



# RayOcular evaluation at Antoine Lacassagne center : a preclinical cases study

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Application in ocular proton therapy

# Study of a new TPS : RayOcular (RaySearch)

## Why RayOcular ?

- Unique TPS
- Personalized eye model
- Takes clip density into account
- Visualization of isodoses and dose-volume histograms
- Monte-Carlo calculation algorithm
- Health organization certified



# Treatment plans comparison

➡ No clinical case studies or comparisons with other TPS

**What advantages does RayOcular offer compared with EyePlan in terms of treatment plans for ocular tumors ?**

**Is it adapted to CAL's clinical practices?**

**Principal types of tumor treated at Lacassagne center :**

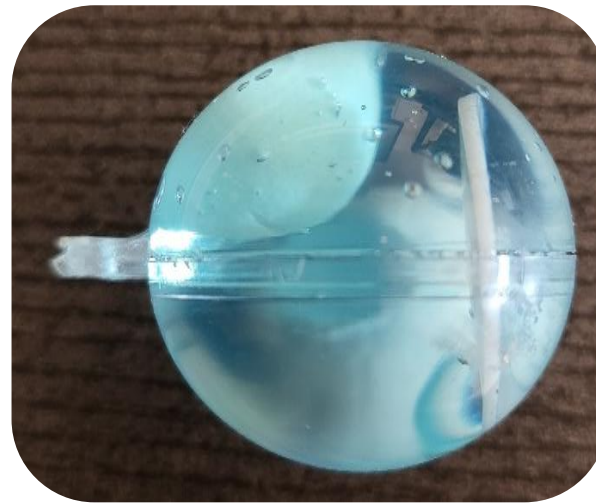
- Uveal melanomas (66%)
- Conjunctival tumors (17%)
- Iris melanomas (8,5%)
- Hemangiomas (8,5%)

## Description of the eye phantom :

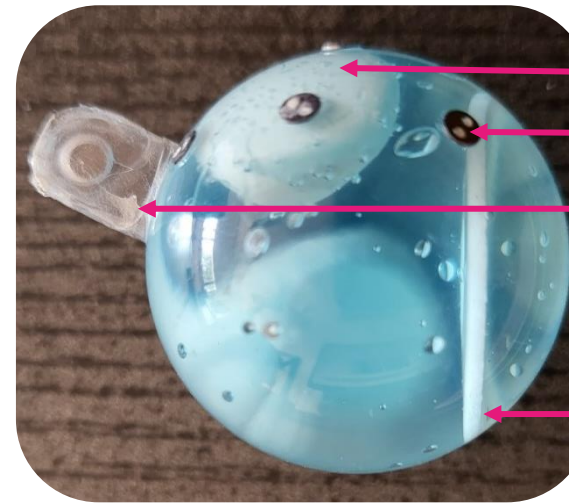
	Eye	Lens	Tumor
Density	1,02	1,14	1,21
Diameters (mm)	30	19	13,4 / 10
Thickness (mm)	Sclera = 1 mm	2	8



Front view



Lateral view

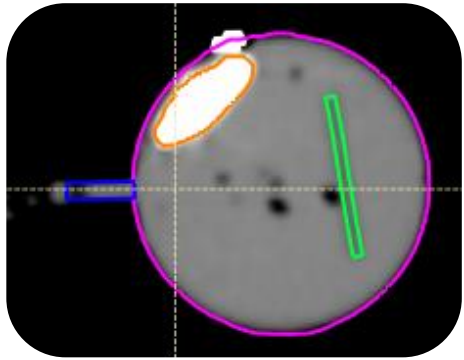


Over view

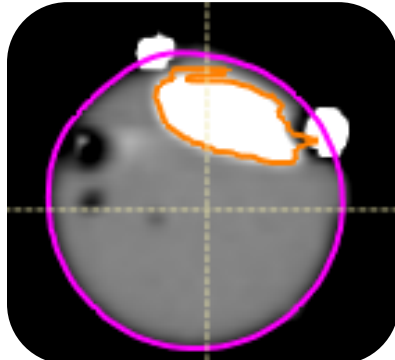
- Tumor
- Tantalum clip
- Optic nerve
- Lens

# Eye phantom imaging:

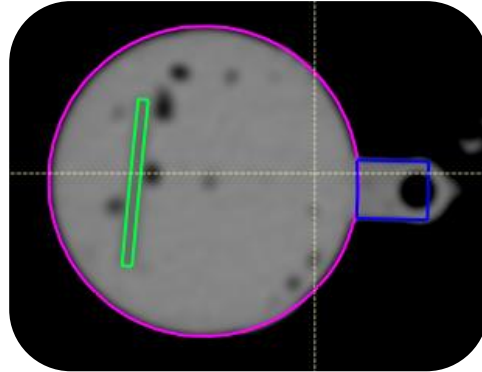
## Scanner



Sagittal view



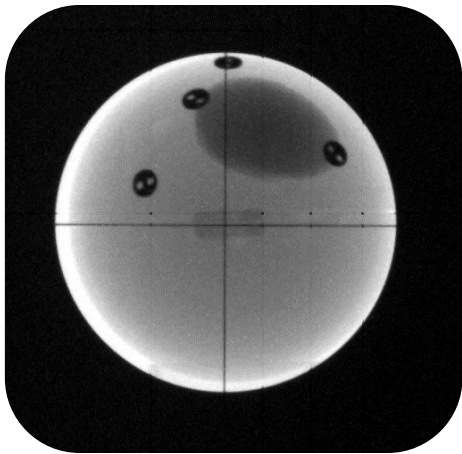
Coronal view



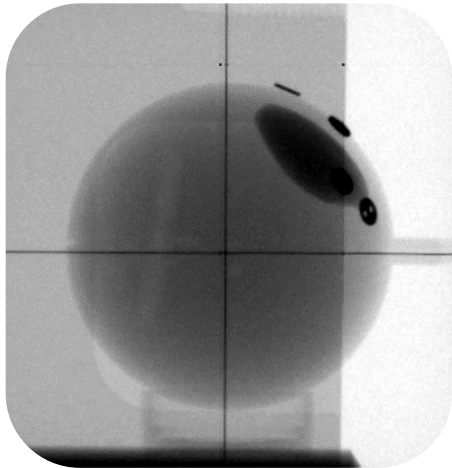
Front view

- Eye
- Lens
- Optic nerve
- Tumor

## X-rays

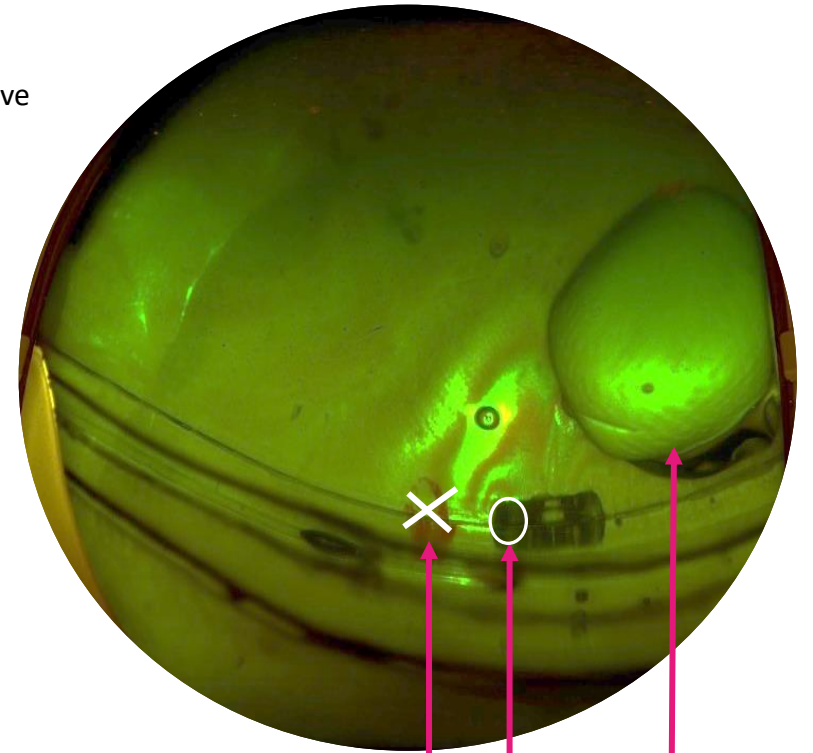


Axial view



Lateral view

## Optomap



Macula    Optic disc    Tumor

Right eye phantom optomap

# Eye phantom imaging:

## RayOcular « Eye modeling »



Easy-to-use

All structures can be customized and adjusted

Artificial lens modeling

Simplified digitalization of clips

No overall deformation of the eye structures set

No connection between macula and optic disc

Distances inter-clip in mm

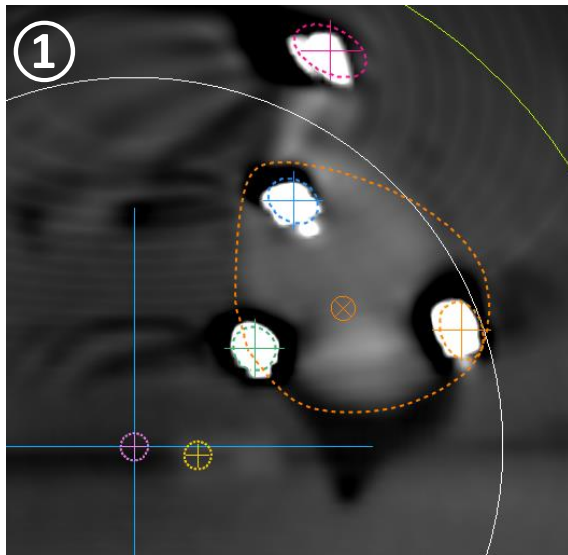
Distances clip-clip	Phantom	RayOcular	EyePlan
1-2	10	9,47	9,8
1-3	18	18,04	18,1
1-4	13	12,58	12,5
2-3	9	9,48	9,2
2-4	10	10,03	9,9
3-4	13	12,8	12,8



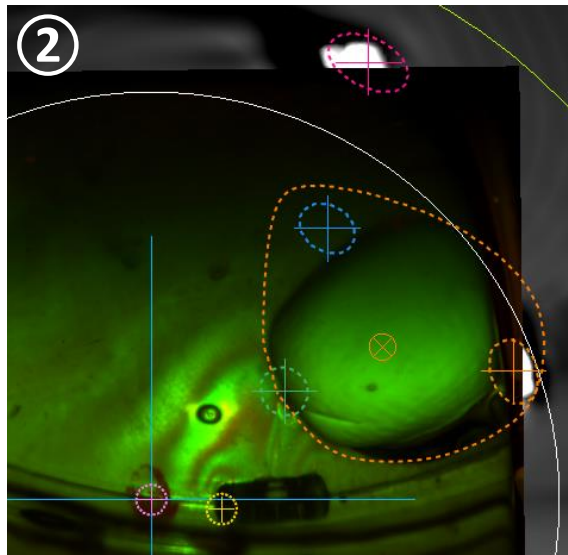
# Clinical cases

## Uveal melanoma : Tumor definition

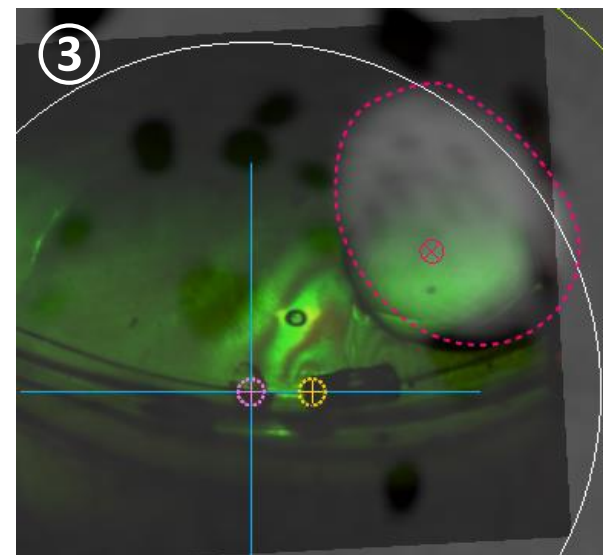
➔ Tumor defined on « Eye modeling » mode in fundus view



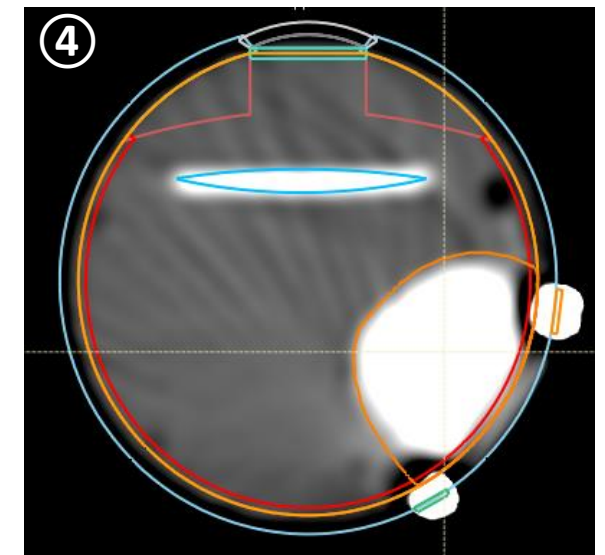
Fundus polar view reconstructed with CT data



Inserting Optomap in polar mode



Fundus view reconstructed without clip



CT axial view and tumor contours



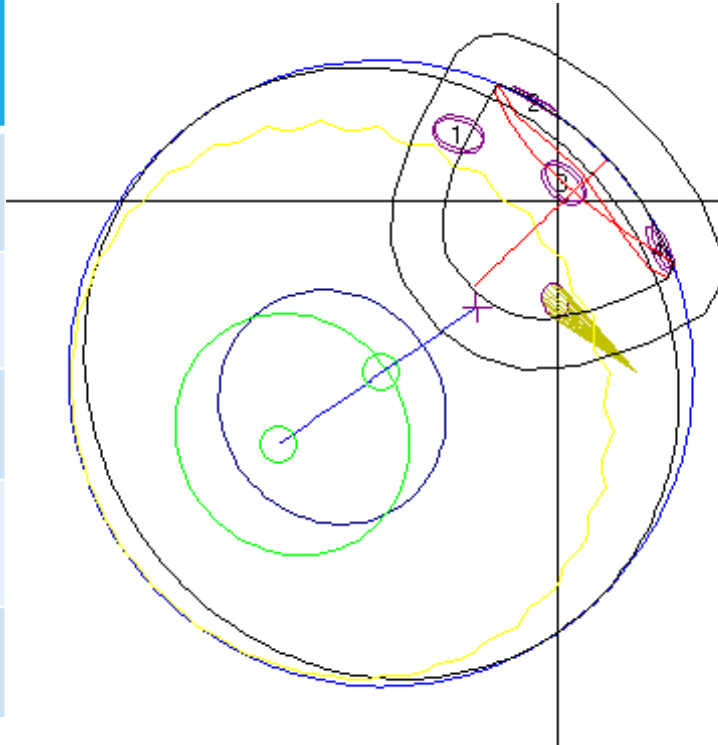
Optomap mismatch with RayOcular fundus view

Solution: consider the Optomap image as a surface image of the tumor, not a 3D projected volume

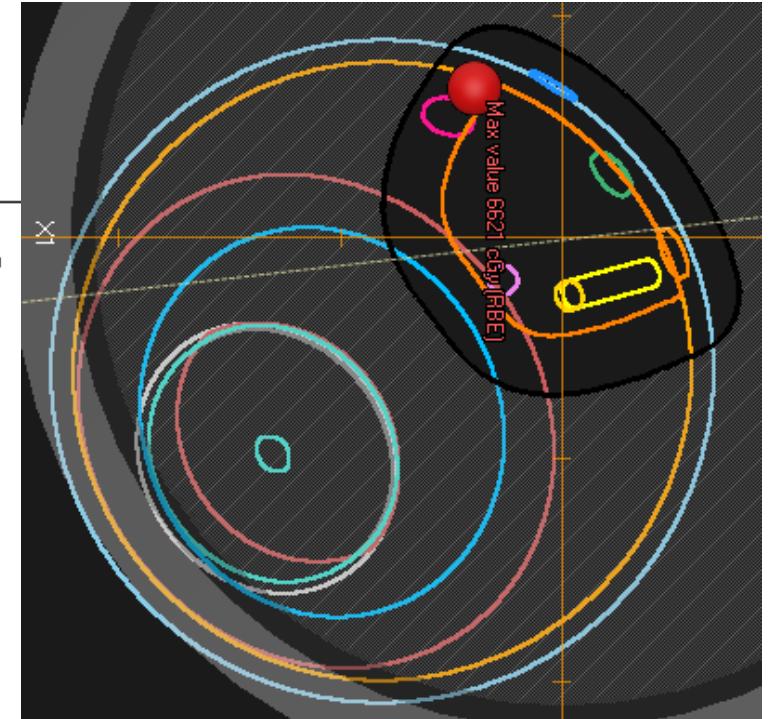
# Uveal melanoma : Plan design and set up

	Planning conditions
Polar gaze angle (deg)	28
Azimuthal gaze angle (deg)	217
Skin plane (mm)	8
XY aperture margins (mm)	2,5
Distal margin (mm)	2,5

EyePlan beam eye view



RayOcular beam eye view

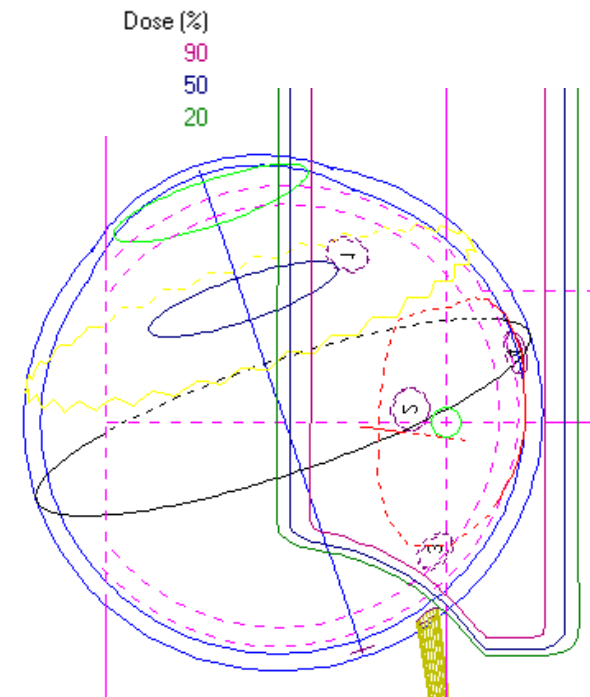


Different method to find the optimal gaze angles  
No nerve angulation linked to the eye fixation move

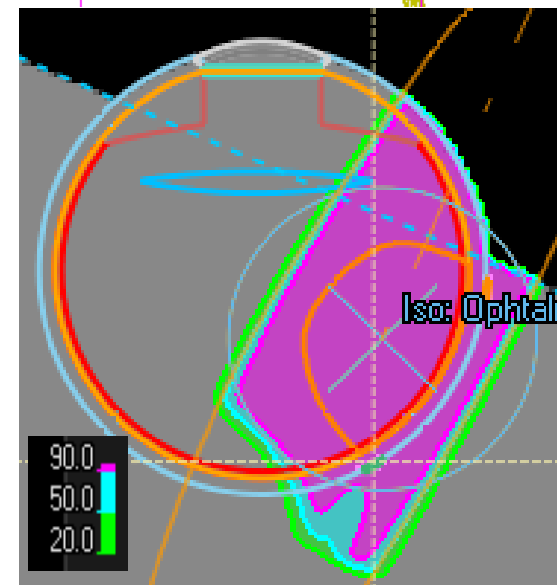


# Uveal melanoma : Dosimetric plan evaluation

Isodoses (%)	Difference (isodoses %)		
	20	50	90
Retina	-1	-3	-1
Lens	-2	-1	-1
Ciliary body	3	1	-1
Optic disc	0	0	0
Macula	0	0	0
Length of nerve (mm)	<i>No data</i>		
Tumor	0	0	0
Cornea	0	0	0



➔ EyePlan :  
SOBP range : 21,2 mm  
SOBP width : 21,2 mm



➔ RayOcular :  
SOBP range : 21 mm  
SOBP width : 21 mm

# Wedges and bolus

➔ Case of a tumor defined nearer to the optic disc

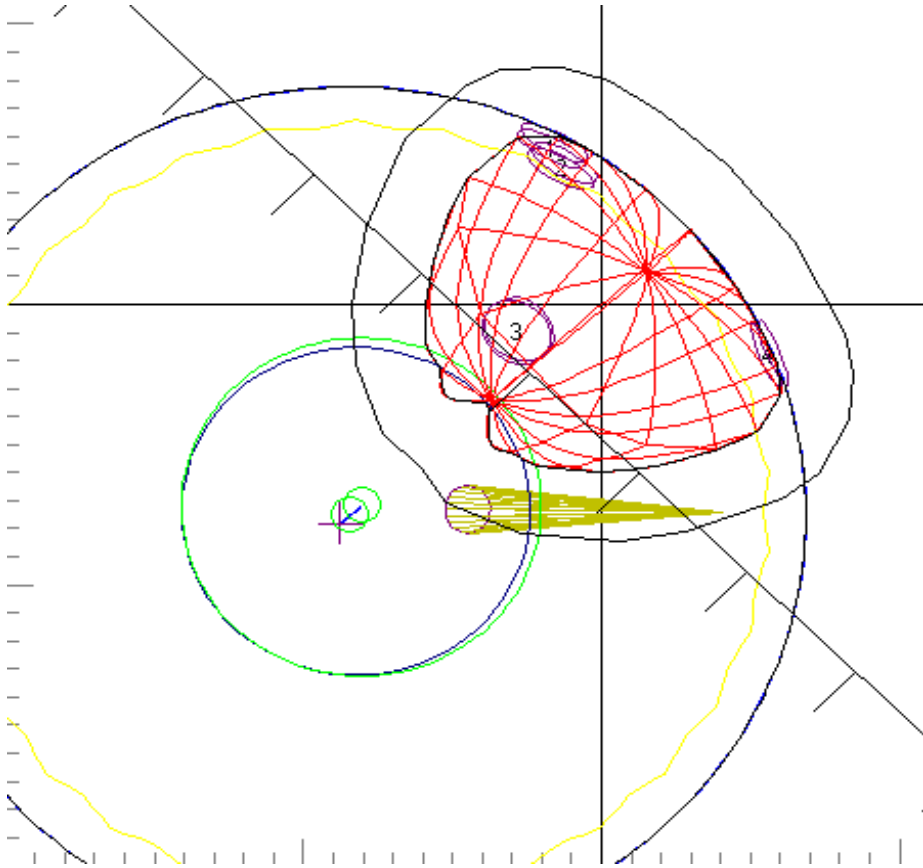
Planning conditions

Skin plane (mm)

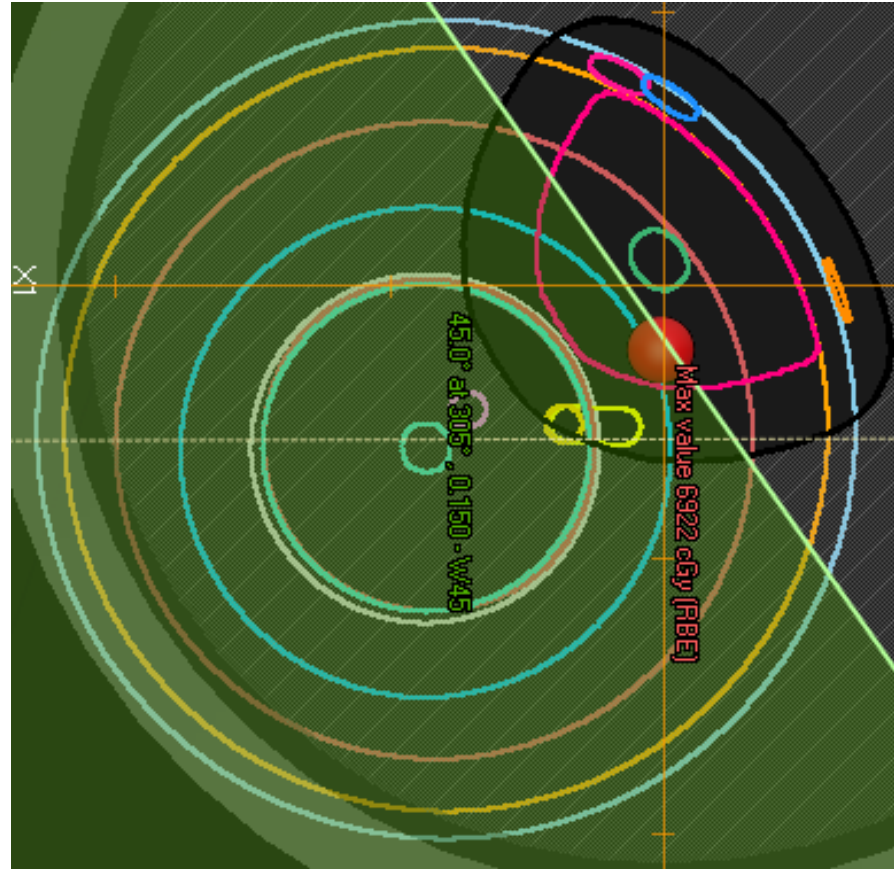
0 -> bolus

Wedge angulation

45°



EyePlan beam eye view + wedge

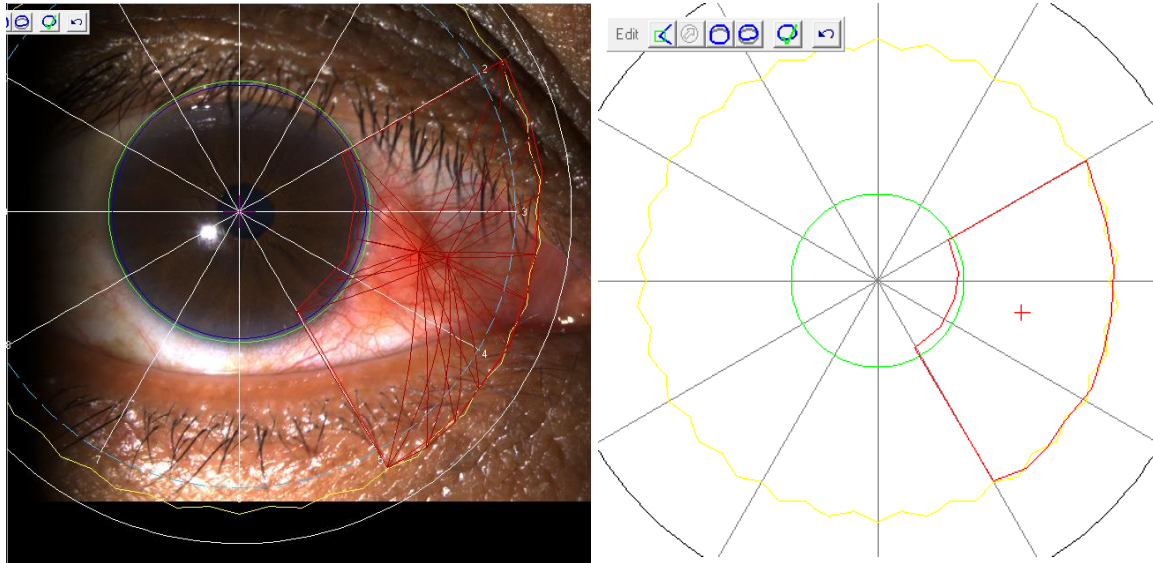


RayOcular beam eye view + wedge

# Anterior tumor: Tumor modeling

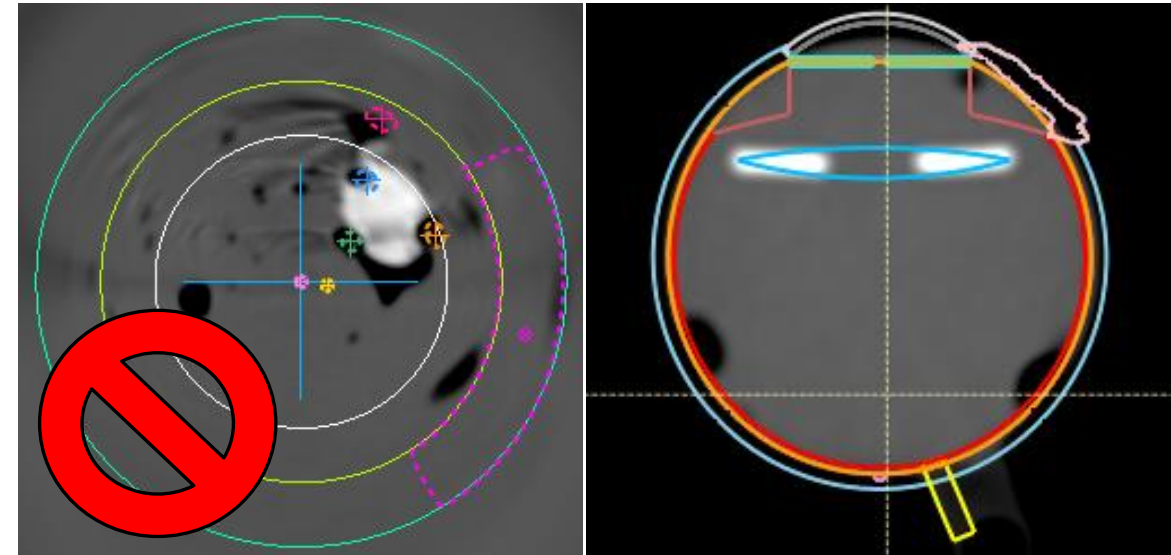
➔ Exemple of a conjunctival umor defined on « Structure definition » mode in coronal view

EyePlan



EyePlan anterior tumor mode

RayOcular



Tumor definition on fundus view

Tumor definition on « structure definition » mode



Solutions:

Choose between an anterior polar view, an iris plan view or a fundus view (depending on the type of tumor)

Work on photos or with a hour grid

**Anterior tumor:**

**Conjunctival tumor**

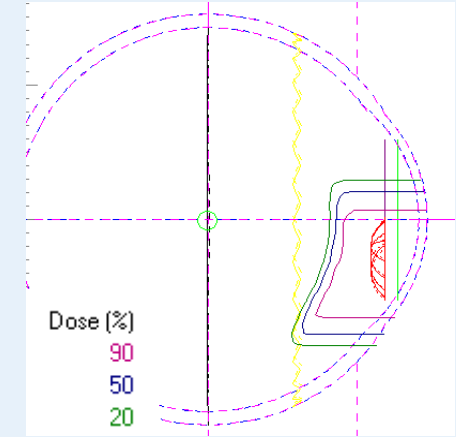
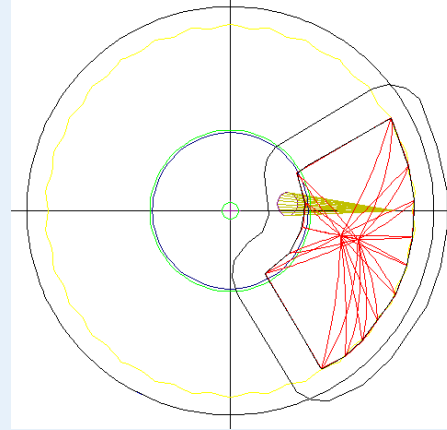
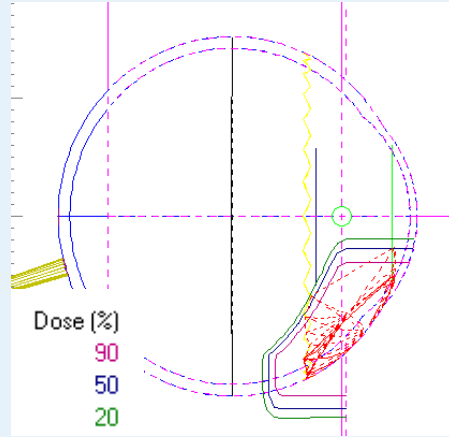
**Iris tumor**

Isodoses

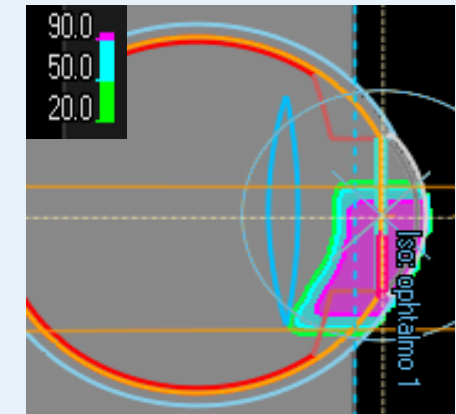
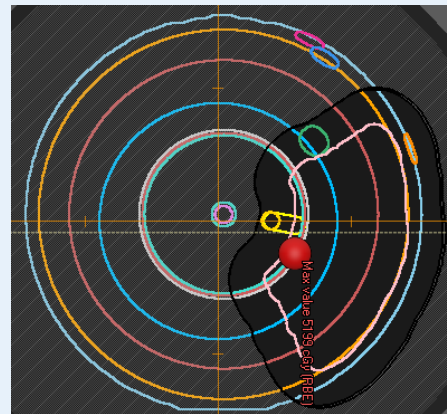
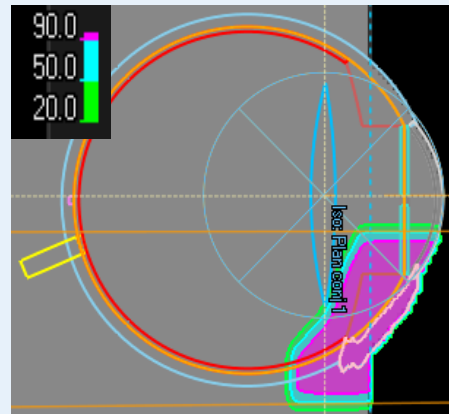
BEV

Isodoses

EyePlan



RayOcular



# Review of points to adapt to CAL work practices:

## Eye modeling :

- Improve the deformation eye ball tool
- Link the macula and optic disc to keep the macula-optic disc distance permanent

## Tumor modeling :

- Consider the Optomap image as a surface image of the tumor, not a 3D projected volume
- Choose between an anterior polar view, an iris plan view or a fundus view (depending on the type of tumor)
- Work on photos or with a hour grid

## Gaze angle search :

- Work directly on a 3D model to find easily the optimal gaze angle
- Display the right nerve angulation related to the eye fixation angulation

## Dosimetric parameters :

- Irradiated length of nerve (link to clinical goal)

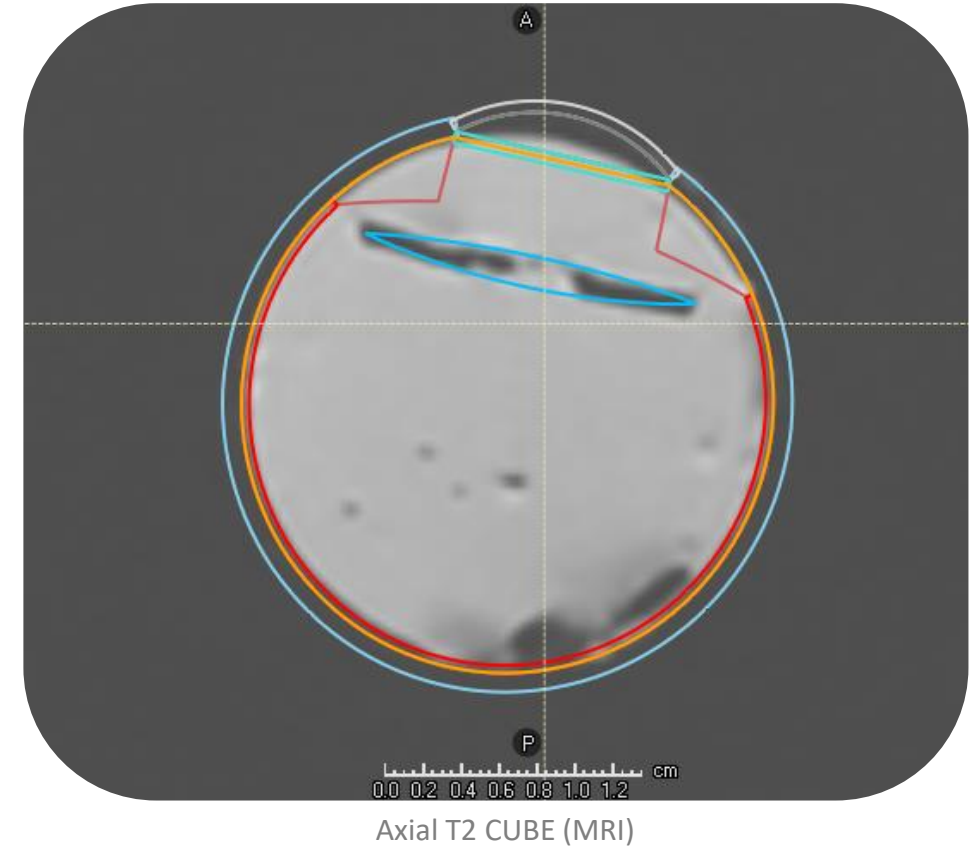
## RayPhysics:

- Work with our machine's characteristics : fixed beamline instead of gantry



# RayOcular improvement for the CAL workflow:

- Ergonomic interface
- DICOM compliance (export and summation of treatment plans)
- Success use of MRI and CT data (high personalized eye model, taking clips density into account)
- Multi-beam management
- Dose calculation algorithm
- HDV and isodoses display



Thank you for your  
attention

