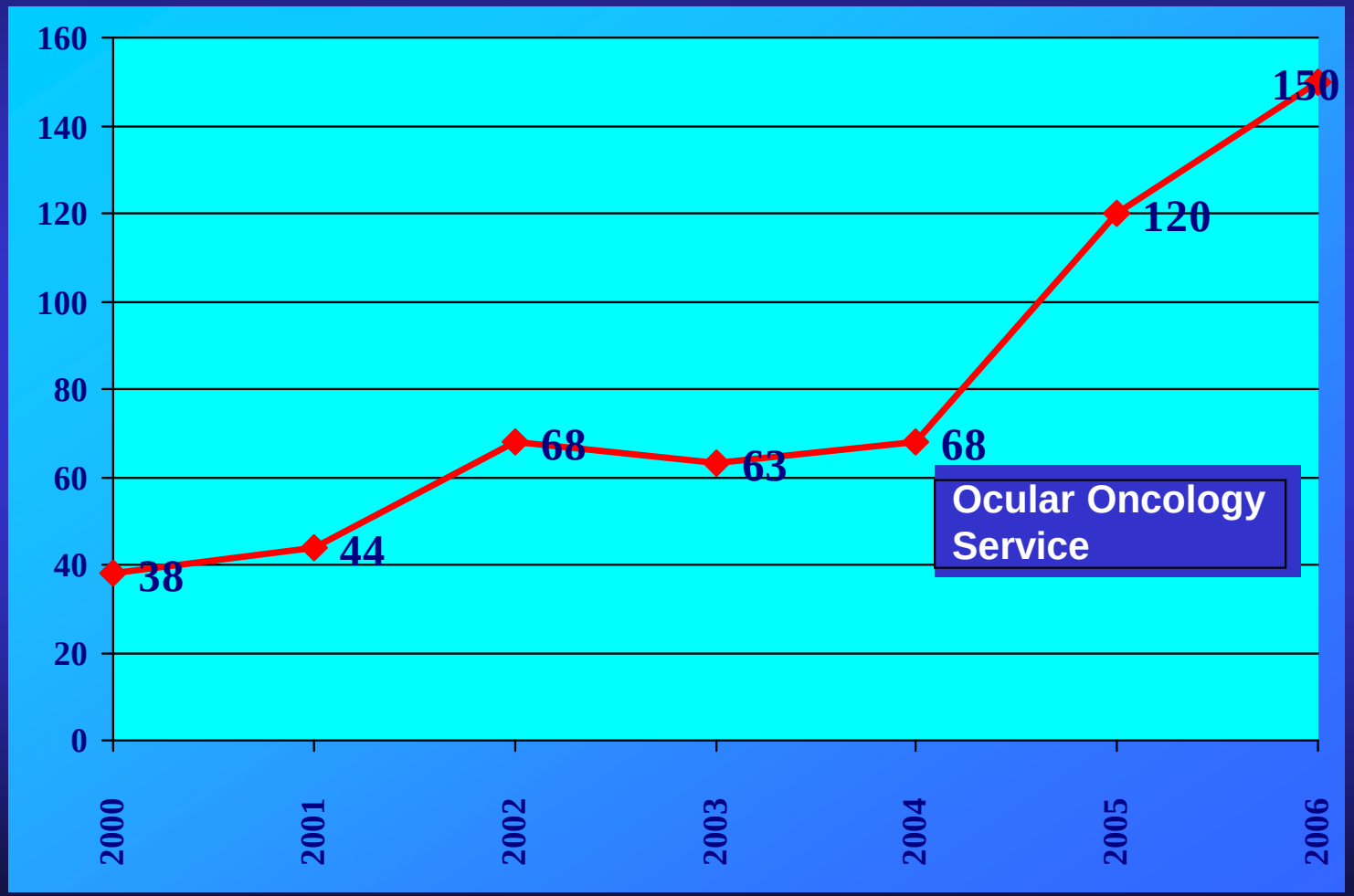
- Established in Jan 2004
- First integrated RB treatment center with state-of-the-art facilities for

  Diagnosis, pathology, genetics, management, documentation & rehab

- Supported by the

  Sight Savers International, Wills Eye Hospital, PA & Children's Hospital of Philadelphia, PA

RB Referrals 2000 - 2006



346

2009

Increasing Referrals

Retinoblastoma in Hyderabad

Jan 1990 – Dec 2005

460 patients

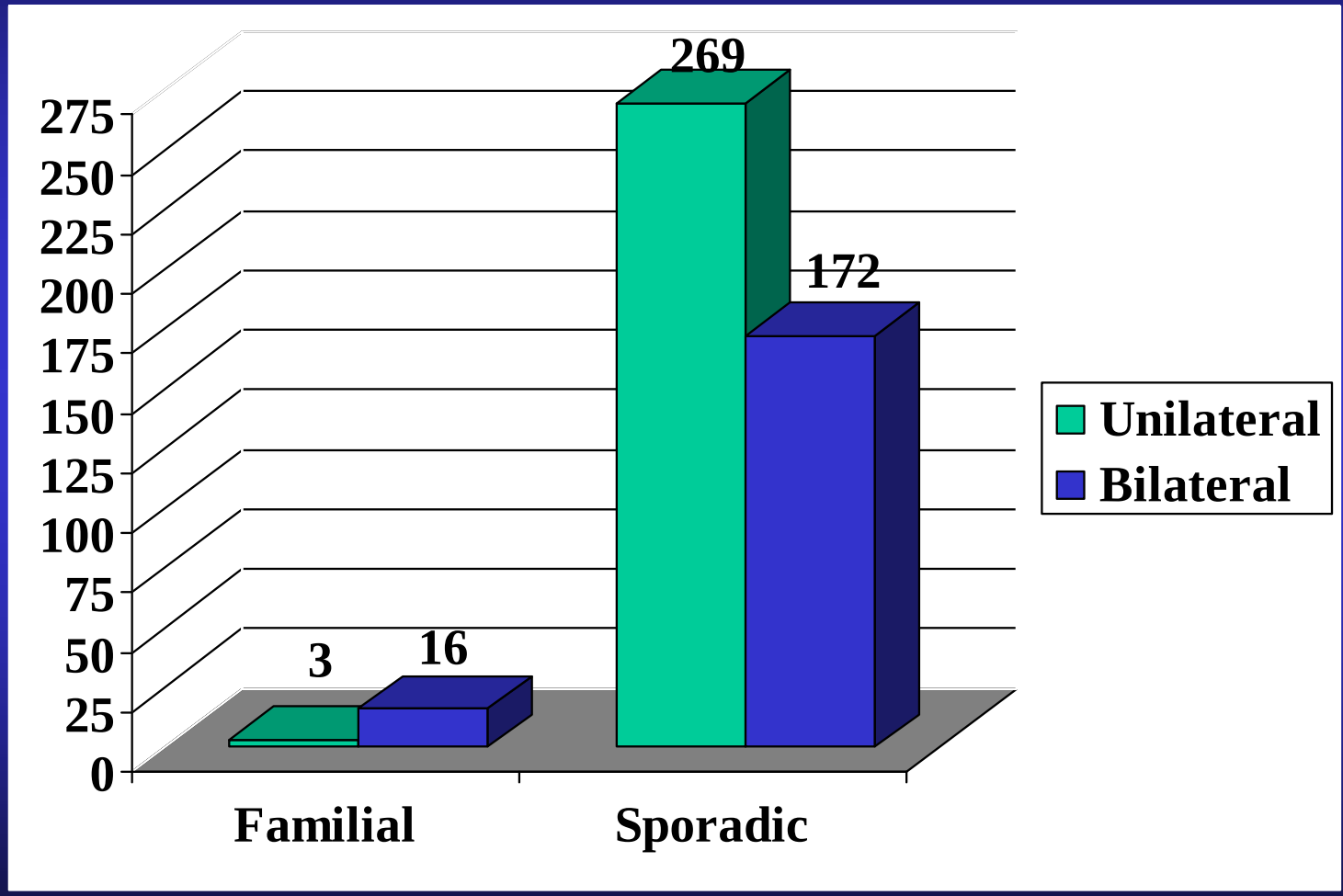
648 eyes

1564 pts till date!

Demographic Data

Sporadic (96%) Vs Familial (4%)

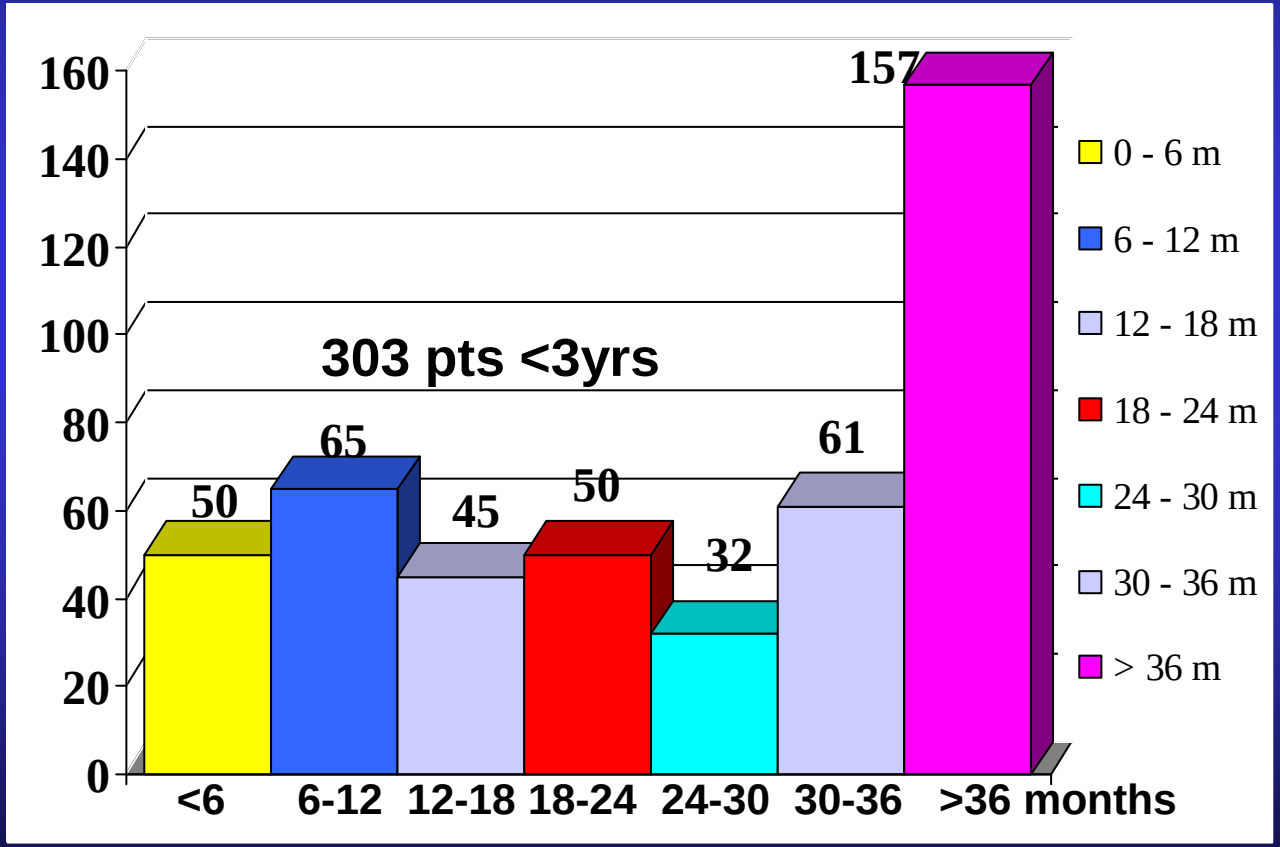
N=460 patients



Only 19 of 460 (4%) pts manifested Familial Retinoblastoma

Demographic Data
Age at Diagnosis

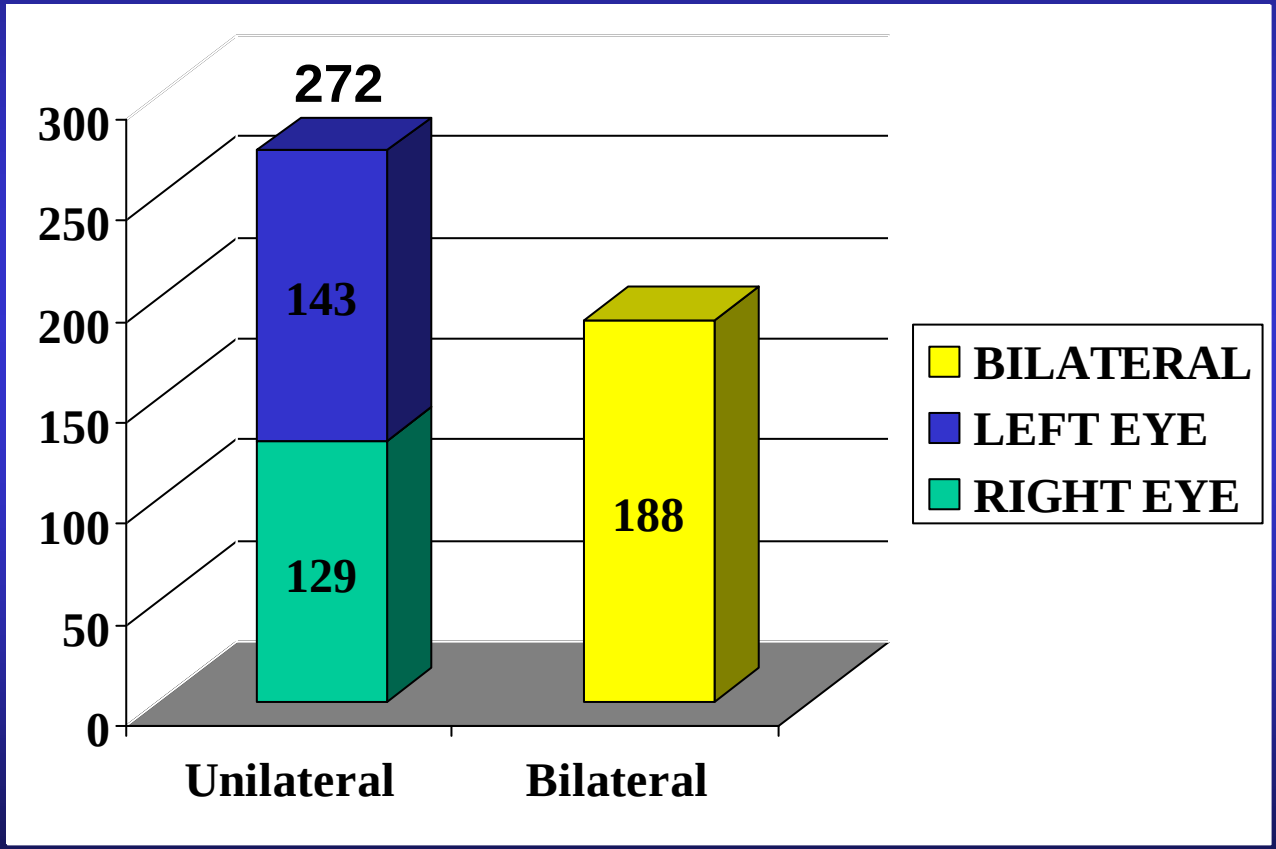
N = 460 patients



About 2/3 diagnosed <3 years age

Demographic Data
Laterality

N=460 patients



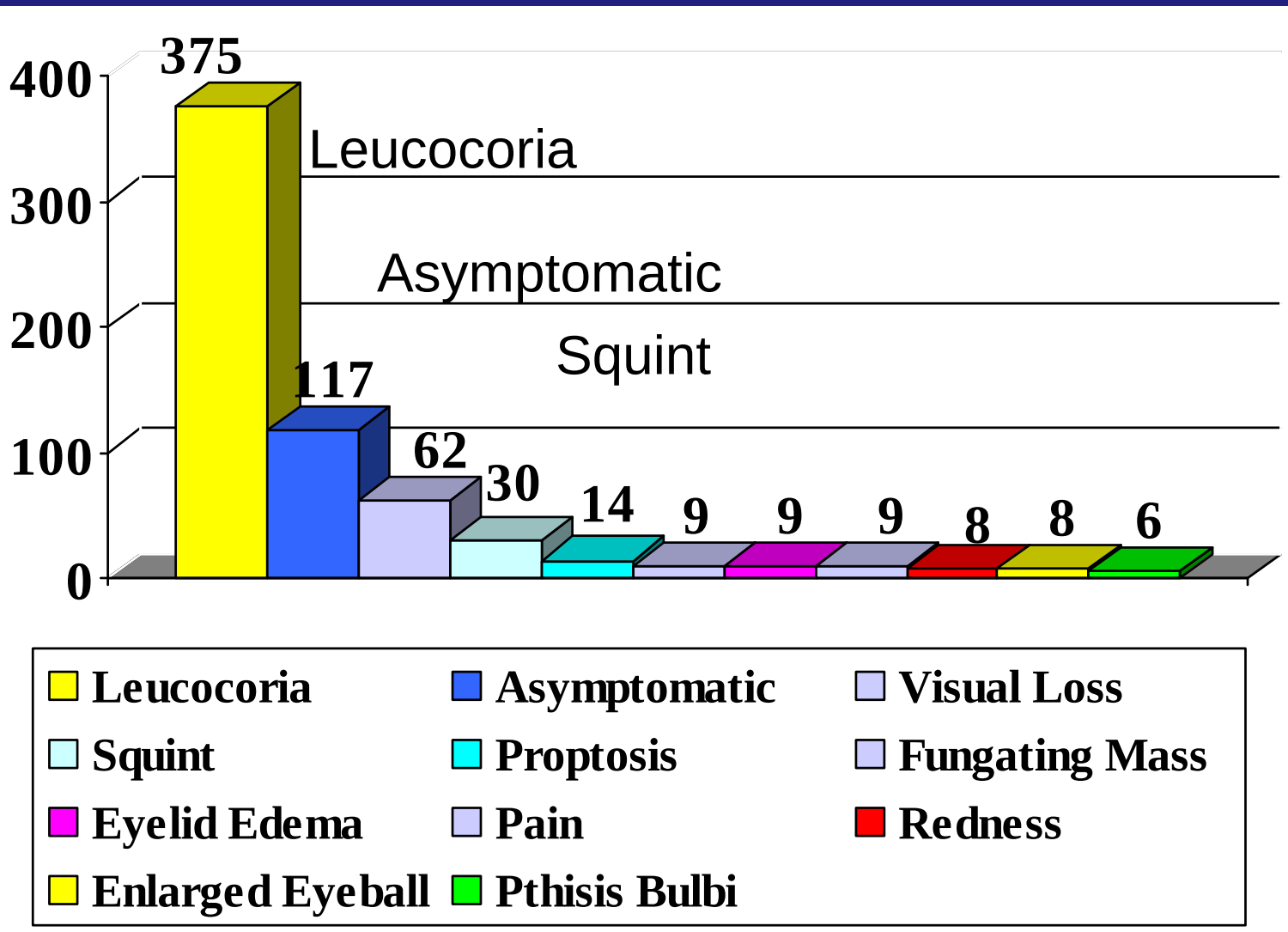
60% unilateral, 40% bilateral

Common Presenting Features of RB

1.	Leucocoria	56%
2.	Strabismus	20%
3.	Red painful eye	7%
4.	Poor vision	5%
5.	Asymptomatic	3%
6.	Orbital Cellulitis	3%
7.	Unilateral Mydriasis	2%
8.	Heterochromia Iridis	1%
9.	Hyphema	1%

N = 648 eyes

Initial Clinical Presentation



Moderately Advanced Lesions

- Endophytic

  Tumor grows into the vitreous cavity

- Exophytic

  Tumor grows towards subretinal space

- Diffuse Infiltrating tumor

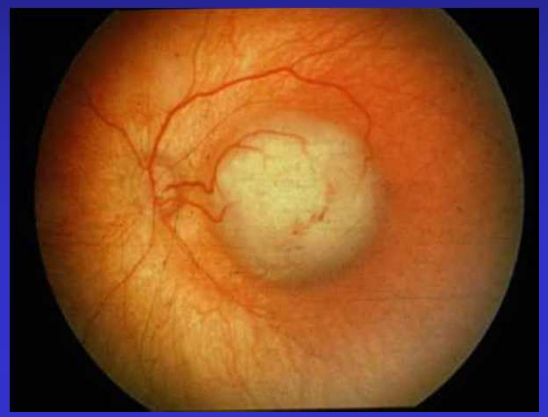
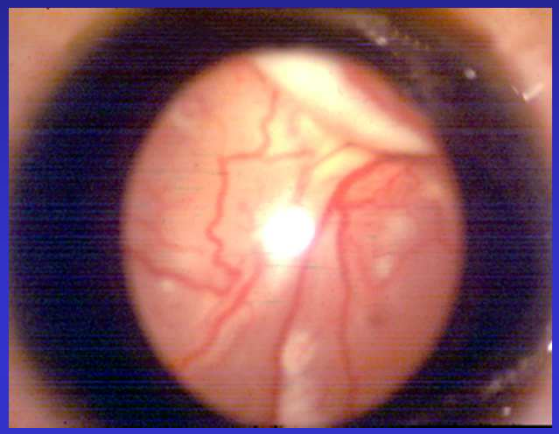
  Tumor diffusely involves the retina causing just a placid thickness of the retina and not a mass (older children)

Very advanced

- Proptosis due to ON or Orbital Extn.
- Spread through ON after breaching Lamina cribrosa
- Orbital Extension at the site of scleral emisalry veins
- Systemic – Brain, Skull, distant bones, LN
- Phthisis bulbi
- Orbital cellulities

Clinical Spectrum

……Intra-ocular RB



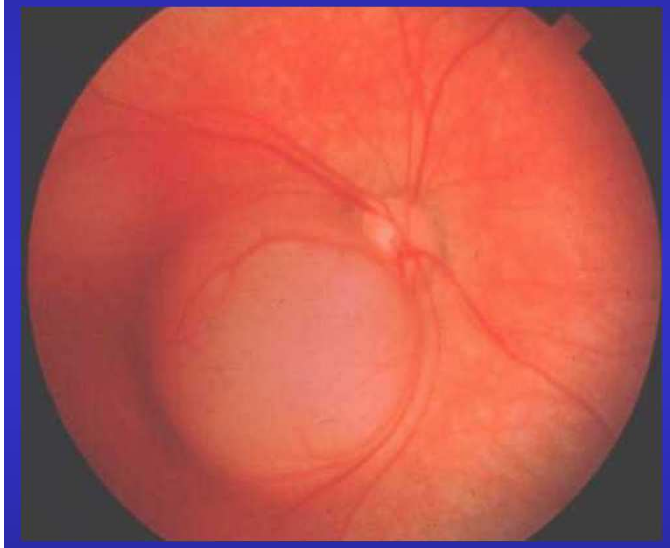
Extra-ocular RB……

Diagnosis

- Clinical evaluation – complete ophthalmic evaluation including dilated fundus exam under G.A.
- Direct visualization of the tumor by an indirect ophthalmoscope is diagnostic of RB in over 90%.
- Ret cam - wide angle fundus camera
  - Useful in accurately documenting RB and monitoring response to therapy.
- Ultrasound – B Scan
- CT Scan & MRI Scan
  - Where extra-ocular or Intra Cranial extn is suspected

Retinoblastoma

Diagnosis

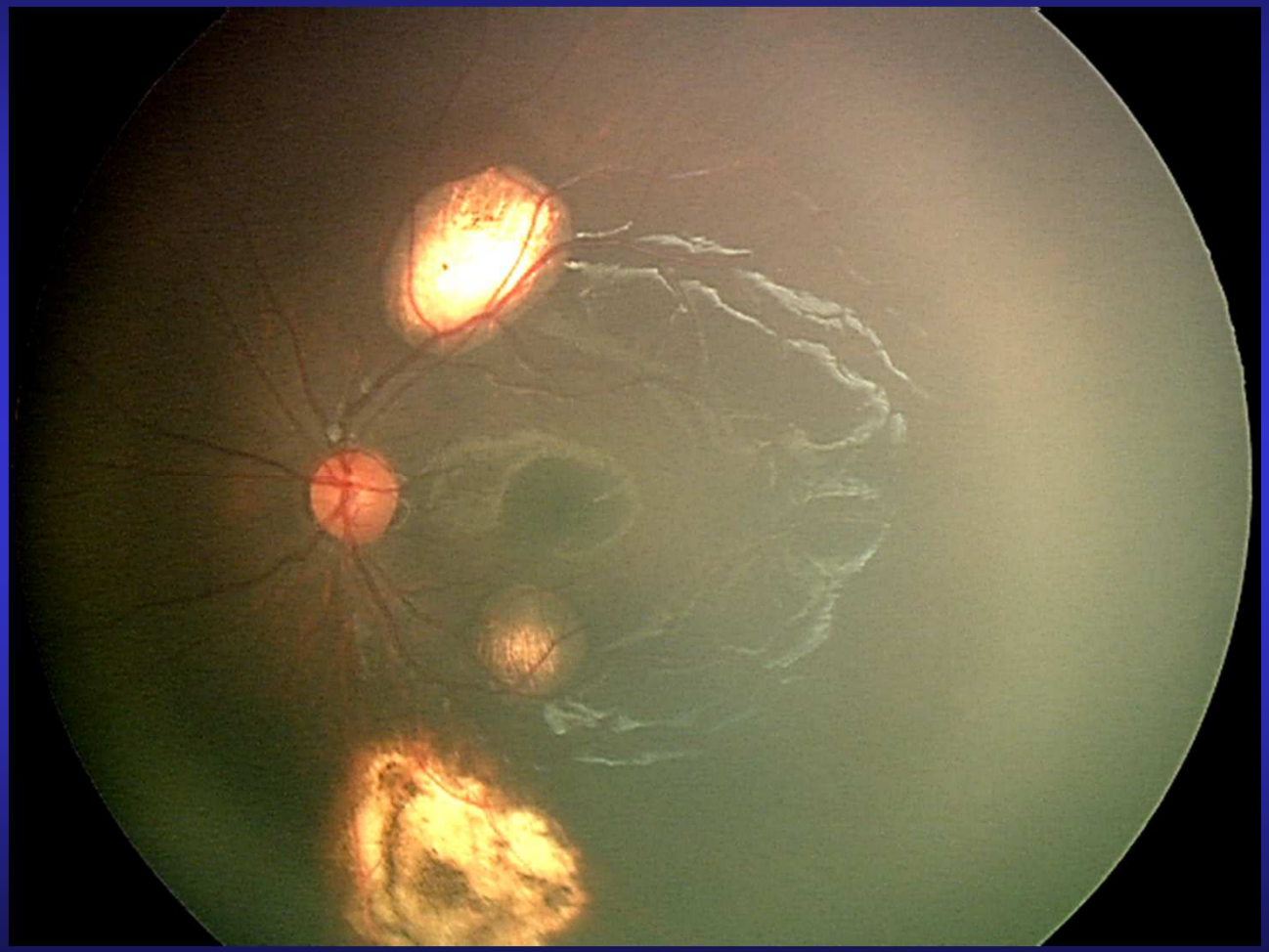


Indirect Ophthalmoscopy

Ultrasonography B-scan

MRI / CT

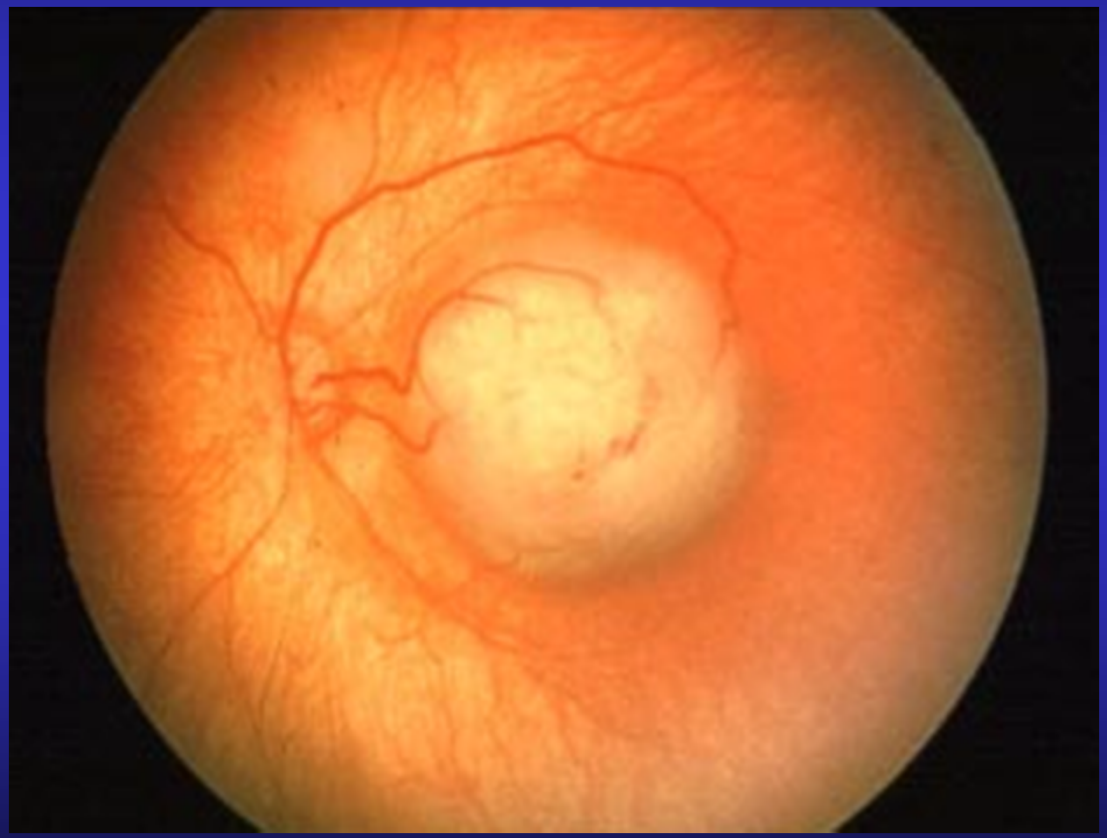
Ret cam



Assessment of response, documentation

Retinoblastoma

Classification



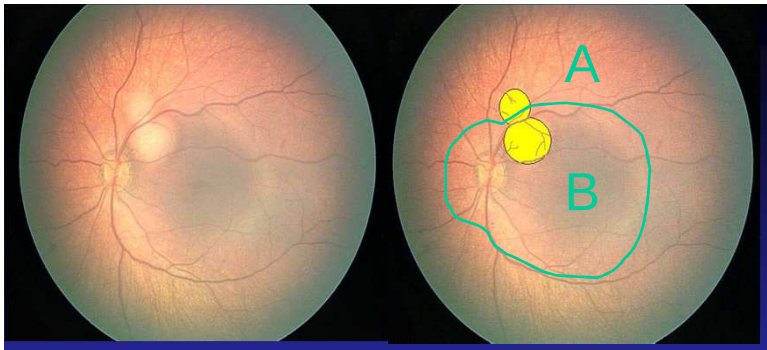
NEW International Staging System

- **Stage 0** No enucleation
  (one or both eyes may have intraocular disease)
- **Stage I** Enucleation, tumor completely resected
- **Stage II** Enucleation with microscopic residual tumor
- **Stage III** Regional extension
  - **A. Overt orbital disease**
  - **B. Preauricular or cervical lymph node extension**
- **Stage IV** Metastatic disease
  - **A. Hematogenous metastasis**
    - **1. Single lesion**
    - **2. Multiple lesions**
  - **B. CNS Extension**
    - **1. Prechiasmatic lesion**
    - **2. CNS mass**
    - **3. Leptomeningeal disease**

Chantada G, Doz F, Antoneli CB, et al. A proposal for an international retinoblastoma staging system. Pediatr Blood Cancer. 2006:47;801-805.

International Classification of Intraocular Retinoblastoma

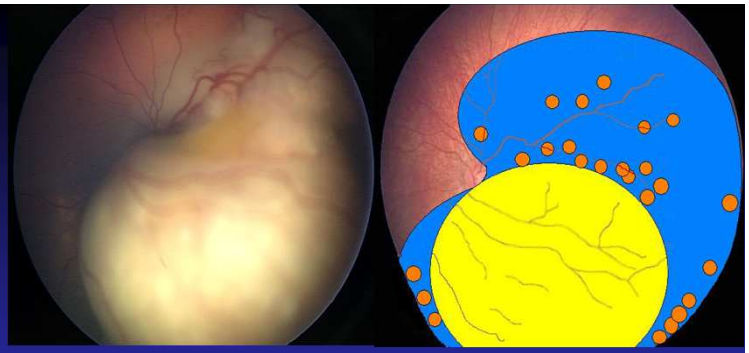
Group-A	Small tumors (<3 mm) outside macula
Group-B	Bigger tumors (>3 mm) or any tumor in macula or any tumor with subretinal fluid
Group-C	Localized seeds (subretinal or vitreous)
Group-D	Diffuse seeds (subretinal or vitreous)
Group-E	Tumor touching the lens, Neovascular glaucoma, Tumor anterior to anterior vitreous face involving ciliary body or anterior segment, Diffuse infiltrating retinoblastoma, Opaque media from hemorrhage, Tumor necrosis with aseptic orbital cellulitis and Phthisis bulbi

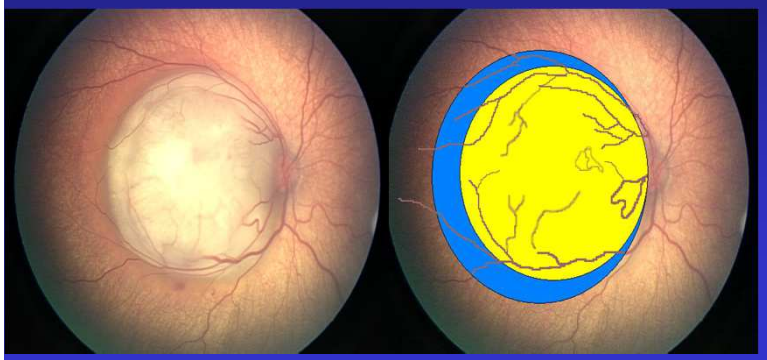


Group A
< 3 mm

Group B
macula
> 3 mm

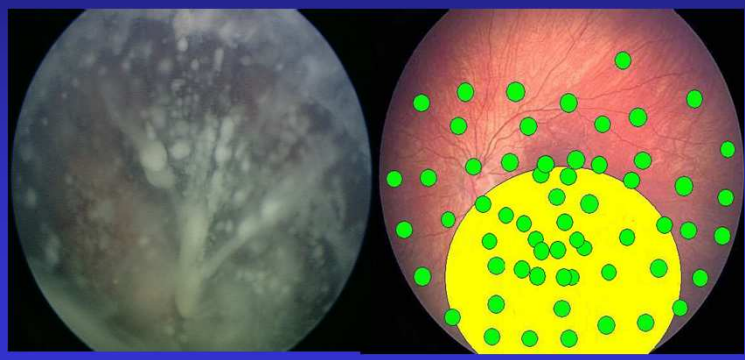
Group D
diffuse
SR
seeds

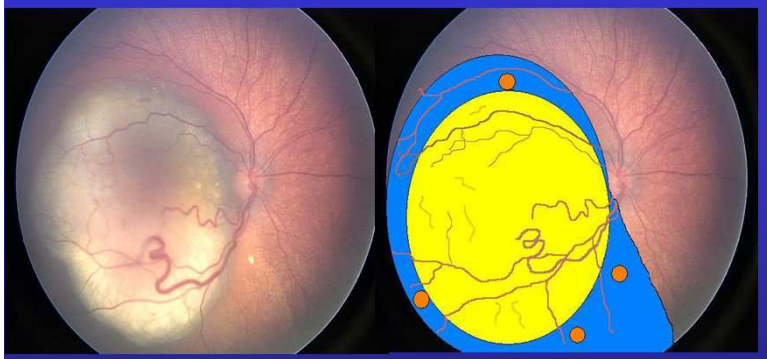




Group B
tumor +
SRF

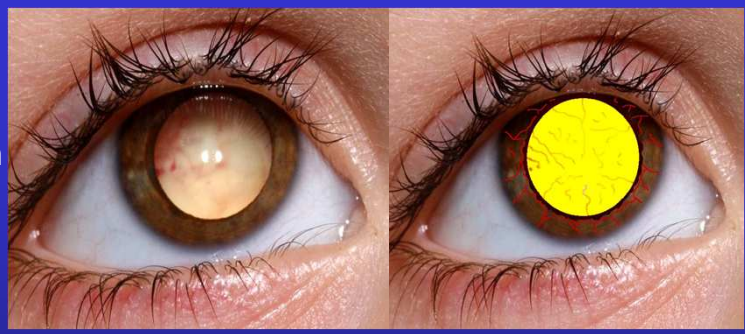
Group D
diffuse
vitreous
seeds

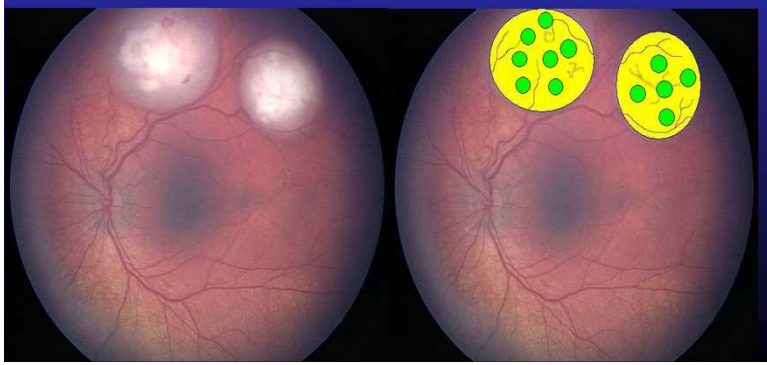




Group C
focal SR
seeds

Group E
high risk
• NVG
• blood
• invasion





Group C
focal
vitreous
seeds

International Grouping of Intraocular Retinoblastoma

Retinoblastoma - Management

Goals of Treatment

Salvage Life

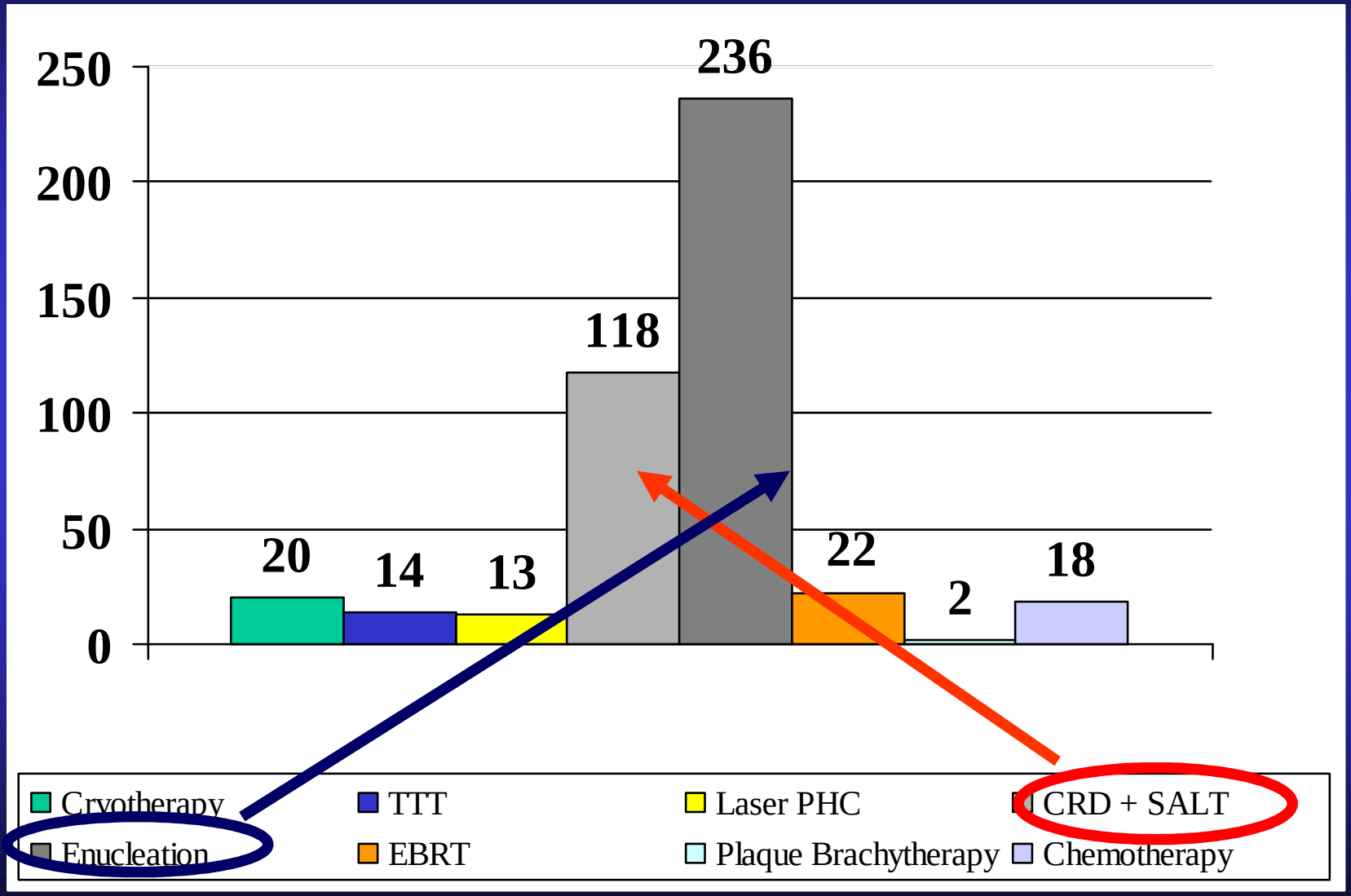
Salvage Organ

Salvage Function

- Save life
- Salvage the eye
- Provide optimal residual vision

Primary Treatment for Intraocular Tumors

N=451 eyes



Intraocular RB
Treatment Options

Focal

Local

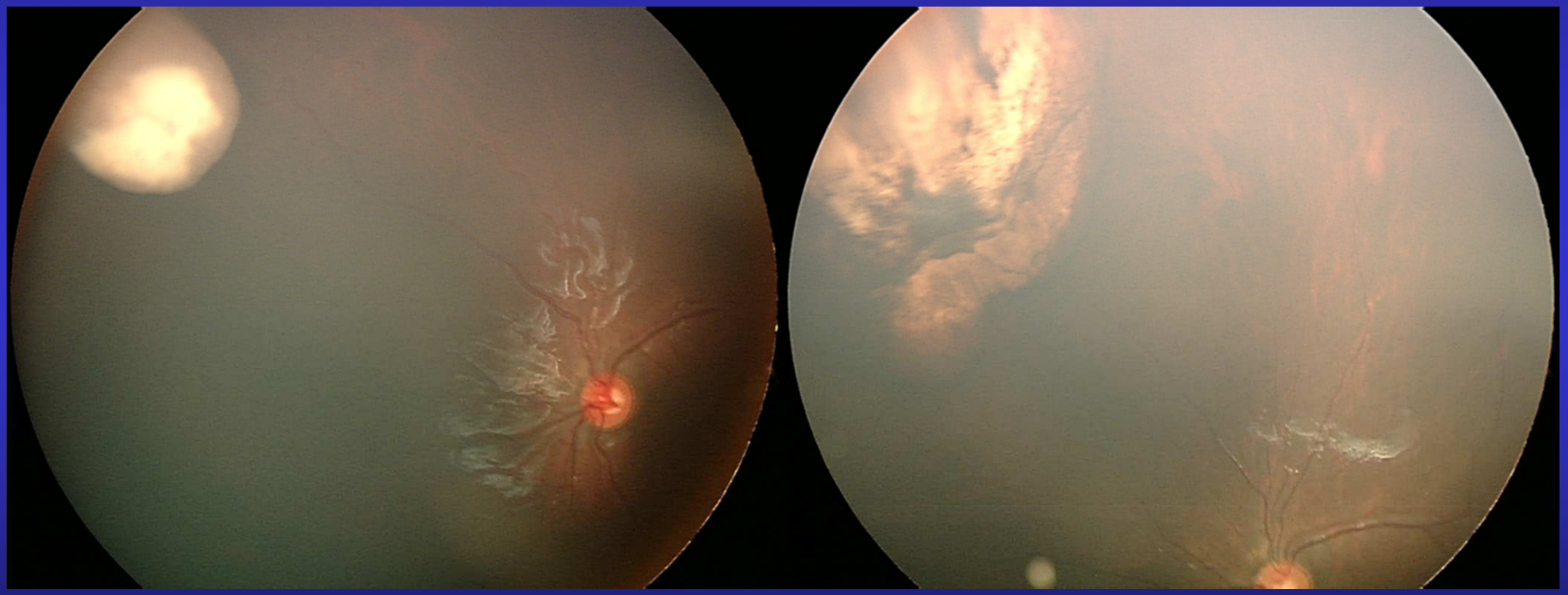
Systemic

- Cryotherapy
- Thermotherapy
- Laser photocoagulation
- Chemoreduction
- Plaque brachytherapy
- External beam radiotherapy
- Enucleation
- Adjuvant therapy
- Orbital exenteration

Cryotherapy

- Small equatorial & peripheral retinal tumors
- Up to 4 mm in basal diameter and 2 mm in thickness.
- Produces a scar much larger than the tumor.
- Cryo done 2-3 hours prior to chemo can increase the delivery of chemo agents across the blood retinal barrier and thus has synergistic effect.

Cryotherapy

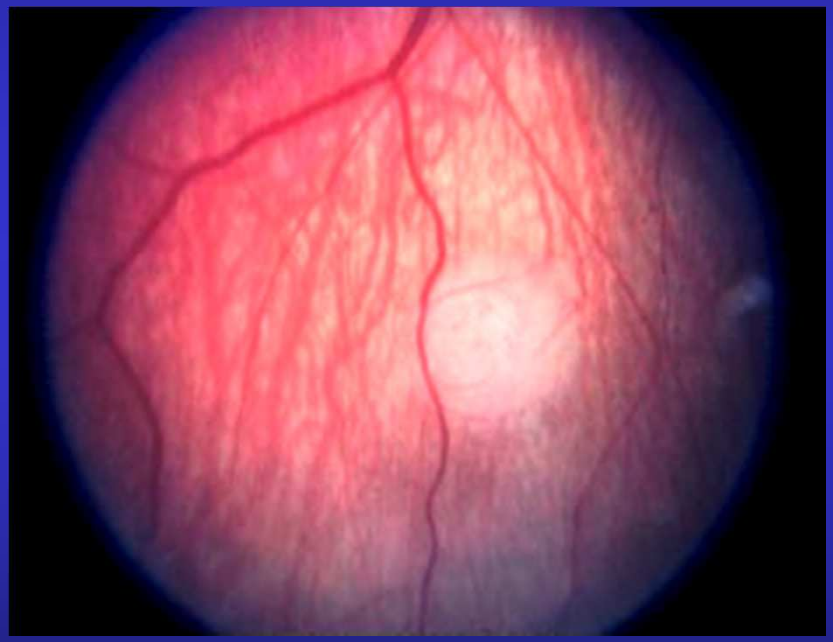


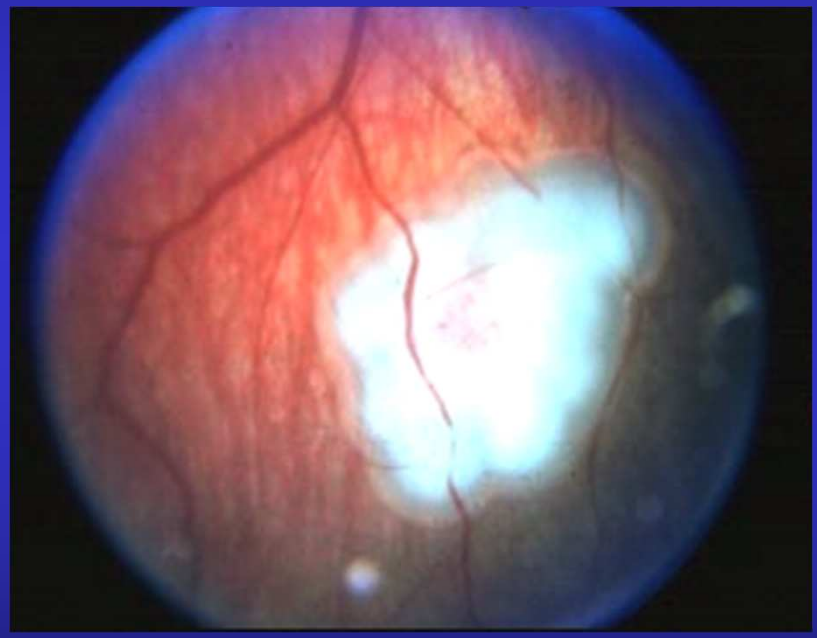
Good local therapy. Leaves Big scars

Laser Photocoagulation

- For small posterior tumors 4 mm in basal diameter and 2 mm in thickness.
- The treatment is directed to coagulate the blood supply to the tumor
- It is less often employed now with the advent of thermotherapy.
- It is contraindicated while the patient is on active chemotherapy

Photocoagulation





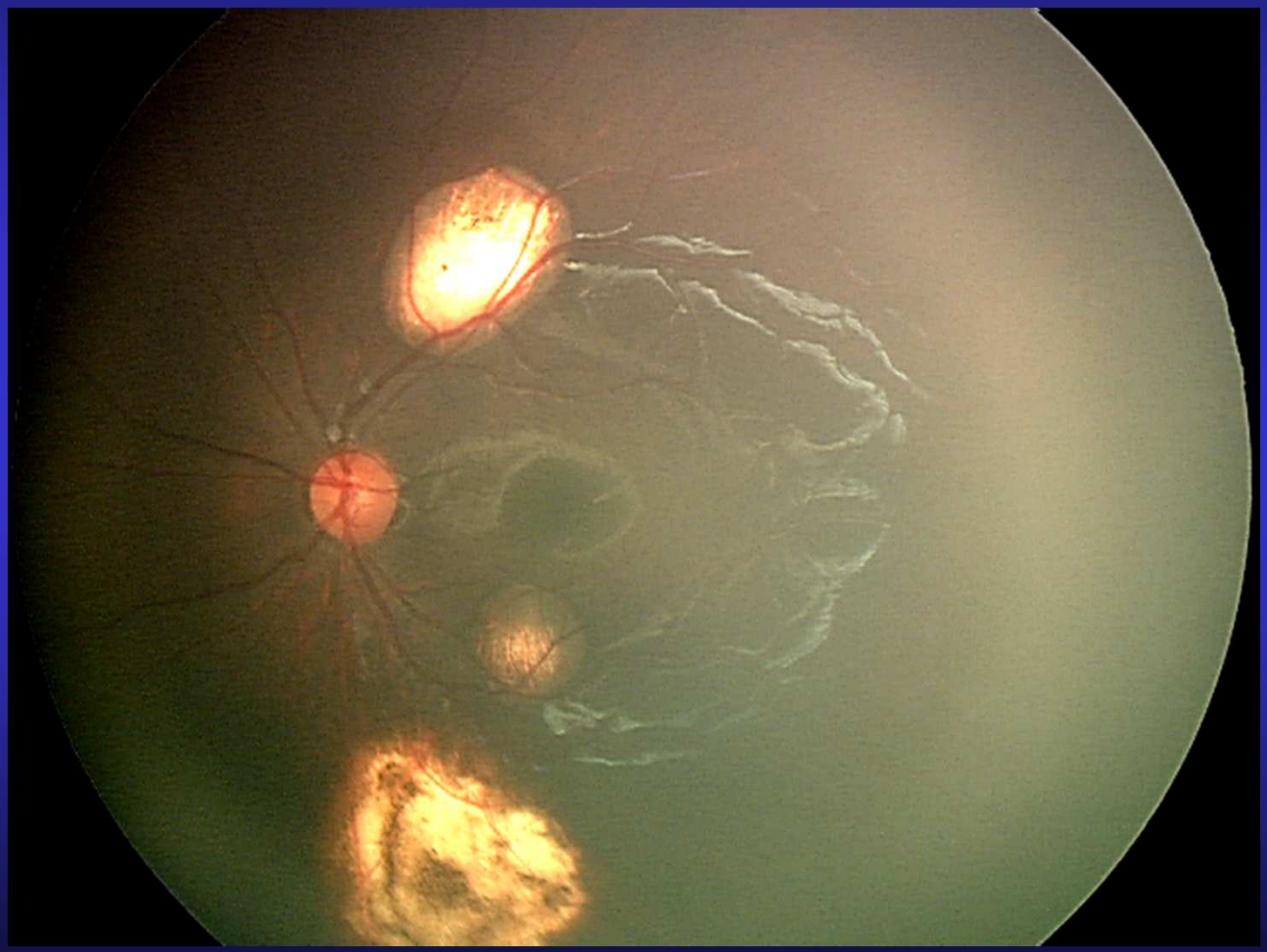
Good local therapy.

Causes big scaring, loses vascularization

Transpupillary Thermotherapy TTT

- Focused heat generated by infrared radiation is applied at subphotocoagulation levels to induce tumor necrosis.
- Complete tumor regression can be achieved in over 85% of tumors using 3-4 sessions
- The major application of thermotherapy is as an adjunct to chemoreduction.
- The application of heat amplifies the cytotoxic effect of platinum analogues.
- This synergistic combination with chemoreduction protocol is termed chemothermotherapy.

Thermotherapy



✓Good local therapy. Minimal scaring

Plaque Brachytherapy

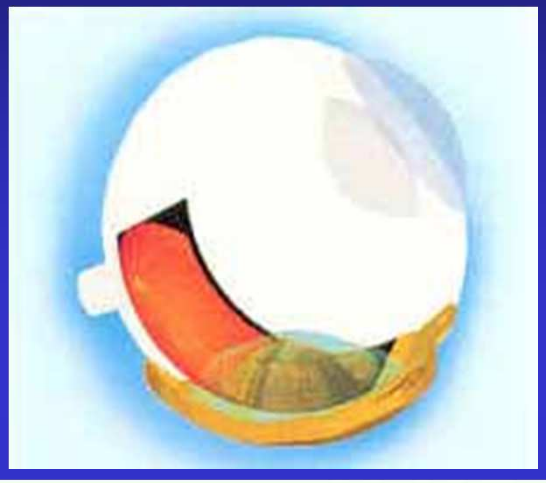
- Chemoreduction failure or recurrence
- Rarely as primary therapy
- Commonly uses Iodine^{125,} Ruthenium^{106}
- 4000-4500 cGy to tumor apex
- 90% success in tumor control

Radioactive Plaques

- **Various sizes & shapes**
- **Round, Single notched, Double notched etc**
- **10- 25 mm in diameter**

Ruthenium 106

Brachytherapy



Plaque therapy

Plaque Brachytherapy

Procedure

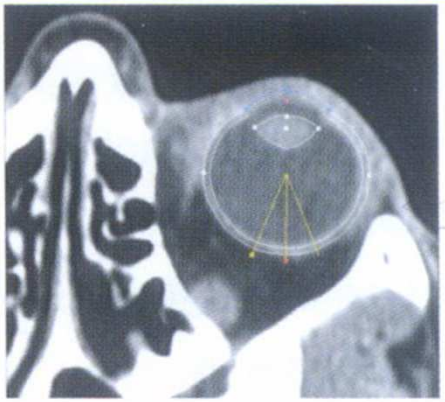
- The tumor thickness is measured by ultrasonography.
- The data is used for dosimetry on a three dimensional computerized tumor modeling system.
- The plaque design is chosen depending on the basal tumor dimensions, its location and configuration.
- The dose to the tumor apex ranges from 4000-5000 cGy.
- The plaque is sutured to the sclera after confirming tumor centration and is left in situ for the duration of exposure, generally ranging from 36 to 72 hours.

Tumor assessment

Clinical & Radiological assessment

- Location
- Basal diameter
- Height

Tumor thickness by ultrasound B-scan



CT-based tumor volumetry

Smt. KANURI SANTHAMMA RETINA VITREOUS CENTRE

L.V. PRASAD EYE INSTITUTE

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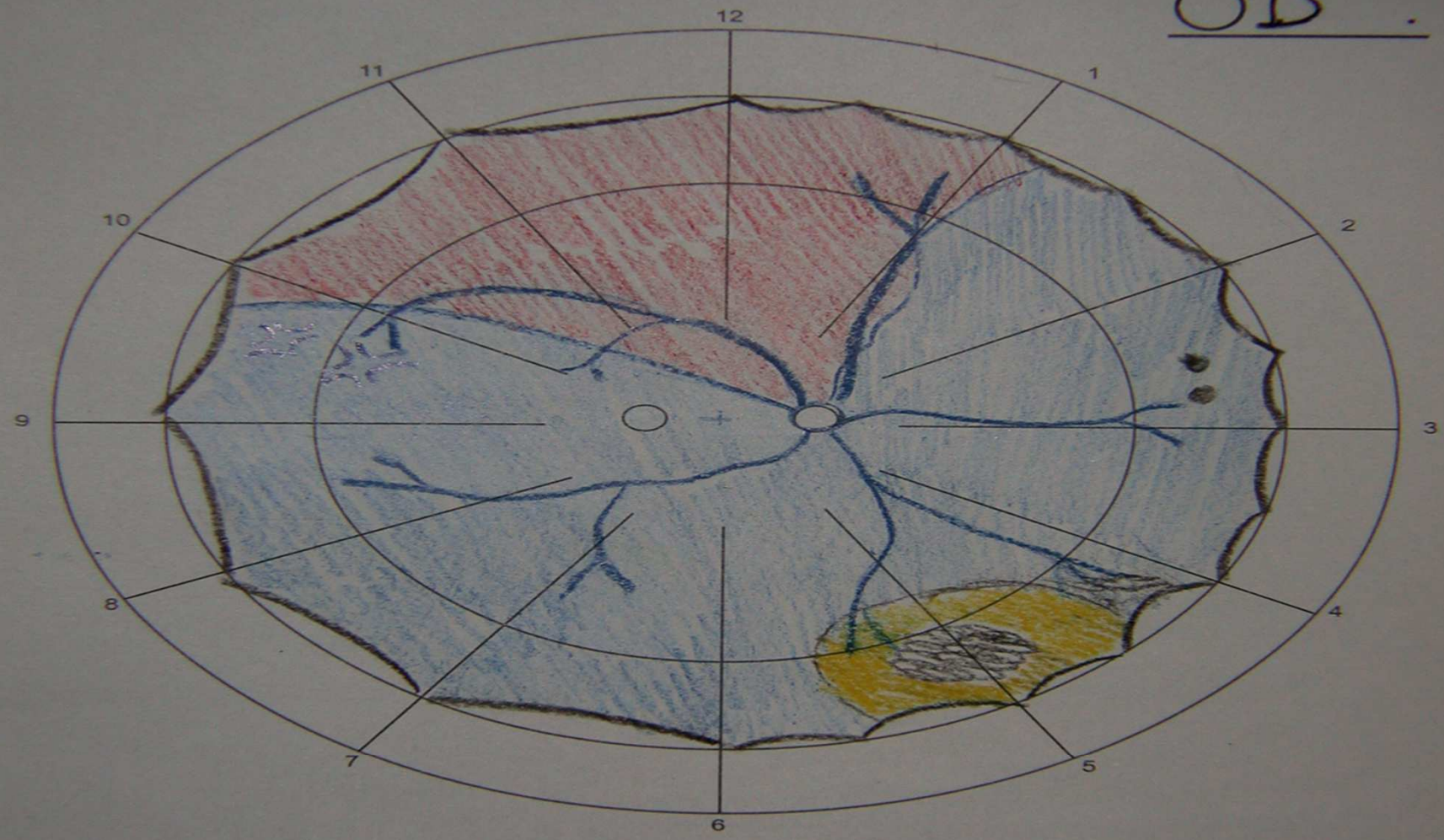


Date : 19/9/02

Number : P266185

Name : Jeevan Prakash

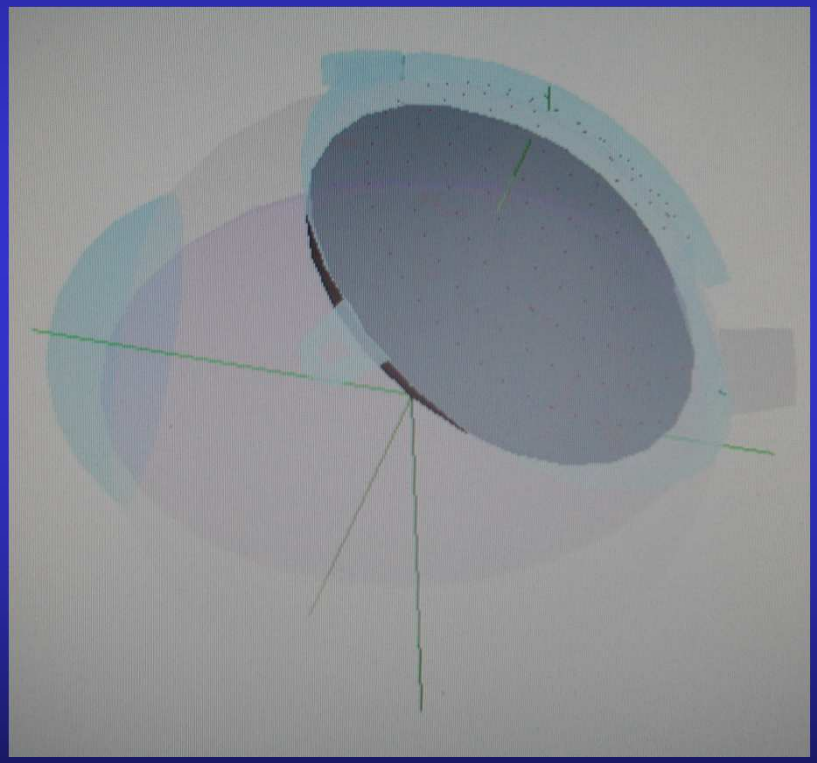
Signature Dr Mukund

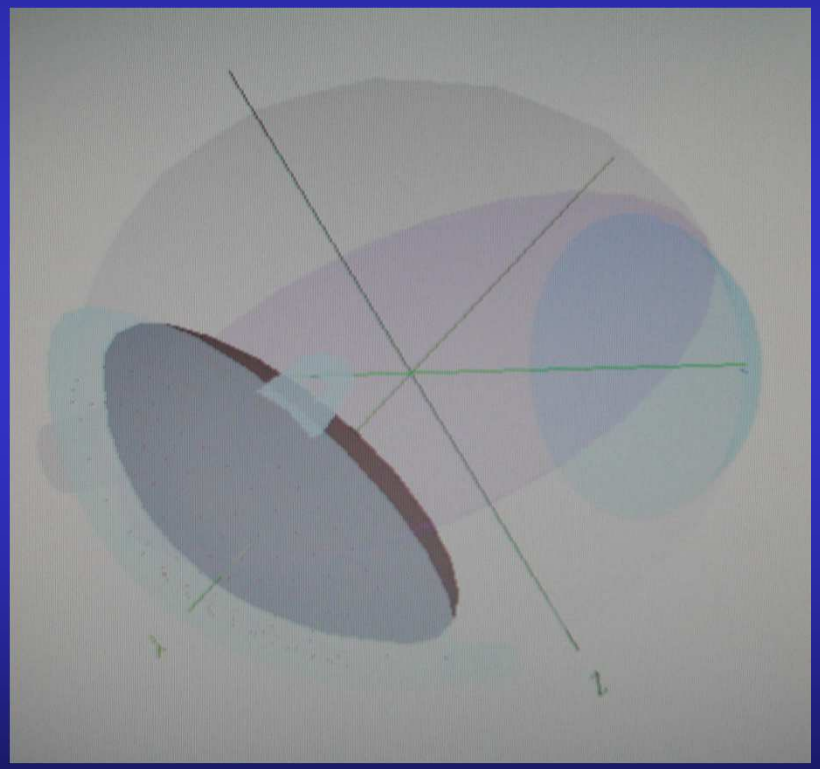
Inv. Image

Radiotherapy Planning

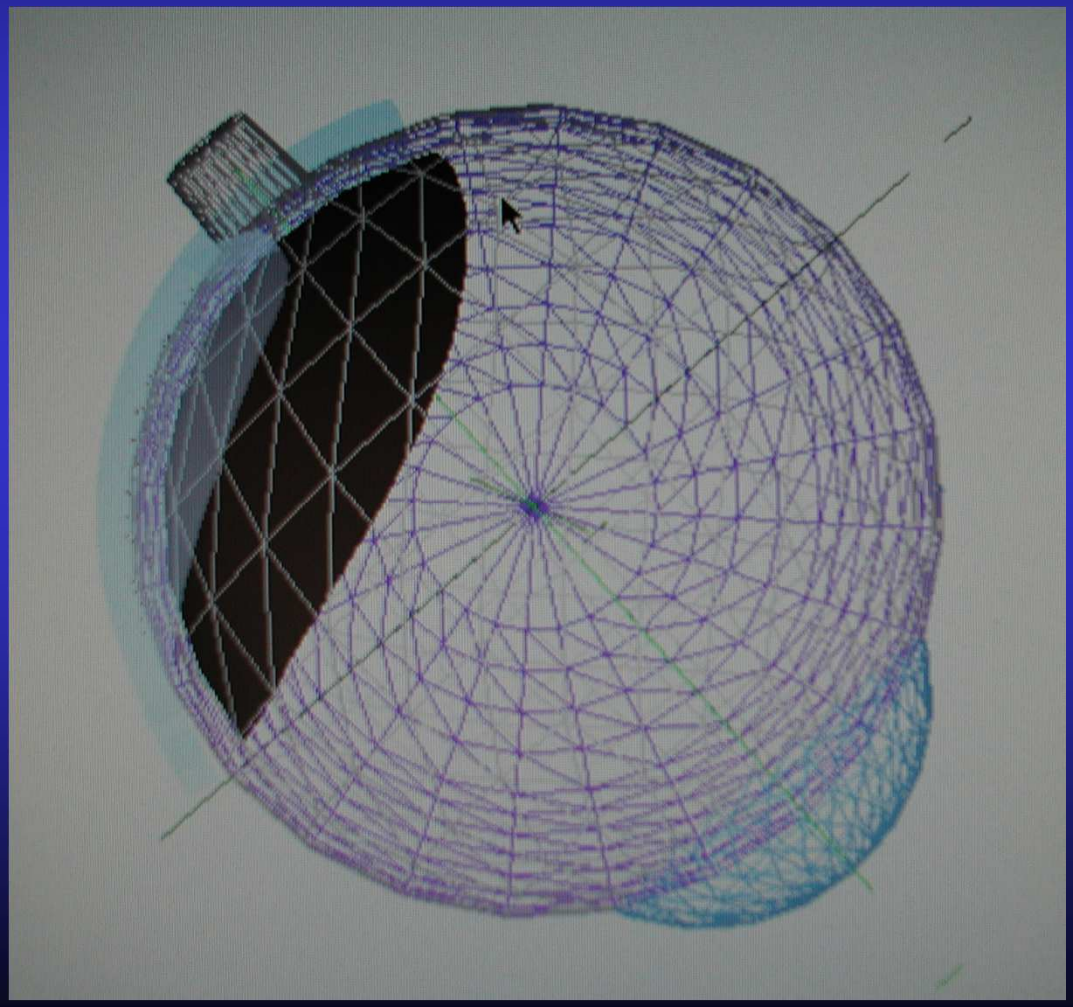
- Brachy software: BEBIG, Germany
- Tumor is drawn on the retinal diagram
- Select the plaque size and shape
- Required dose is prescribed to base/apex
- Dosimetry: Autotomated dosimetry
- Dose & Exposure time are calculated
- Team Work
  - Ophthalmologist, Radiotherapist, Radiation Physicist

Tumor and Plaque placement

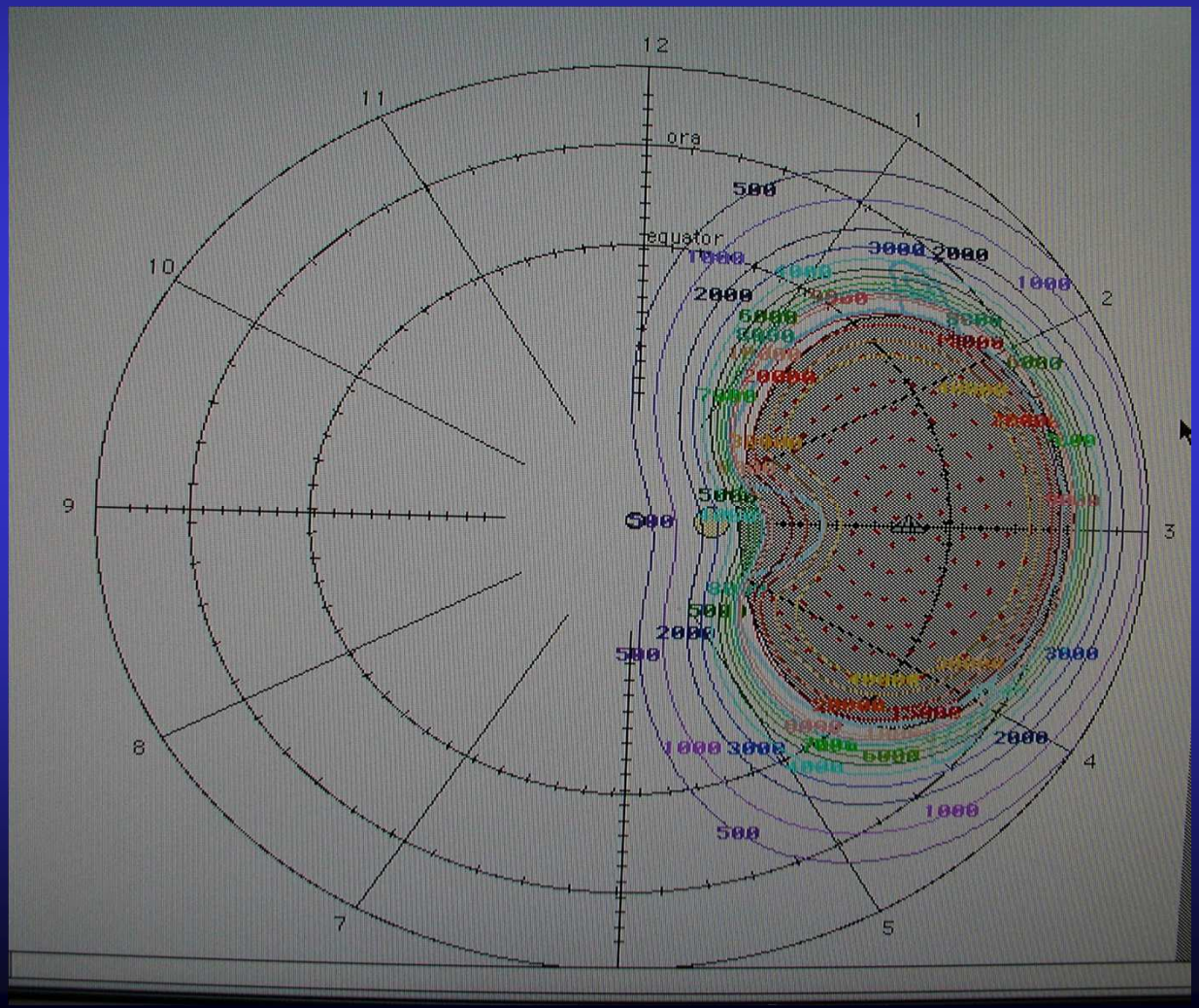




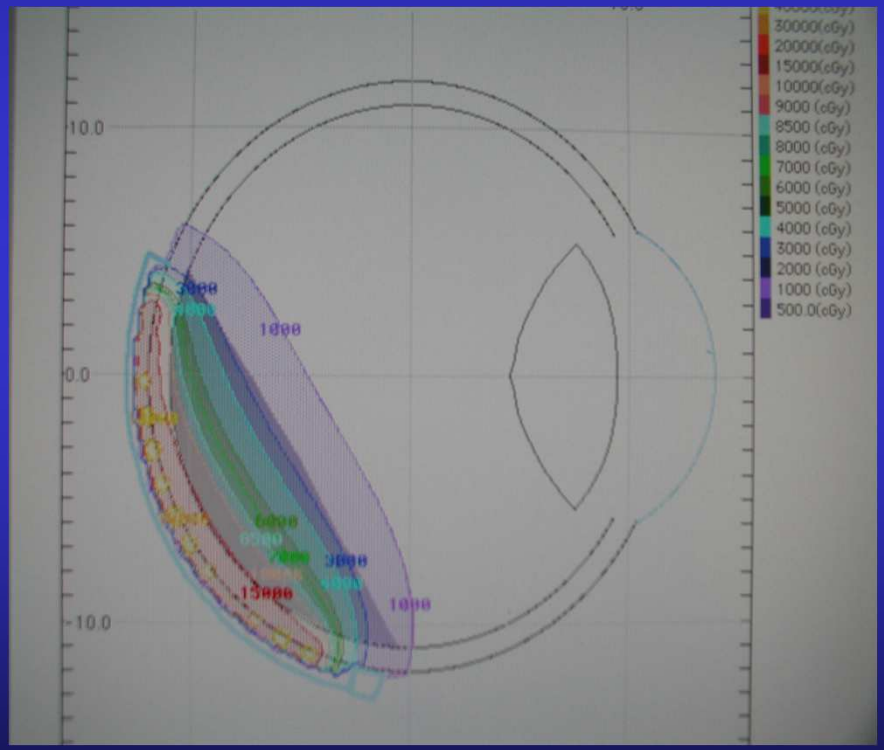
Tumor and Plaque placement

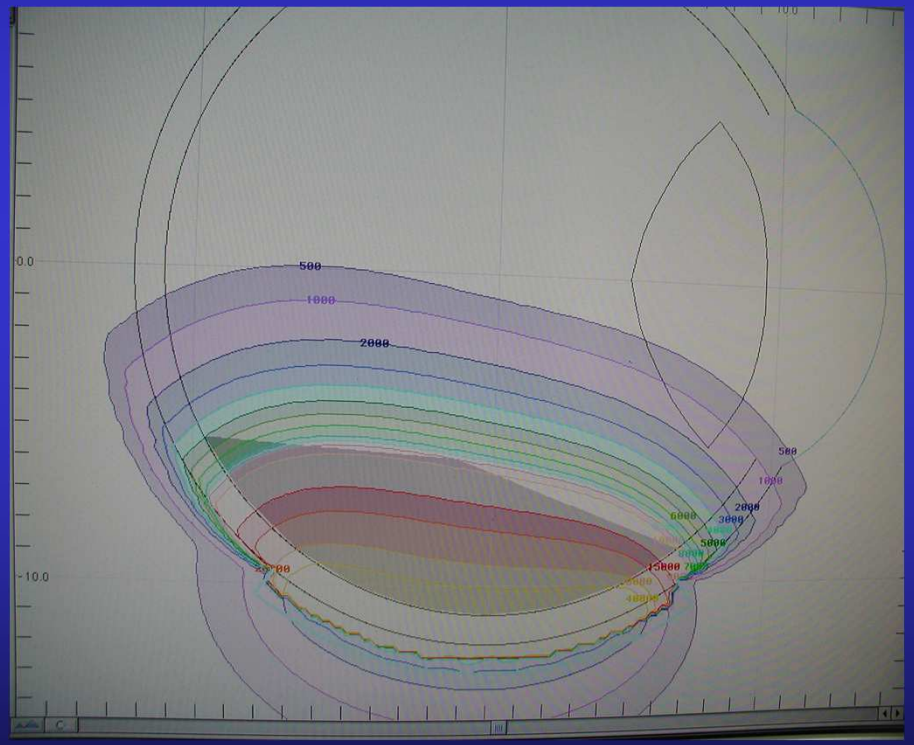


Dosimetry



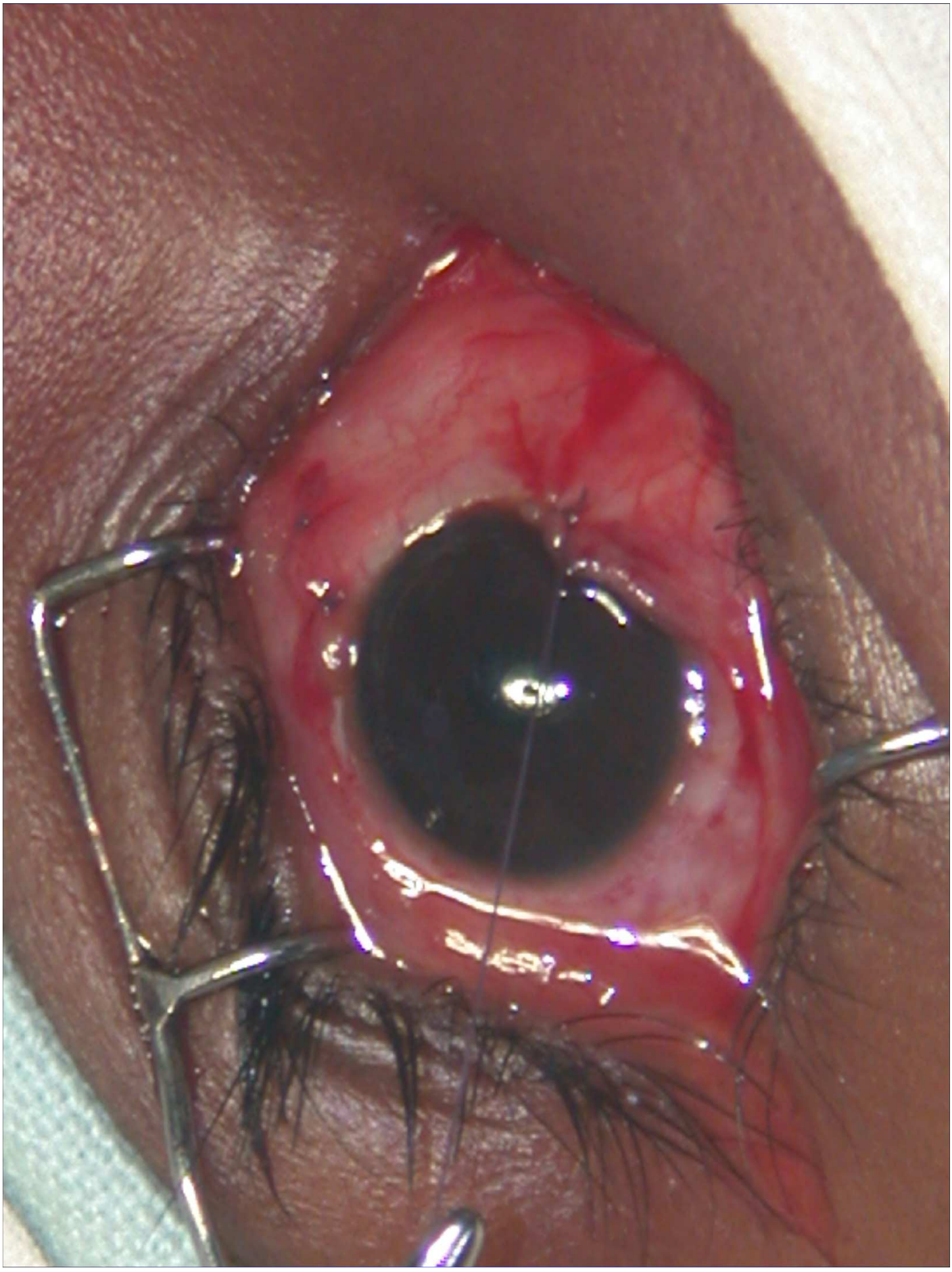
Dose distribution

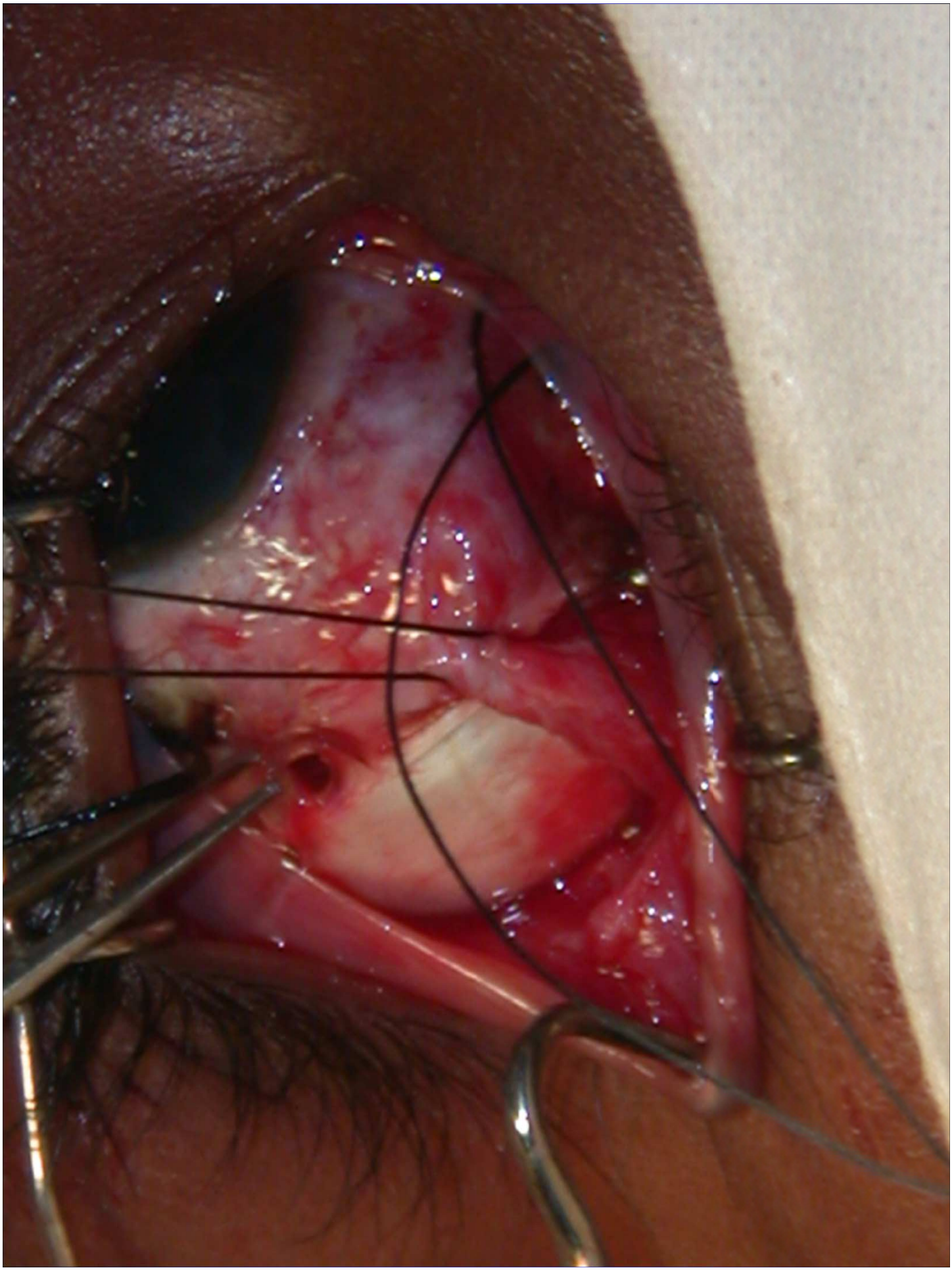


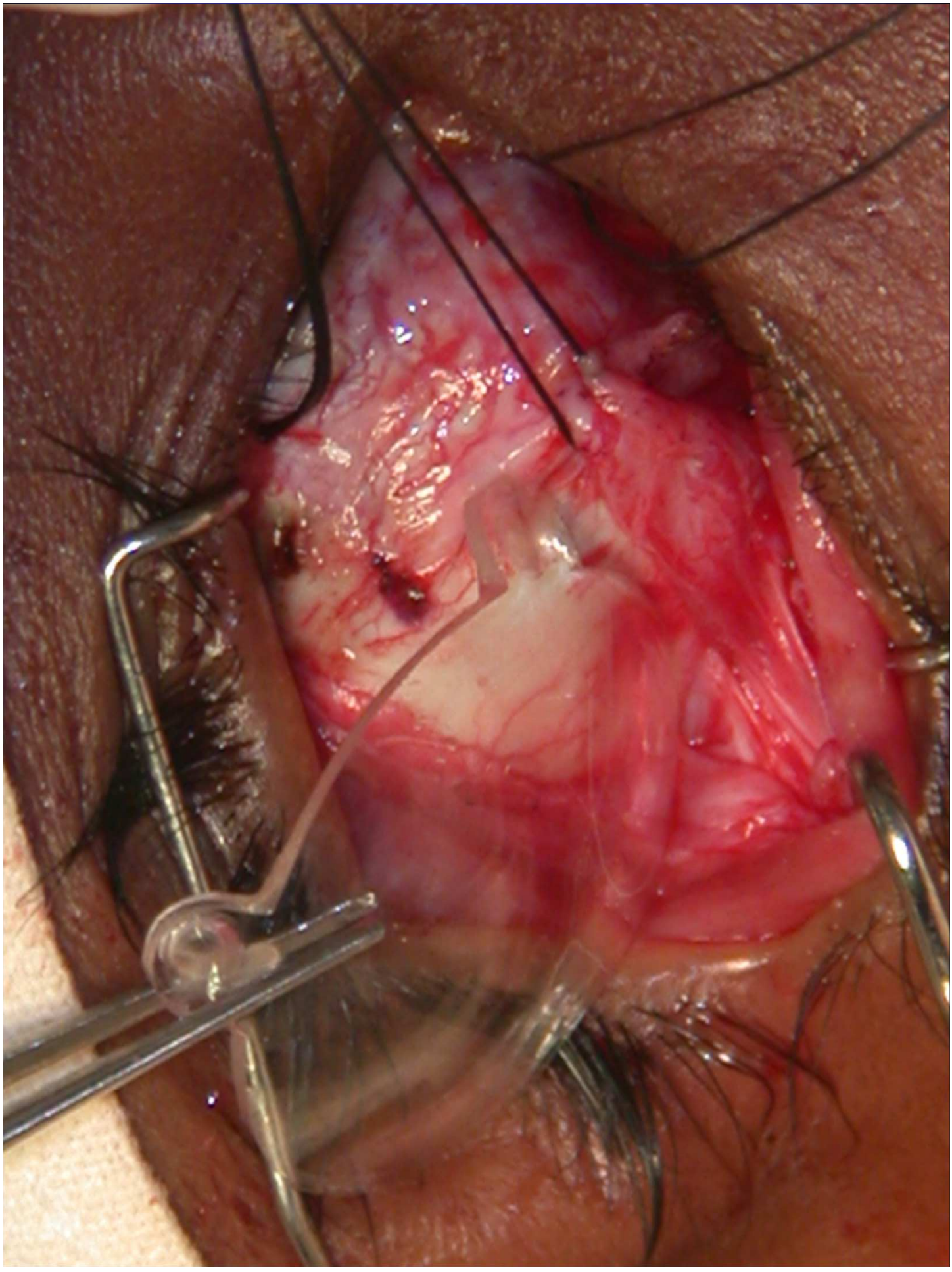


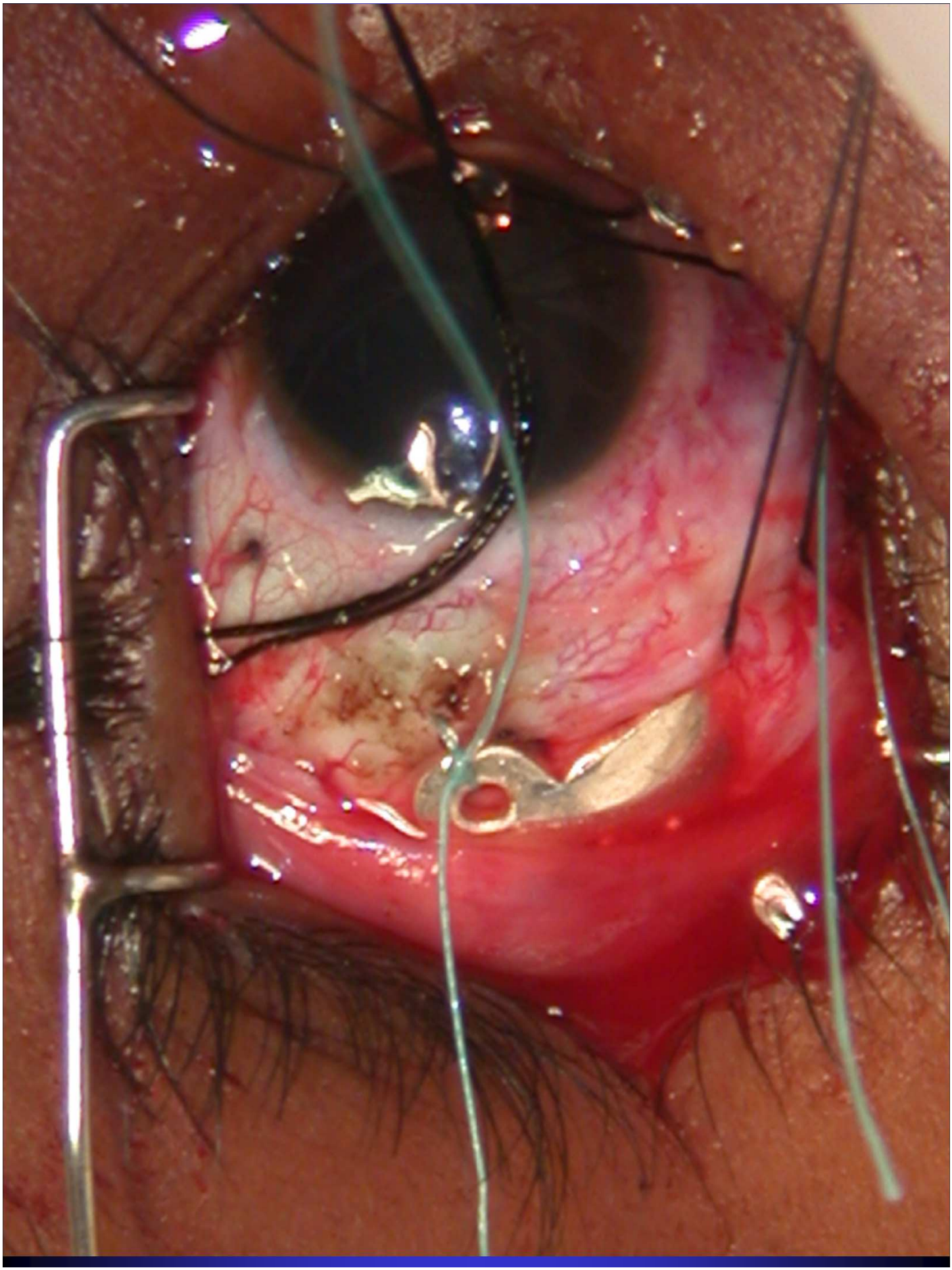
Plaque placement

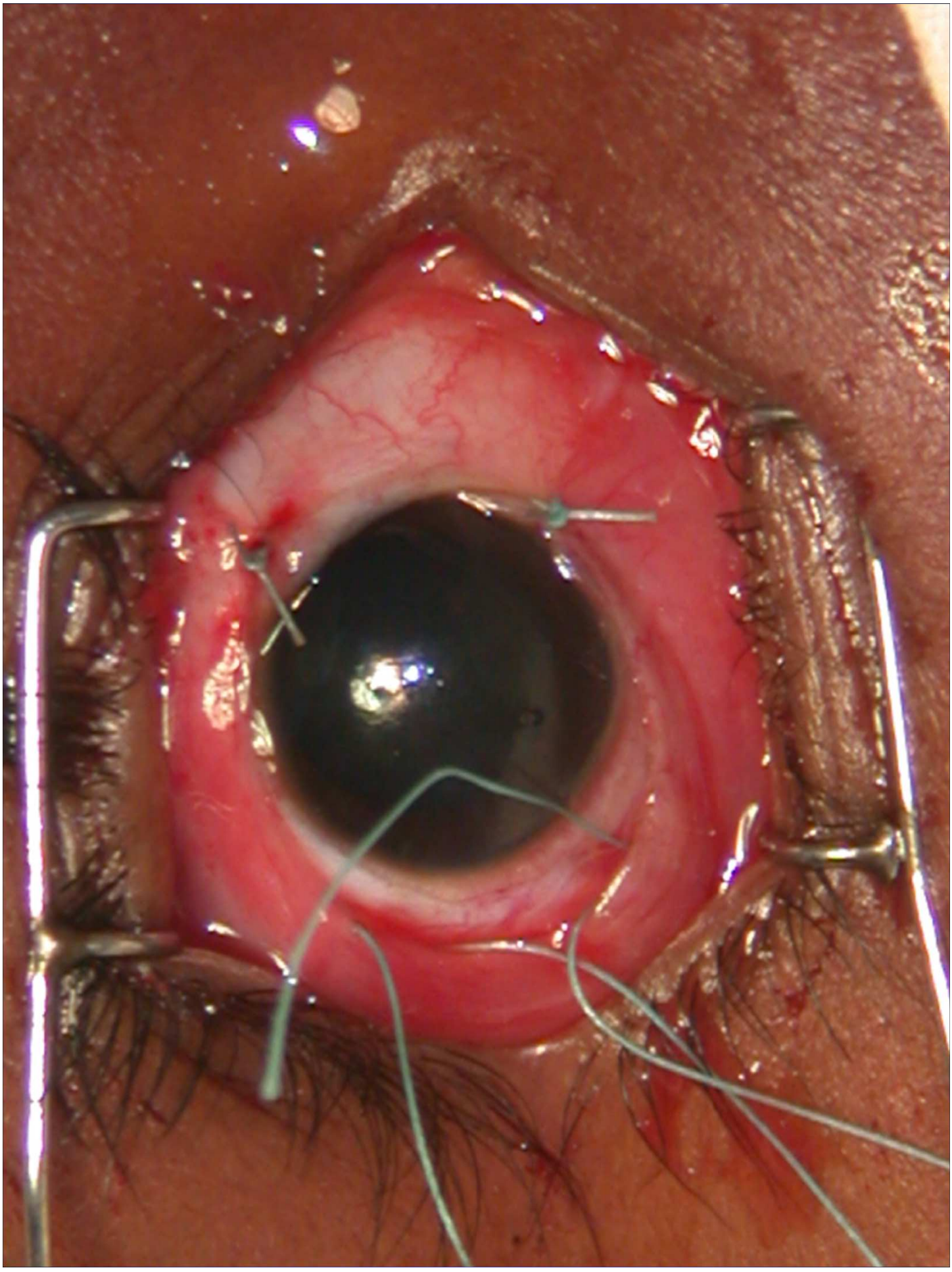
- Under GA / LA
- Conjuntival peritomy
- Tumor location marked on sclera
- Dummy plaque used to confirm location
- Rh Plaque placed & sutured to sclera
- Conjunctiva sutured
- Patient is kept in isolation



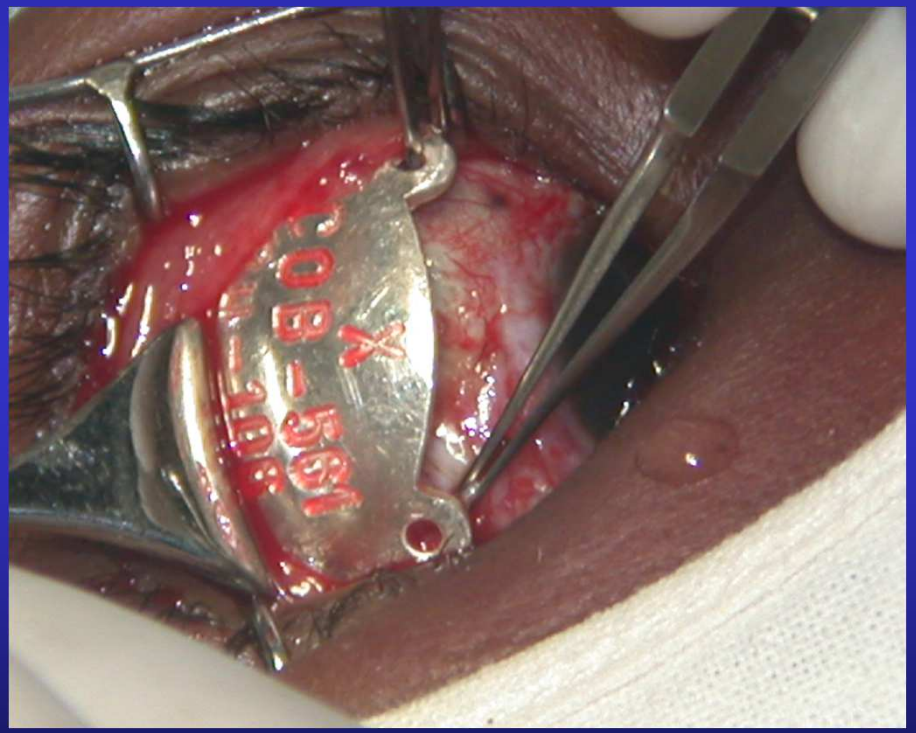








Plaque Brachytherapy



Ext Beam Radiotherapy in RB

Novalis Tx

Radiotherapy : Indications

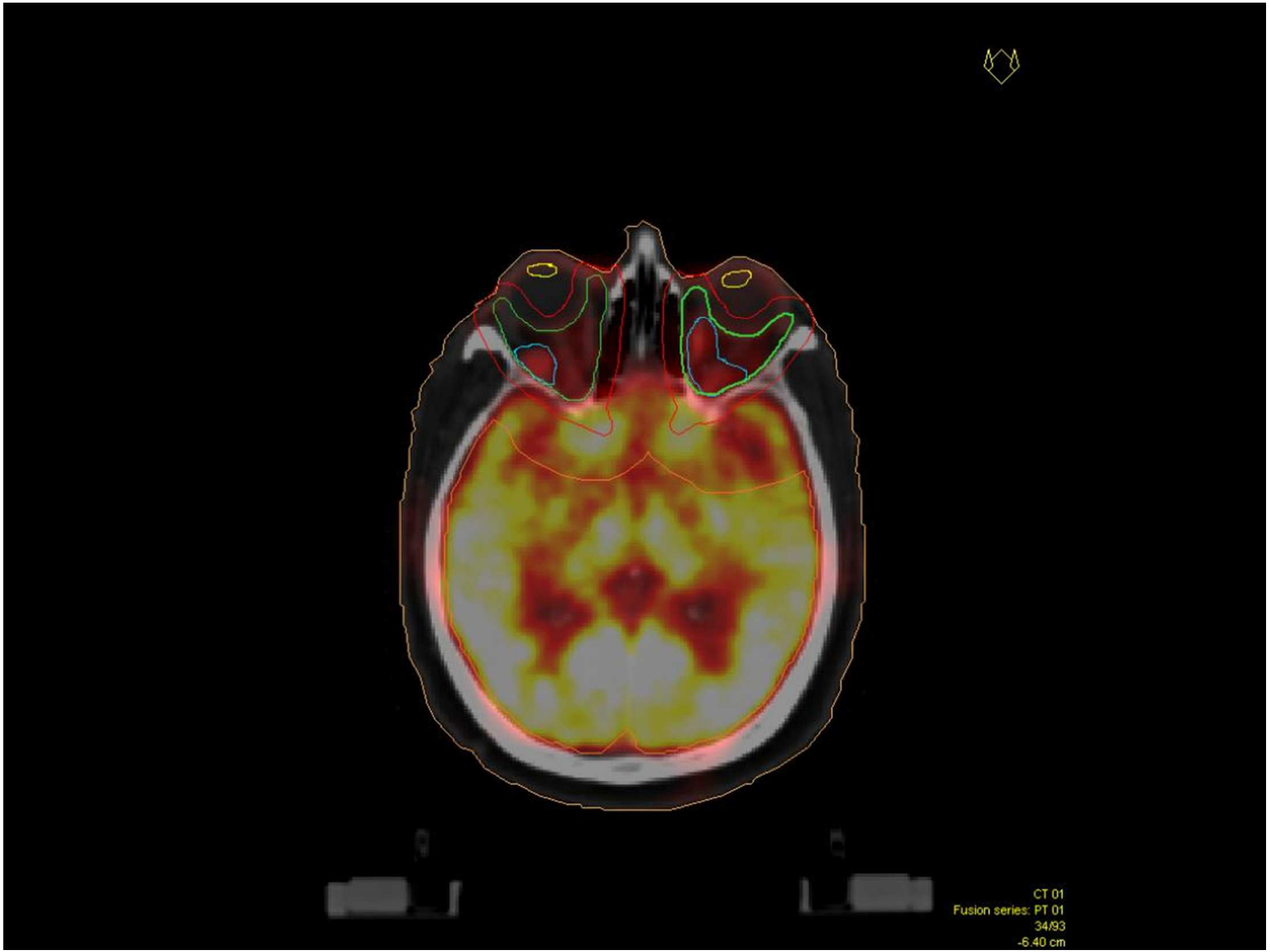
1. Residual disease after Chemotherapy and local therapy
2. Diffuse vitreous seeds
3. Recurrence after chemotherapy
4. Post enucleation – High risk features
    a). Sclera involvement
    b). Extraocular extension
    c). Optic Nerve involvement

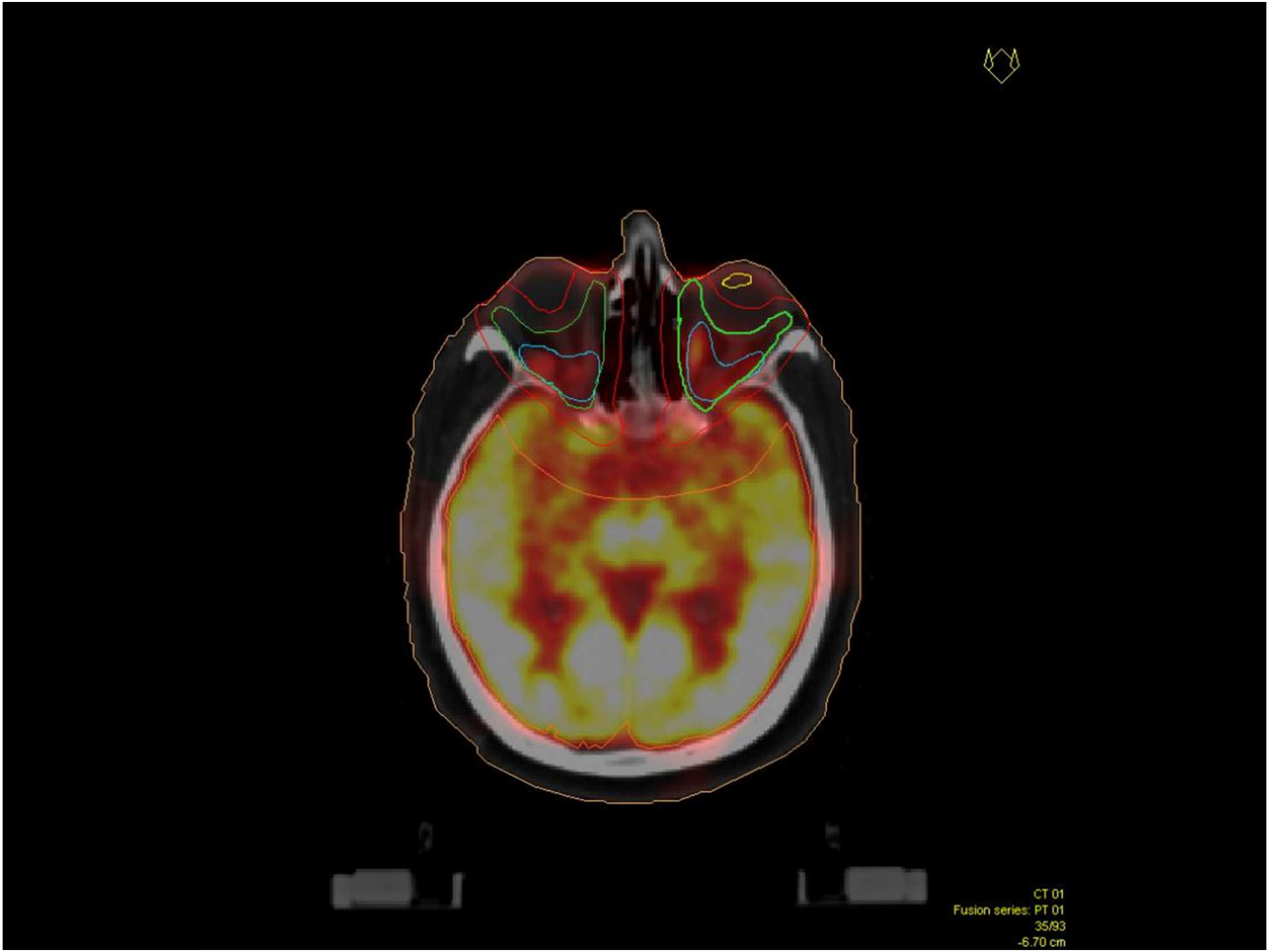
Dose of Radiation 3500 to 4600 cGy depending on age and dose per fraction.

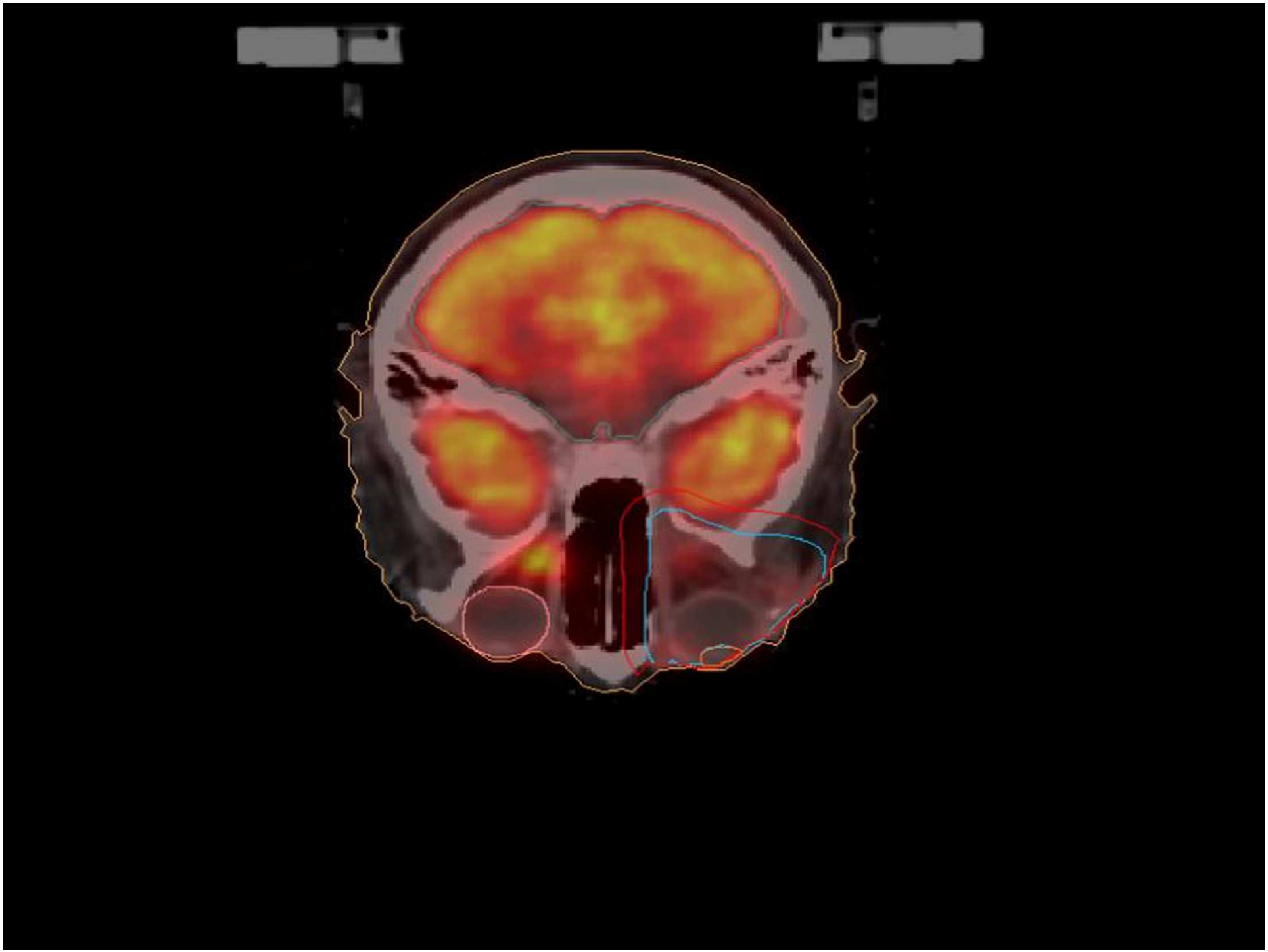
Radiotherapy – Techniques

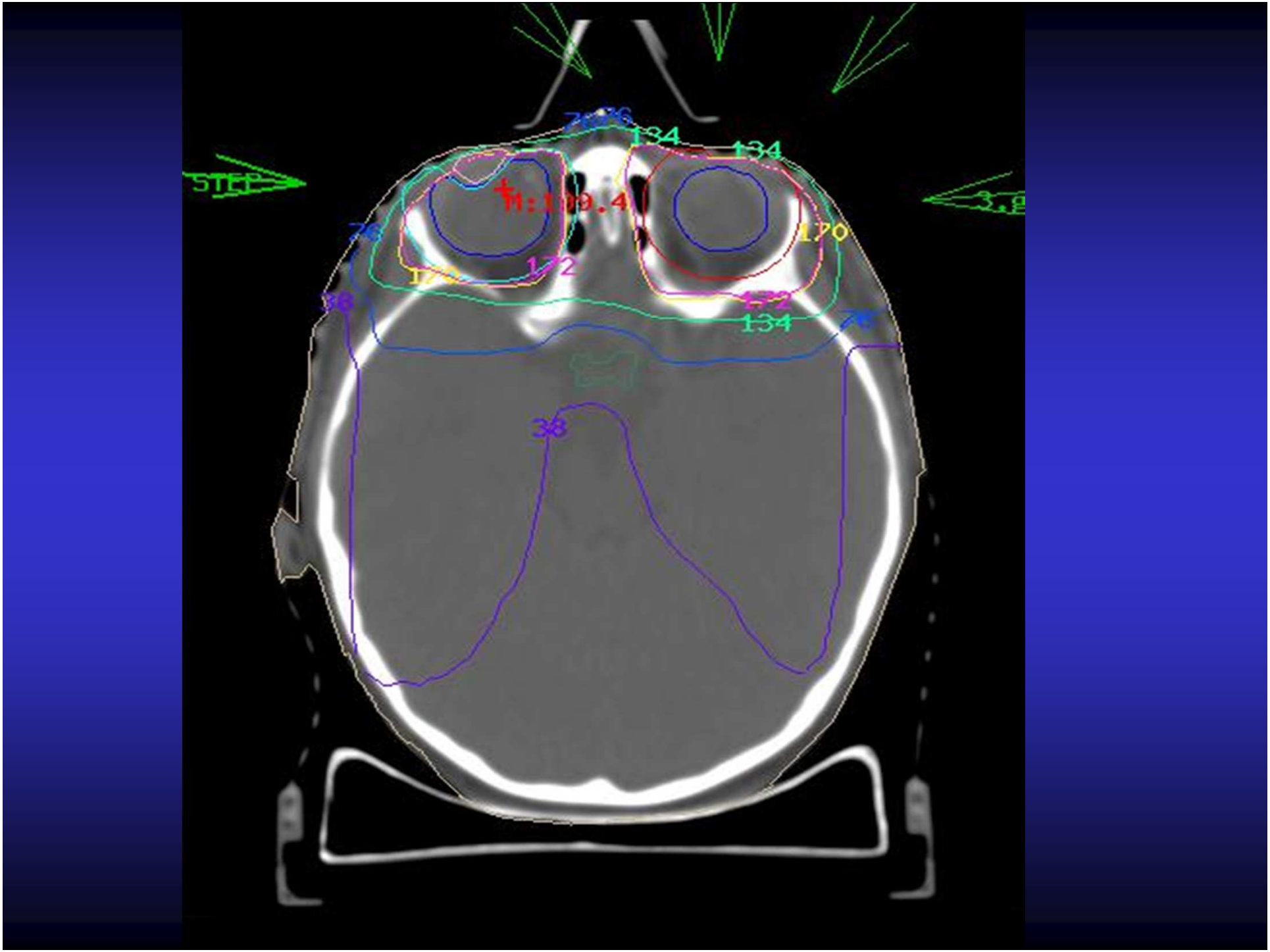
- EBRT is delivered by either Cobalt-60 (γ-rays) or Linear Accelerator (X-rays).
- It is preferable to use LA with multi-beam technique with open eyes
- Newer methods of delivering EBRT are being used to increase dose conformity to the target, minimize toxicity.

  Intensity Modulated Radiotherapy (IMRT), Image Guided Radiotherapy (IGRT), Steriotactic Radiotherapy (SRT) and Proton Beam therapy


CT 01
Fusion series: PT 01
34/93
-6.40 cm


CT 01
Fusion series: PT 01
35/93
-6.70 cm




134
134
170
172
134
38

Ext Beam Radiotherapy

Eye Salvage Rates

RE Group	Ellsworth 1977	Hungerford 1995
I	91%	100%
II	83%	84%
III	82%	82%
IV	62%	43%
V	29%	36%

EBRT Complications

- Corneal ulcers, scaring
- Cataract, retinopathy, papillopathy
- Phthisis bulbi
- Growth retardation, Orbital & facial

EBRT

Second Malignant Neoplasm

- Increased risk
- 35% Vs 6% in bil cases
- Dependant on pt age (age < 12 mo)

not an ideal situation..

change was necessary....

a change came about...

Chemoreduction!

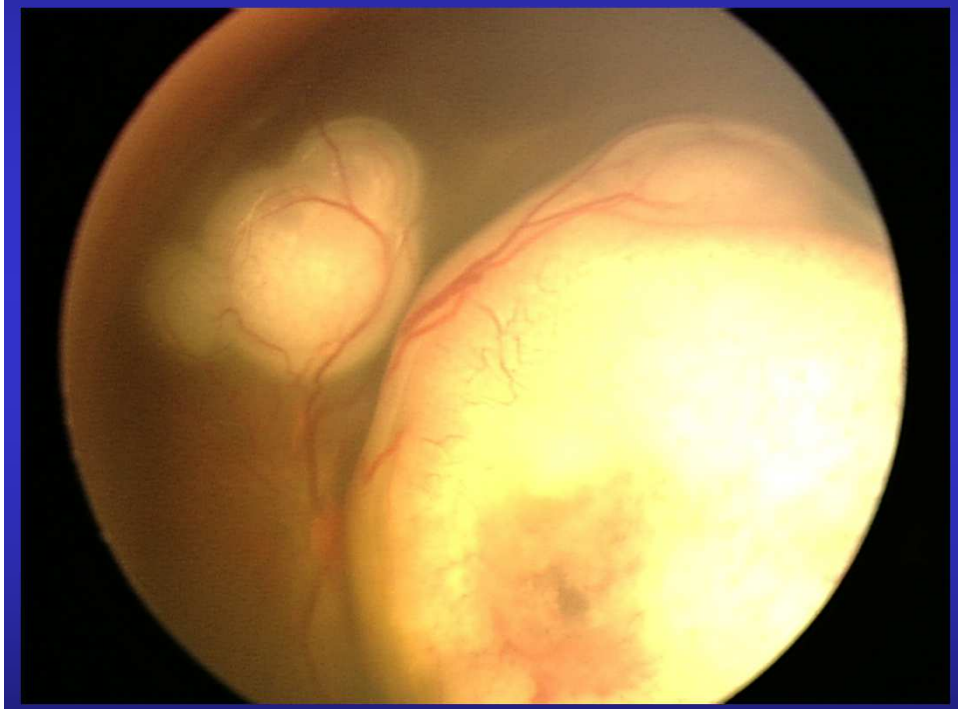
Chemoreduction

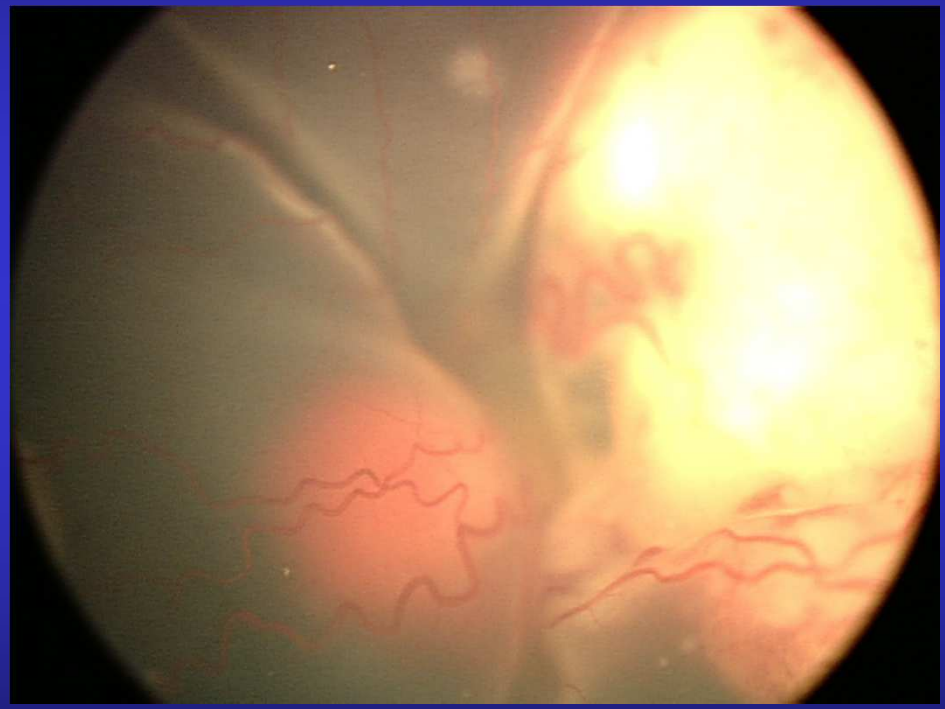
- Reduces tumor volume
- Allows more focused, less damaging therapeutic measures

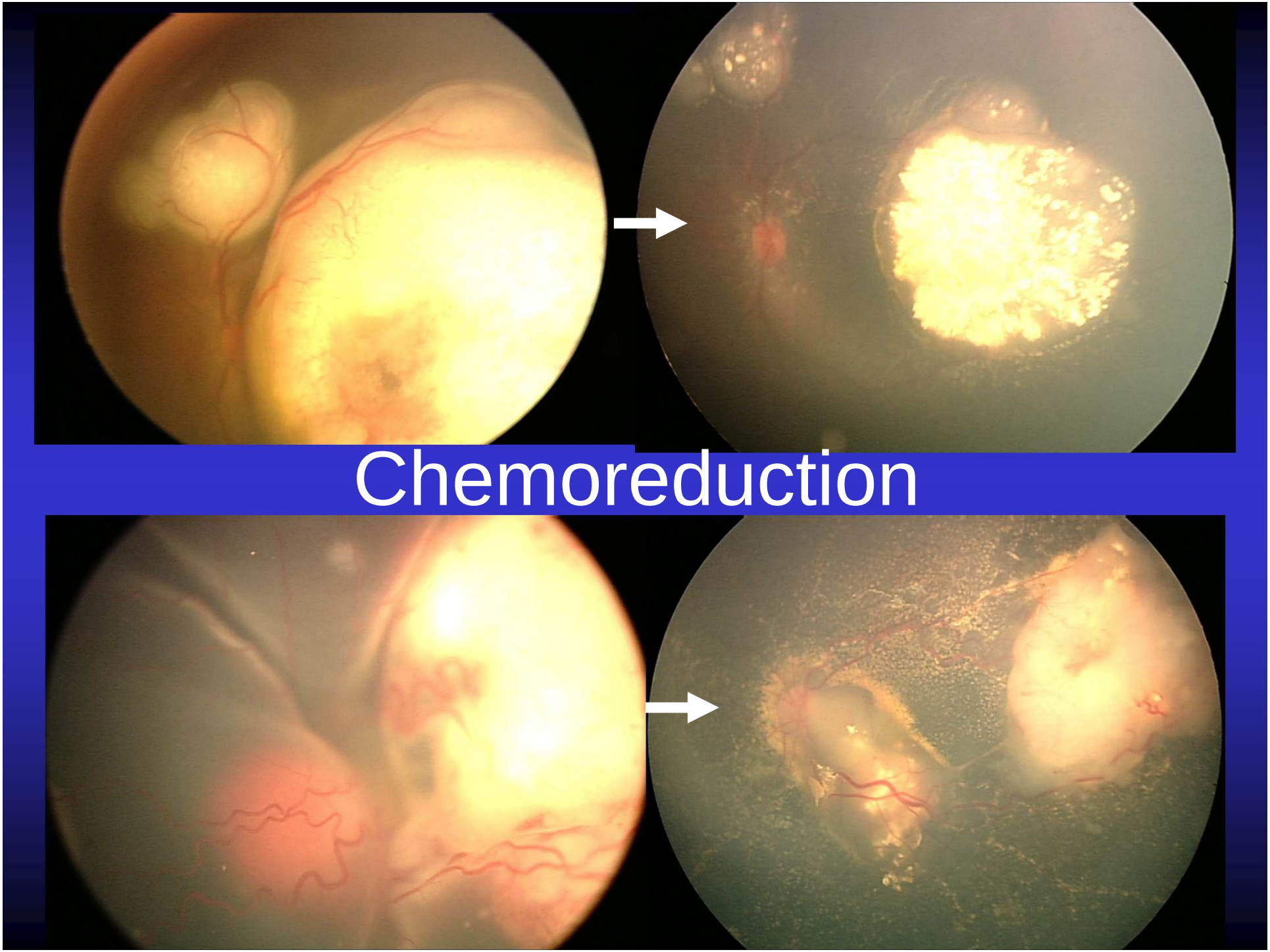
“going back in time – down staging”

Chemoreduction

Bilateral Retinoblatoma






Chemoreduction

Chemoreduction
Advantages

- Allows for salvage of the eye
- Maximizes potential for residual vision
- Possibly prevents systemic metastasis
- Delays onset of or prevents pinealoblastoma

Chemo Regimen and Doses for RB

Day 1 : Vincristine + Etoposide + Carboplatin

Day 2 : Etoposide

Standard Dose (3 weekly, 6 cycles) :

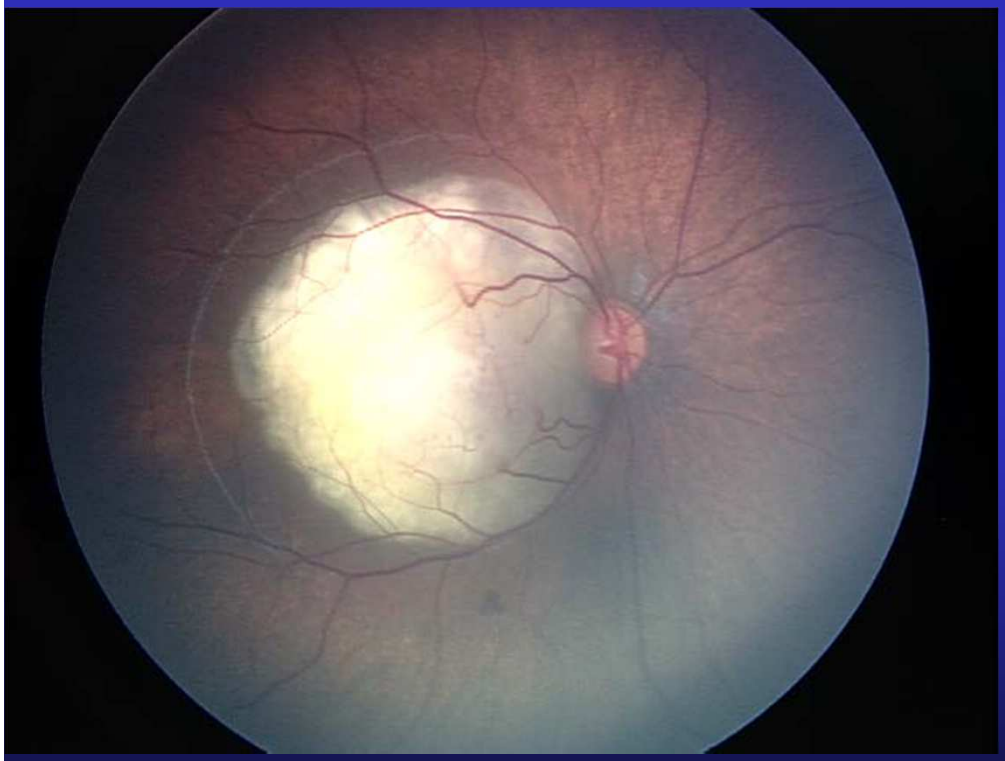
- Vincristine 1.5 mg/m^2 (0.05 mg/kg for <3y & max dose <2mg).
- Etoposide 150 mg/m^2 (5 mg/kg for children <3yrs of age
- Carboplatin 560 mg/m^2 (18.6 mg/kg for children <3y of age

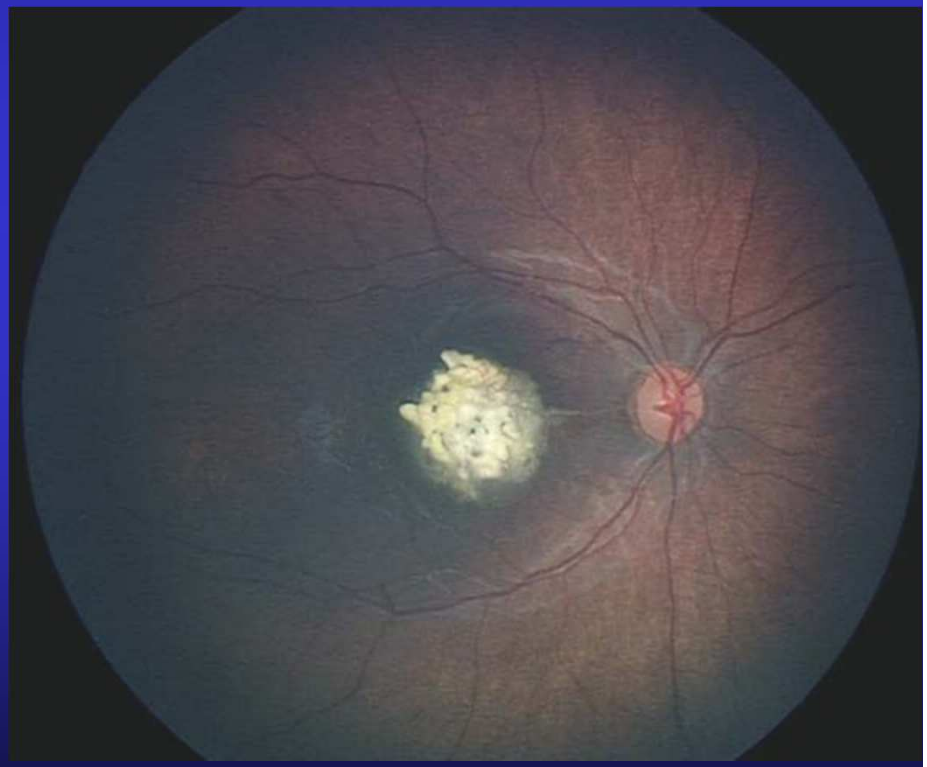
High Dose (3 weekly, 6-12 cycles) :

- Vincristine 0.025 mg/kg.
- Etoposide 12 mg/kg.
- Carboplatin 28 mg/kg.

Chemoreduction for retinoblastoma

Chemoreduction alone

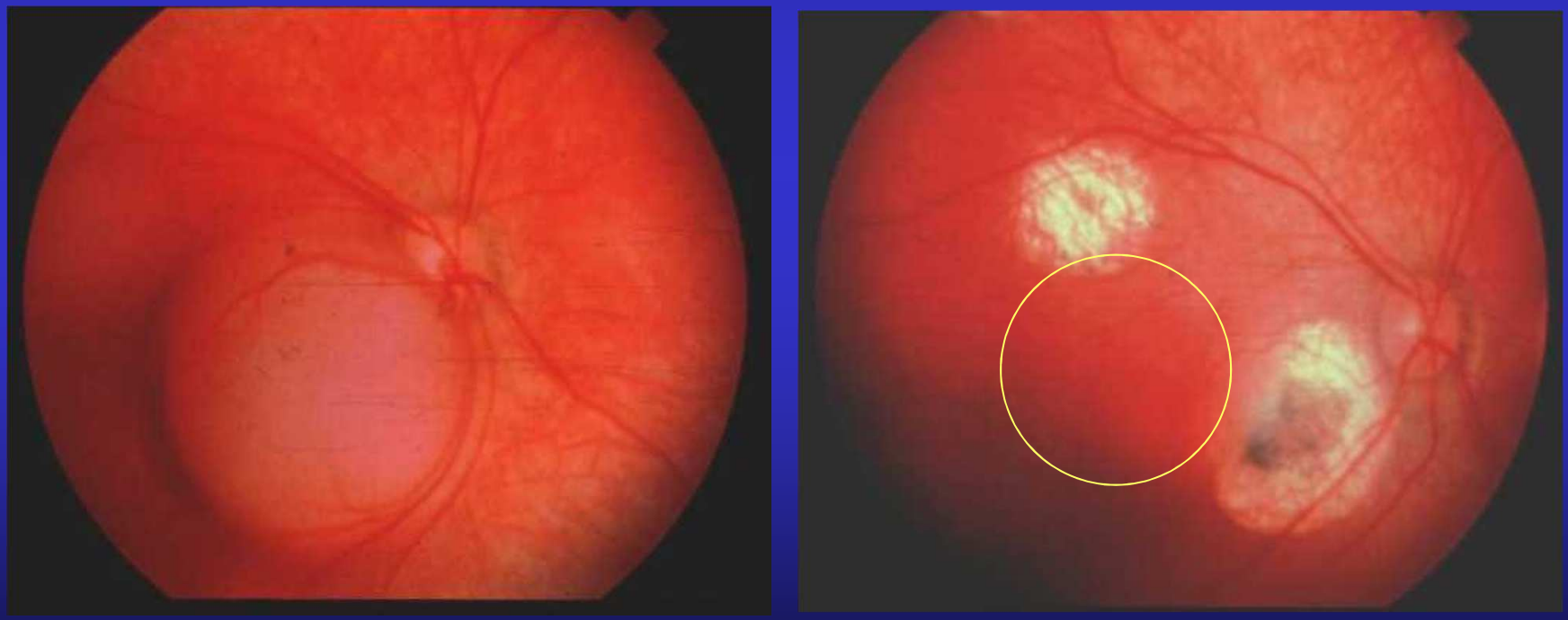




Macular tumor: laser not done to optimize vision

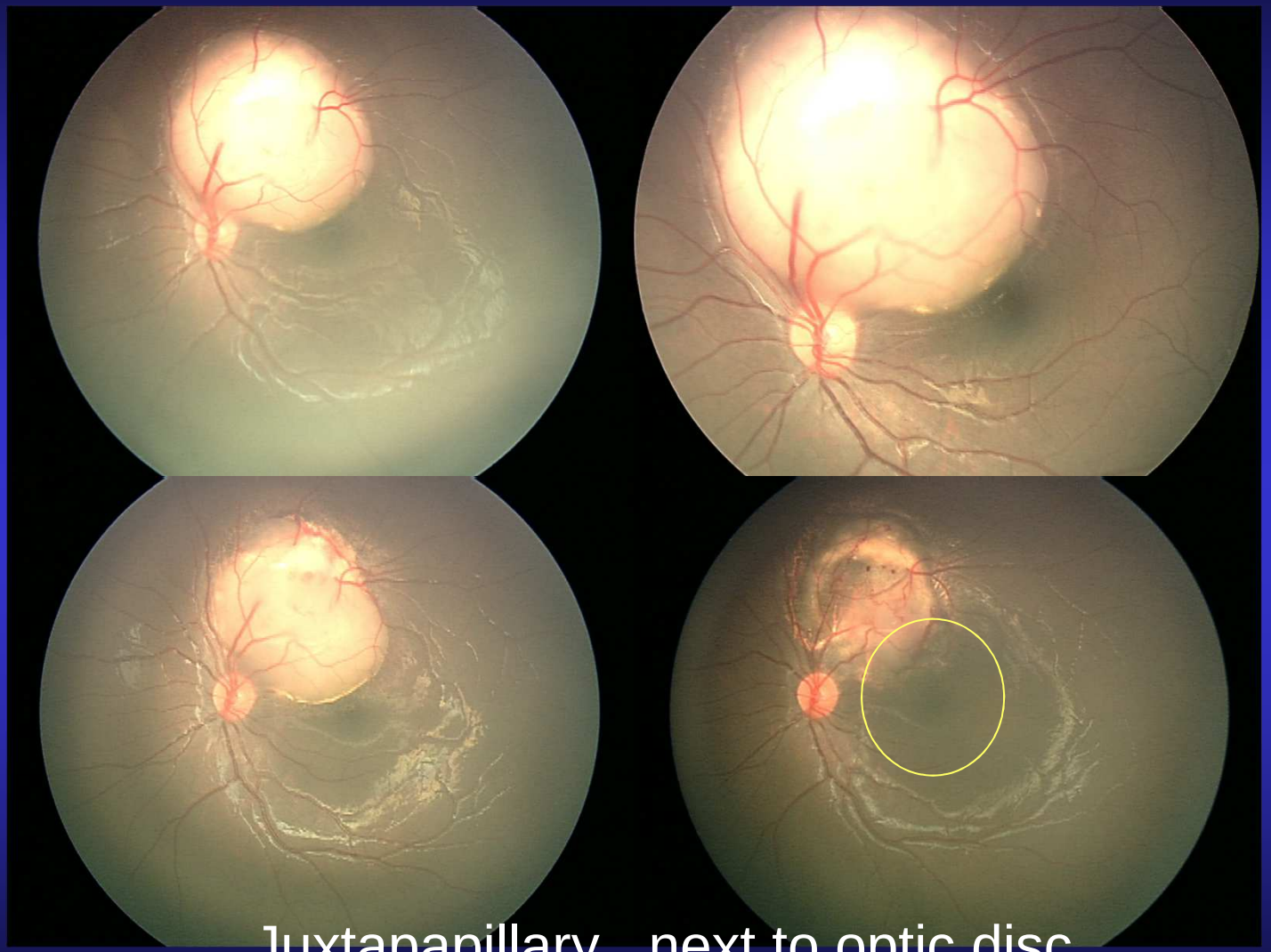
Chemoreduction for retinoblastoma

Chemoreduction + TTT



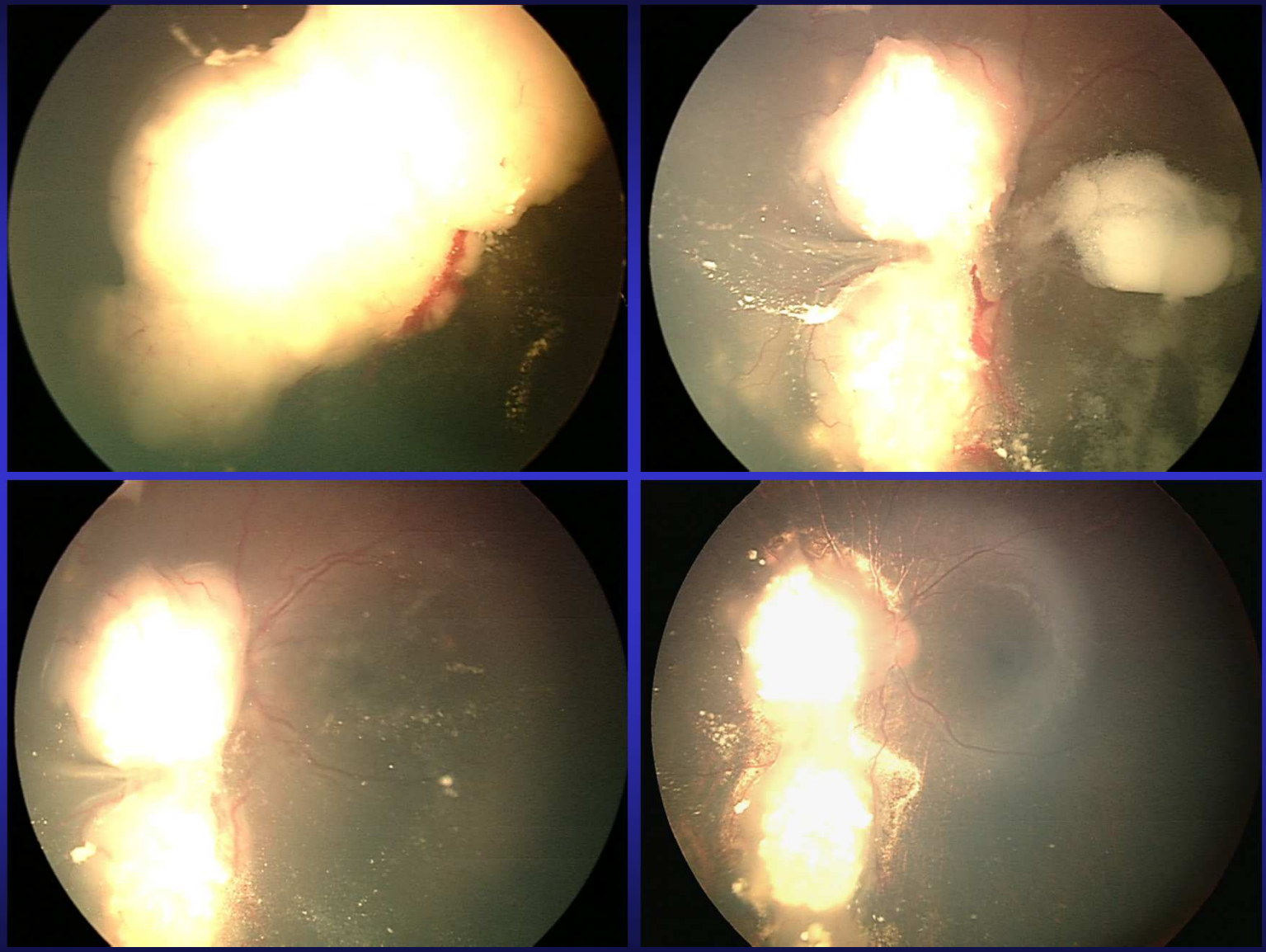
Macular tumors

Two large tumors, scar sizes r much smaller than the tumor



Juxtapapillary , next to optic disc

Two large tumors, scar sizes r much smaller than the tumor



Chemoreduction + TTT

Periocular Chemotherapy

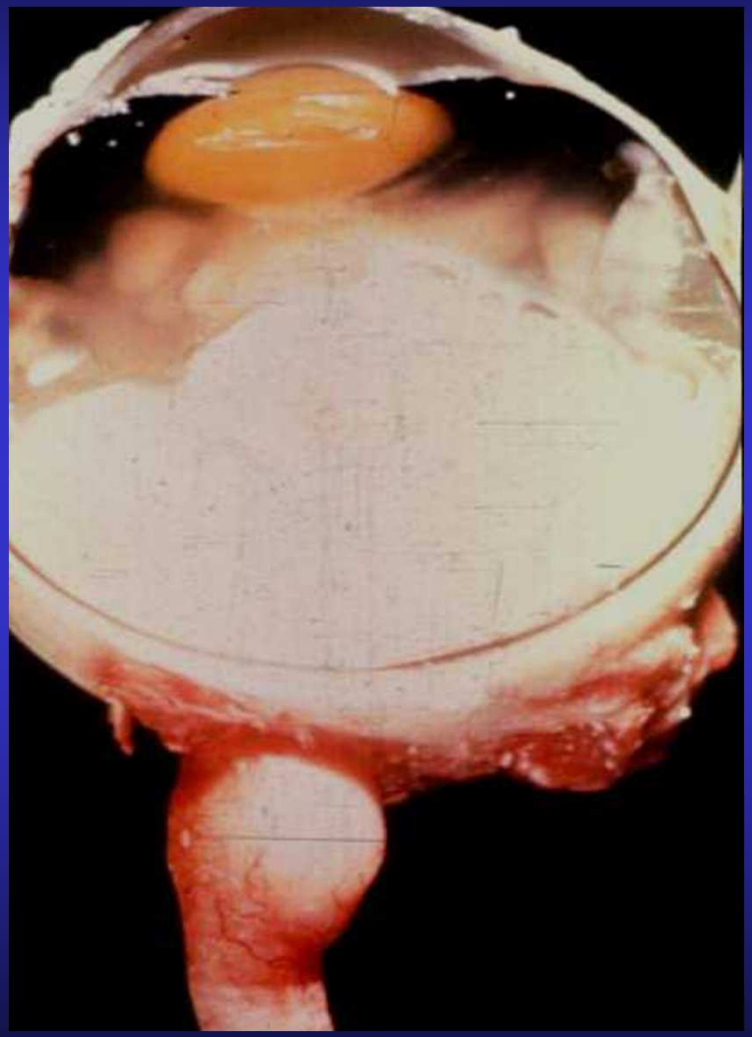
- Deep posterior subtenon Carboplatin injection
- Currently under trial
- Encouraging results in Grp V B
- (70% eye salvage Vs 30%)

EBRT Vs Chemoreduction

Eye Salvage Rates

RE	Ellsworth 1977 EBRT	Hungerford 1995 EBRT	Shields 2003 CRD+SALT	LVPEI 2005 CRD+SALT*
I	91%	100%	100%	100%
II	83%	84%	100%	100%
III	82%	82%	100%	100%
IV	62%	43%	75%	90%
V	29%	66%	50%	75%

* HD Chemotherapy for group V, Periocular chemotherapy for VB



Enucleation

Changing Trends

- 1970 : 95%
- 1980 : 75%
- 1990 : 50%
- 2000 : 25%

Enucleation

- Advanced unilateral tumor
- Secondary glaucoma, pars plana invasion, anterior segment seeding
- Worse eye of an advanced bil case

Enucleation in Retinoblastoma

1.	Minimal manipulation
2.	Avoid perforation of the eye
3.	Harvest long (>15mm) optic nerve stump
4.	Inspect the enucleated eye for macroscopic extraocular extension and optic nerve involvement
5.	Harvest fresh tissue for genetic studies
6.	Avoid biointegrated implant if postoperative radiotherapy is necessary

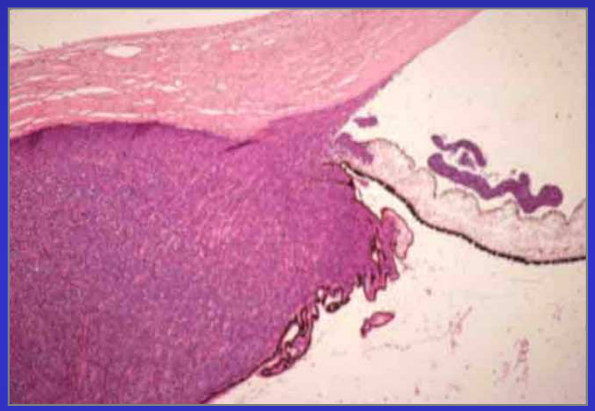
Enucleation

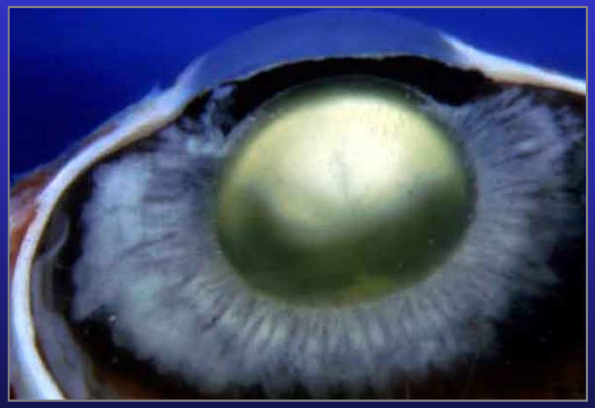
- Minimal manipulation technique
- Long optic nerve stump

Enucleation is NOT the end of Rx

It is JUST the beginning!

Histopathologic risk factors

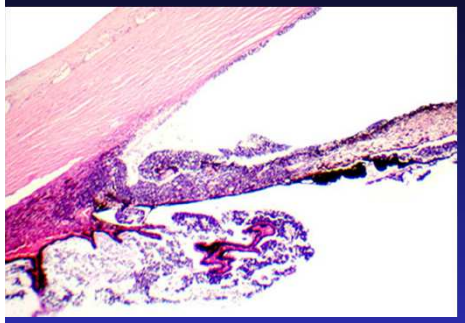


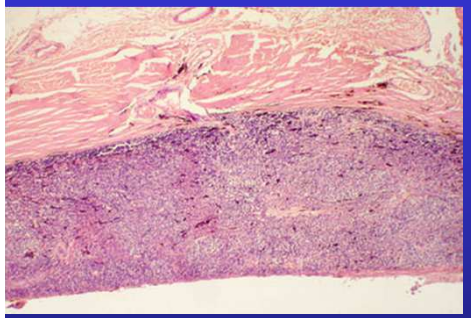


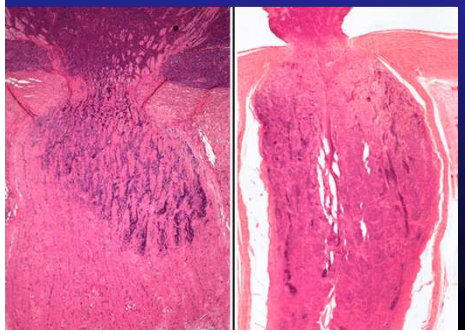
- Anterior chamber infiltration
- Trabecular meshwork infiltration
- Ciliary body infiltration

Histopathologic High risk Factors Predictive of Metastasis

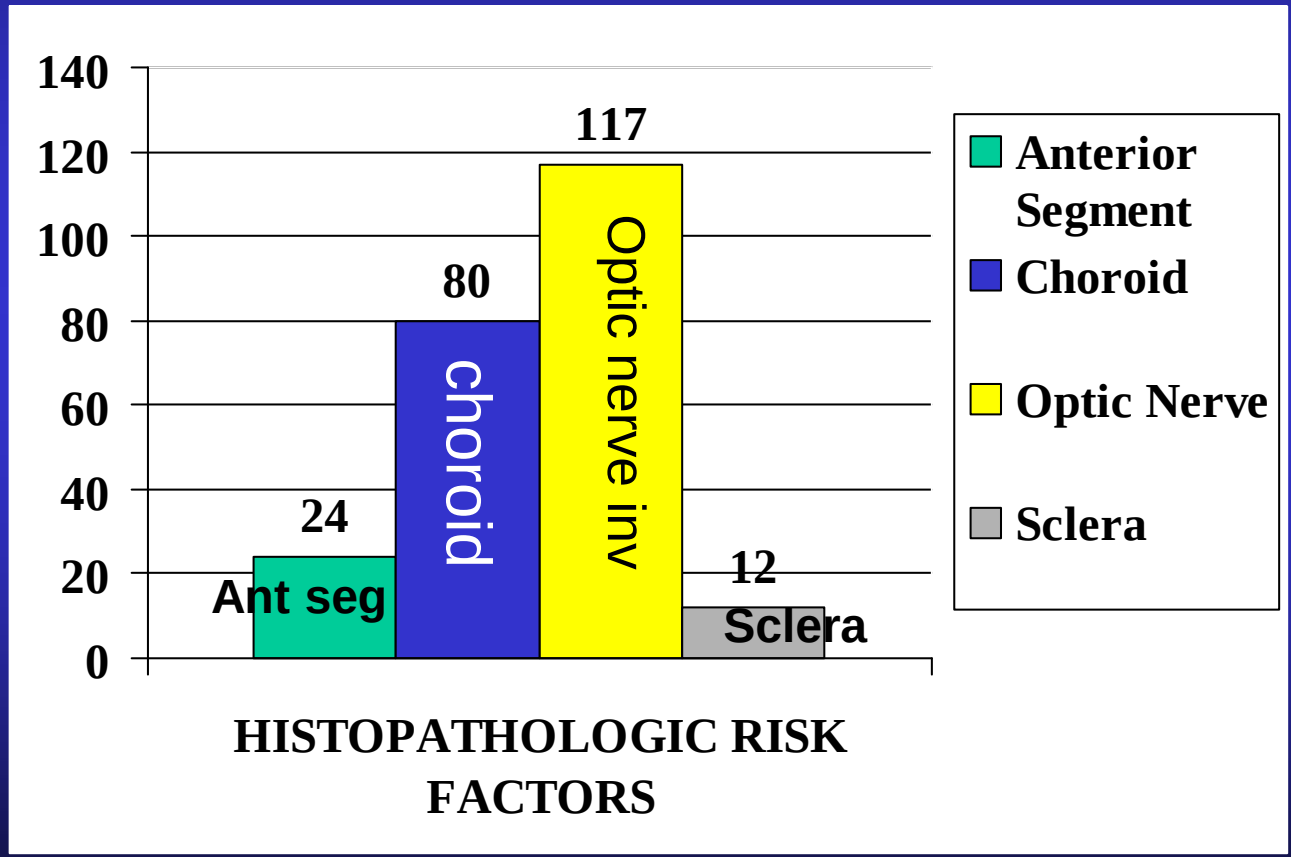
1.	Anterior chamber seeding
2.	Iris infiltration
3.	Ciliary body infiltration
4.	Massive choroidal infiltration
5.	Invasion of the optic nerve lamina cribrosa
6.	Retrolaminar optic nerve invasion
7.	Invasion of optic nerve transection
8.	Scleral infiltration
9.	Extrascleral extension





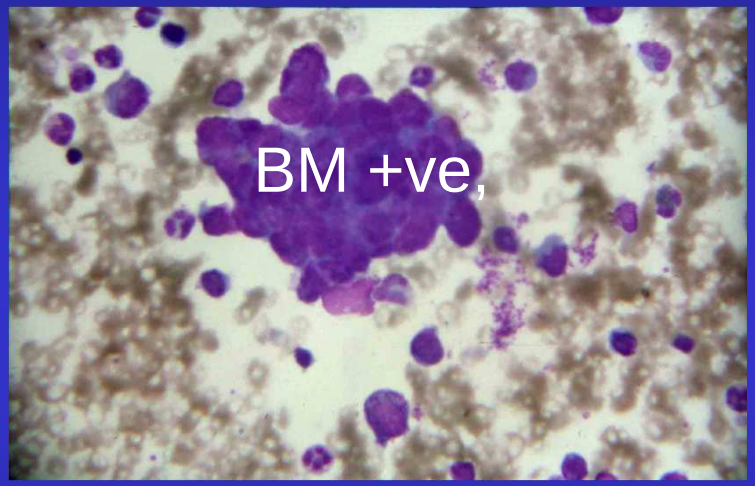


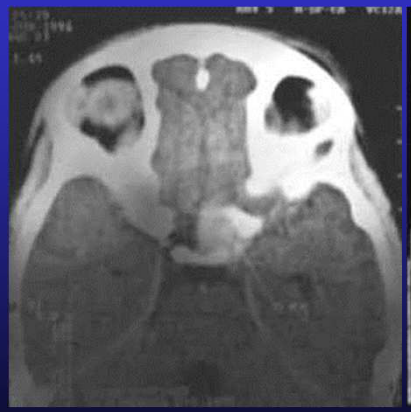
Histopathologic Risk Factors
152 of 277 (55%) **N=277 eyes**



Numbers do not total up to 152 because multiple HRF were present

Investigations in a patient with histopathologic high-risk factors



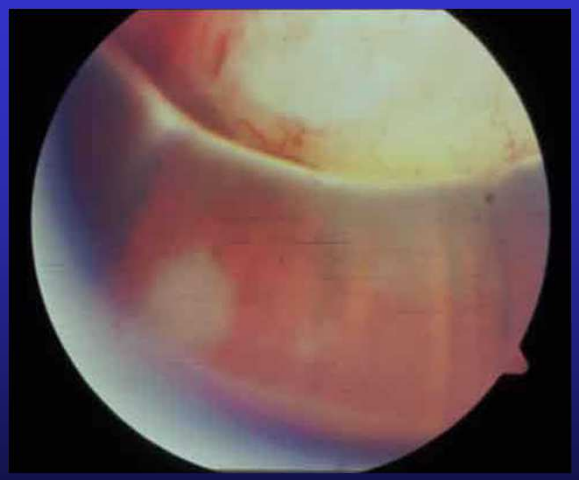


CSF +ve, Intracranial exten.

Adjuvant Chemotherapy

- All pts with histopath risk factors
- 6 cycles of VCE
- 12 cycles of High Dose chemo for pts with EOE and ON-TR

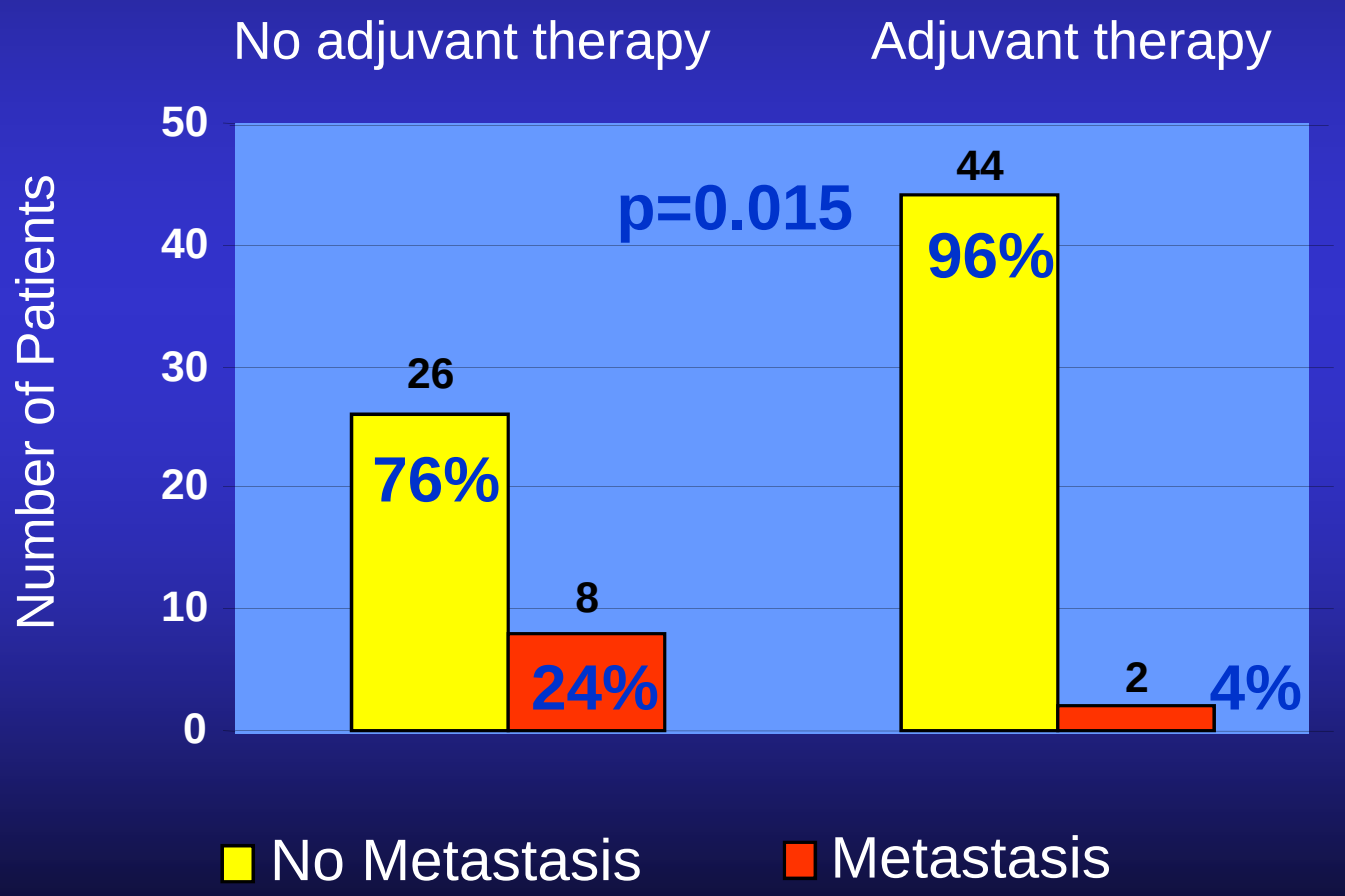
Adjuvant Orbital EBRT



- Optic nerve invasion to the level of transection
- Scleral / extraocular extension
- Inadvertent ocular perforation or intraocular surgery in unsuspected retinoblastoma

Does adjuvant therapy help ?

Incidence of metastasis



Orbital Retinoblastoma

- Primary
- Secondary
- Accidental
- Overt
- Microscopic

Orbital Retinoblastoma

Management Options

- Orbital exenteration
- External beam radiotherapy
- Systemic chemotherapy

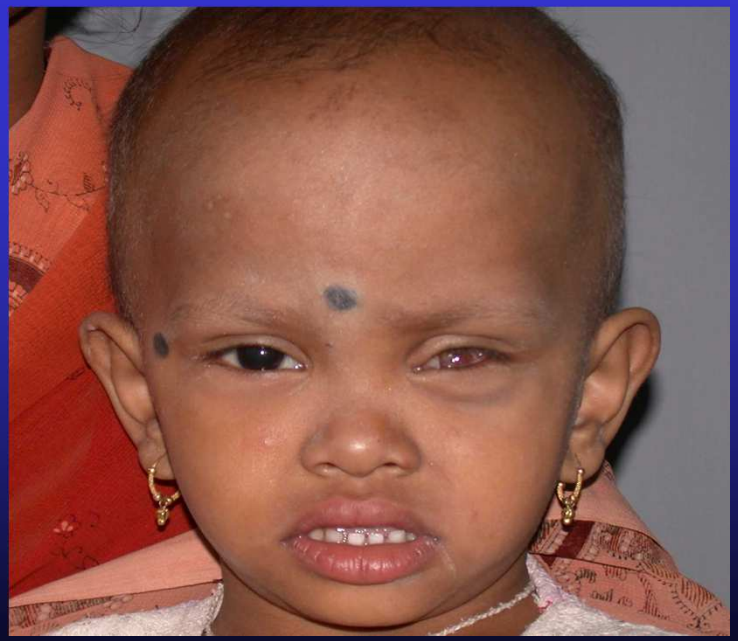
70% MORTALITY!

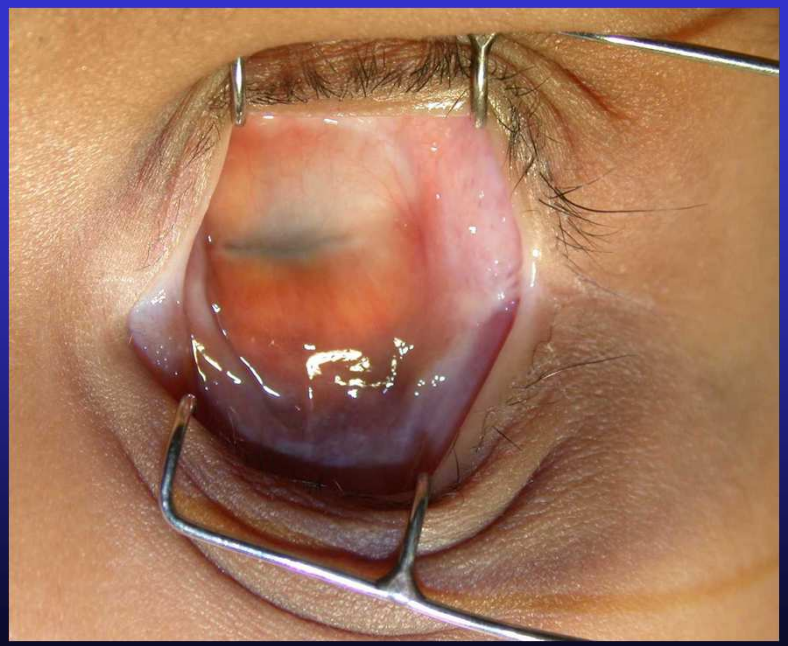
Orbital Retinoblastoma Treatment Protocol

- High-dose chemotherapy
- Enucleation after minimum 3 cycles
- Orbital EBRT
- Continued high-dose chemotherapy for 12 cycles

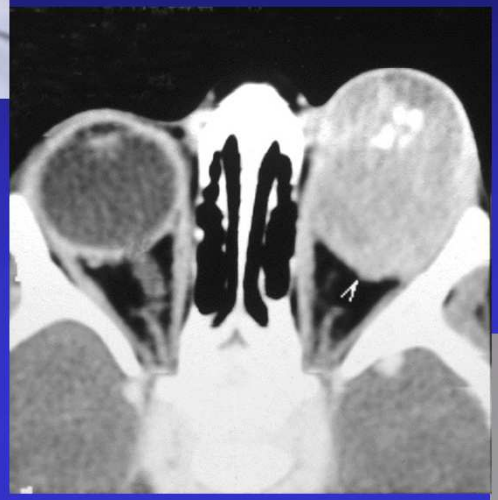
Neo-adjuvant Chemotherapy

Neo-adjuvant Chemotherapy





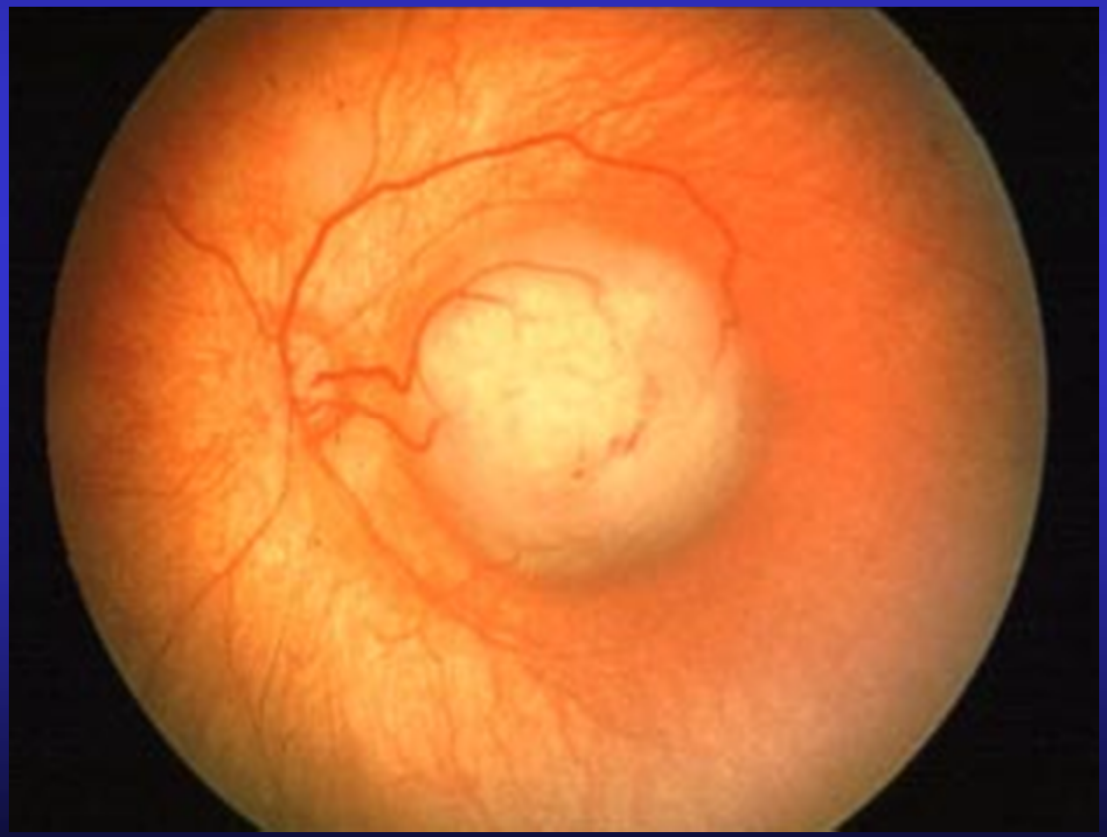
Neo-adjuvant



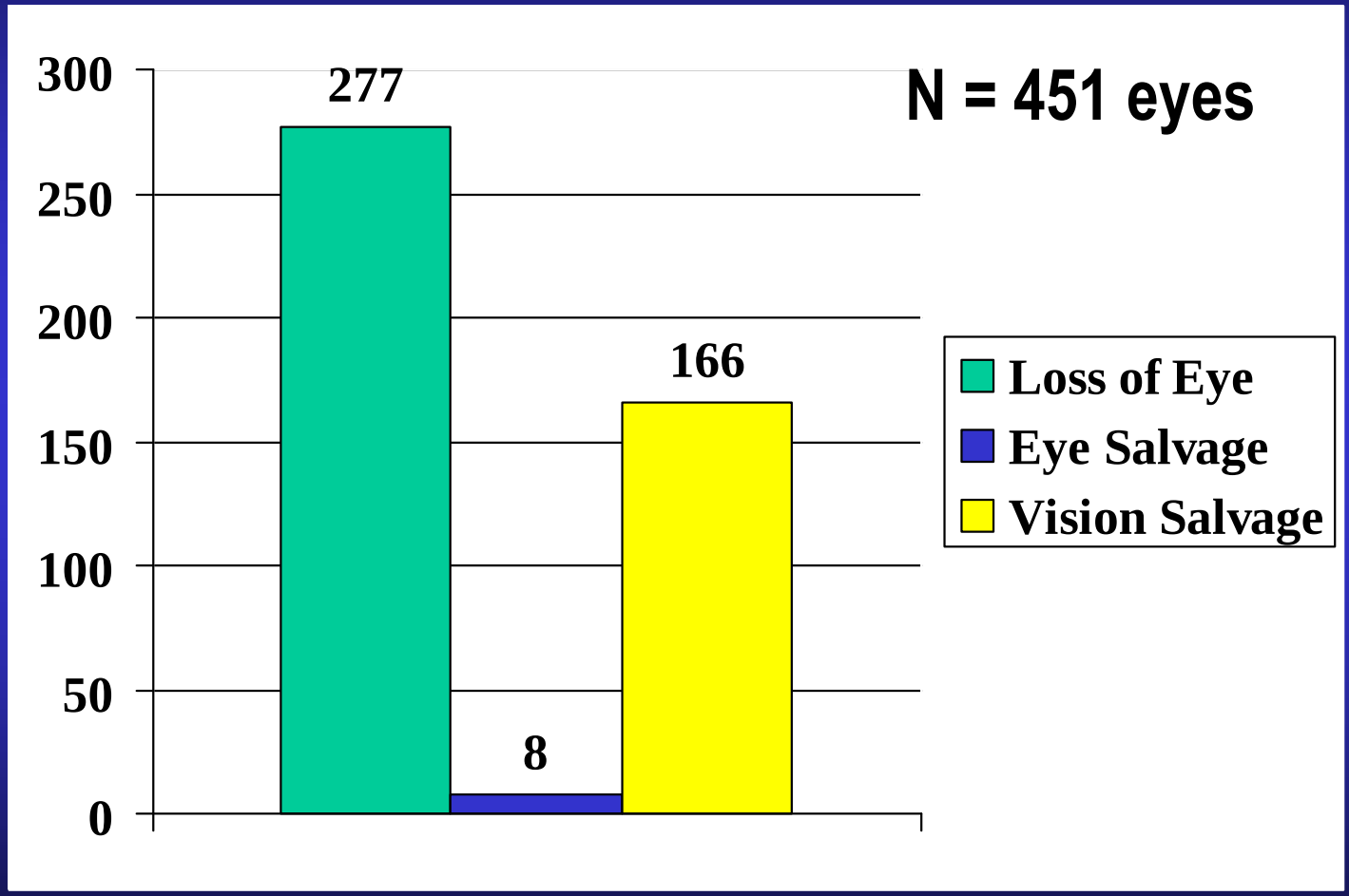
Chemotherapy

Retinoblastoma

Overall Outcome



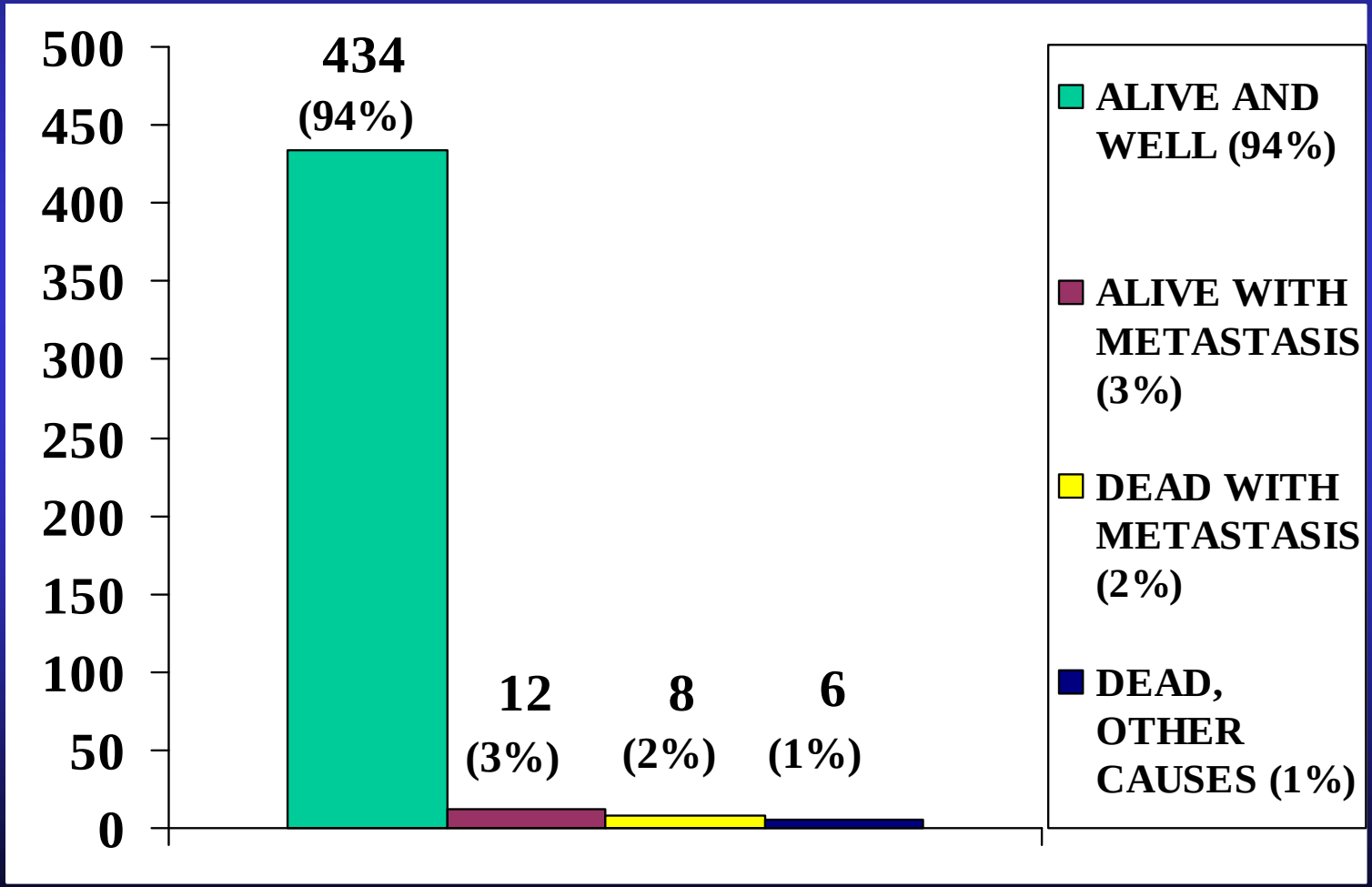
Final Ocular Status
All Treatment Summary



Overall, 61% eyes needed enucleation

N=460 patients

Final Systemic Status
All Treatment Summary



Summary

- In a tertiary care situation with integrated RB clinic in India, the OS was 94%, comparable to the West
- 61% of eyes needed enucleation
- 55% of eyes undergoing enucleation had HP risk factors and needed adj. therapy
- Chemoreduction had 92% eye salvage

Summary

- RB management is complex Individualized management
- Current trend is towards Chemoreduction and focal therapy with ***improving life, eye and vision salvage***
- Team approach

Summary of Recent Advances

- Replacement of EBRT as primary modality
- Use of Chemoreduction to minimize the regression scar hence, increases the visual potential
- Identification of histo high-risk factors following enucleation
- Provision of Adjuvant therapy to reduce the local and distant recurrence
- Neo adjuvant chemotherapy in Orbital RB

CURRENT SUGGESTED PROTOCOL

Intraocular tumor, International Classification – Group A to C, Unilateral or Bilateral	
1.	Focal therapy (cryotherapy or transpupillary thermotherapy) alone for smaller tumors (<3mm in diameter and ht.) located in visually noncrucial areas
2.	Standard 6 cycle chemoreduction and sequential aggressive focal therapy for larger tumors and those located in visually crucial areas
3.	Defer focal therapy until 6 cycles for tumors located in the macular and juxtapapillary areas. Transpupillary thermotherapy or plaque brachytherapy for residual tumor in the macular and juxtapapillary areas after >6 cycles
4.	Focal therapy for small residual tumor, and plaque brachytherapy / external beam radiotherapy (>12 months age) for large residual tumor if bilateral and enucleation if unilateral

CURRENT SUGGESTED PROTOCOL

Intraocular tumor, International Classification – Group D, Unilateral or Bilateral	
1.	High dose chemotherapy and sequential aggressive focal therapy
2.	Periocular carboplatin for vitreous seeds
3.	Consider primary enucleation if unilateral, specially in eyes with no visual prognosis

Intraocular tumor, International Classification – Group E, Unilateral or Bilateral	
1.	Primary enucleation
2.	Evaluate histopathology for high risk factors

CURRENT SUGGESTED PROTOCOL

High risk factors on Histopathology, International Staging –Stage 2	
1.	Baseline systemic evaluation for metastasis
2.	Standard 6 cycle adjuvant chemotherapy
3.	High dose adjuvant chemotherapy and orbital external beam radiotherapy in patients with scleral infiltration, extraocular extension and optic nerve extension to transection

Extraocular tumor, International Staging – Stage 3A	
1.	Baseline systemic evaluation for metastasis
2.	High dose chemotherapy for 3-6 cycles, followed by enucleation or extended enucleation, external beam radiotherapy and continued chemotherapy for 12 cycles

CURRENT SUGGESTED PROTOCOL

Regional Lymph Node Metastasis, International Staging – Stage 3B	
1.	Baseline evaluation for systemic metastasis
2.	Neck dissection, high dose chemotherapy for 6 cycles, followed by external beam radiotherapy and continued chemotherapy for 12 cycles

Hematogenous or Central Nervous System Metastasis, International Staging – Stage 4	
1.	Intent-to-cure or Palliative therapy in discussion with the family

Eye Salvage Rates
EBRT Vs Chemoreduction

Reese Ellsworth Group	Ellsworth, 1977 EBRT	Hungerford, 1995 EBRT	Shields, 2003 Chemoreduction	LVPEI, 2005 Chemoreduction
I	91%	100%	100%	100%
II	83%	84%	100%	100%
III	82%	82%	100%	100%
IV	62%	43%	75%	90%
V	29%	66%	65%	75%

EYES
make
World Beautiful

thank u

Dr Vijay Anand P Reddy