



# The benefit of lens PRV in VMAT for glioblastoma

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## INTRODUCTION

**GBM** is the most common primary malignant brain tumor in adults. In radiotherapy of GBM the prescribed dose is 60 Gy which making it difficult to spare organs at risk [1]. Volumetric modulated arc therapy (VMAT) is an advanced radiotherapy technique that offers high conformity of the dose which makes it highly sensitive to patient setup error [2]. Human lens is one of the most sensitive tissue to radiation that has maximum tolerance limit 7 Gy and their high mobility can lead to deviation between the planned and delivered dose [3].

## AIM

This study aims to prove the benefit of using lens planning risk volumes (PRV), and its effect on target evaluation parameters [homogeneity index (HI), conformity index (CI) and paddic conformity index (PCI)] in glioblastoma.

## MATERIALS

Ten GBM cases with 60 Gy prescribed dose were planned for treatment with 2 VMAT dual arcs using 6 MV photons with HD 120 MLC. The plans were calculated using Eclipse treatment planning system with Anisotropic Analytical Algorithm (AAA) photon dose calculation algorithms.

For evaluation, DVH statistics used to get lens maximum dose and target HI, CI and PCI which calculated by the following relationships:

$$HI = D2 / D98 \quad (1) \quad CI = \frac{PTV \cdot PD}{PIV} \quad (2)$$

$$PCI = \frac{PTV \cdot PD}{PTV} \times \frac{PTV \cdot PD}{PIV} \quad (3)$$

Where PTV (PD) refers to the PTV coverage at the prescription dose and PIV represents prescription isodose surface volume.

## METHOD

### PLANNING AND UNCERTAINTY

#### Basic plans

- Eye lens constrain set directly to eye lens in the optimization process (L plan), Figure (1).
- Eye lens constrain set to lens PRV in optimization process (LPRV plan).

#### Shifted plans

- To simulate a lens position uncertainty we applying an isocenter shift of 3mm toward the lens (L plan - LPRV plan).
- Calculating the plans without re-optimization.

### COMPARISON

- Basic plans (L plan and LPRV plan) comparison for eye lens maximum dose was performed to evaluate PRV benefit without setup error.
- Shifted plans comparison for eye lens maximum dose was performed to evaluate PRV benefit in setup error (lens position uncertainty).
- Basic plans comparison for target evaluation parameters to estimate the effect for using lens PRV.

## RESULTS

The study revealed that the maximum dose to both of eye lens decreased by using lens PRV in optimization process instead of the lens only, **chart (1)**.

For uncertainty effect the lens maximum dose in (L shifted plan) increased higher than tolerance limit 7 Gy in about 60% of the patients, while for (LPRV shifted plan) the maximum dose exceeds tolerance limit in only 5% of the patients, **chart (1)**.

On the other hand the measurements show there is no noticeable effect on target evaluation parameters between (L and LPRV plans) for HI, CI, and PCI **table (1)**.

Organ	Plan	Volume [cc]	Points	Resolution [mm]	Priority
BODY	L plan	5918	49563	4.50	120
Brain Stem	L plan	40	2000	2.82	120
BRAINSTEM PRV	L plan	67	2233	3.00	90
CHIASM	L plan	2	1385	1.00	80
CTV	L plan	315	19494	3.00	120
Li Cochlea	L plan	0	335	1.00	1.00
LT Eye, NOS	L plan	6	2000	1.42	1.00
LT LENS	L plan	0	137	1.00	80
LT LENS PRV	L plan	1	775	1.00	80
LT Optic Nerve	L plan	0	407	1.00	50
PTV	L plan	502	18733	3.00	120
Rt Cochlea	L plan	0	254	1.00	1.00
RT EYE	L plan	6	2000	1.40	1.00
RT LENS	L plan	0	133	1.00	50
RT LENS PRV	L plan	1	751	1.00	50
RT OPTIC NERVE	L plan	1	706	1.00	50

Figure 1. Constrains set to lens PRV instead of lens in optimization process.

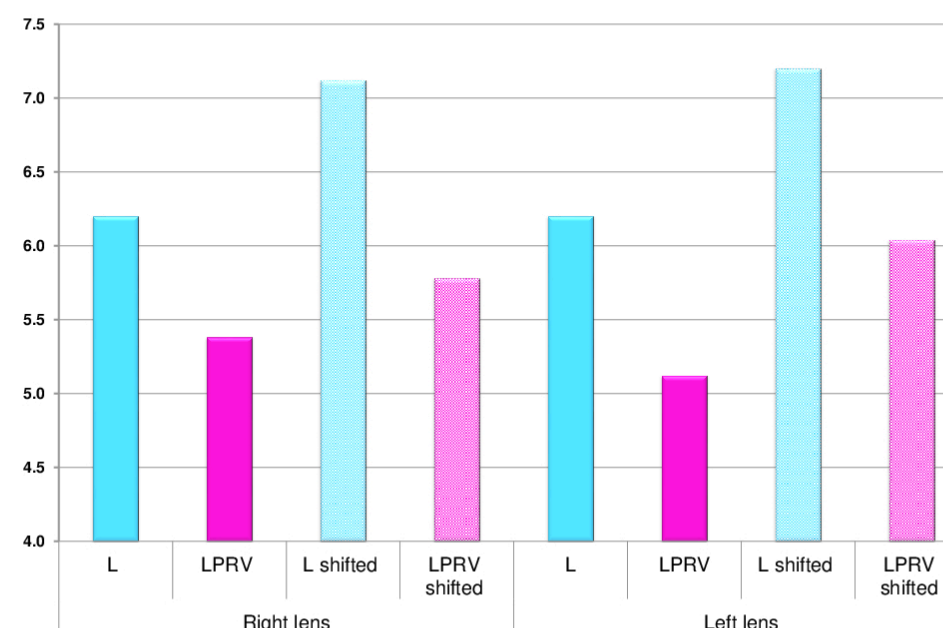


Chart 1. Comparison between the average of lens maximum doses in all plans.

Table 1. Comparison of HI, CI, and PCI for (L and LPRV) plans in all cases:

Index	Plan	Average	Minimum	Maximum
HI	L plan	1.014	1.002	1.034
	LPRV plan	1.014	1.002	1.034
CI	L plan	0.988	0.981	0.992
	LPRV plan	0.987	0.978	0.995
PCI	L plan	0.788	0.714	0.884
	LPRV plan	0.778	0.703	0.878

## CONCLUSIONS

VMAT is an advanced technology has greatly conformal nature for dose distributions that make it highly sensitive to the patient uncertainty.

The present study analysis of using lens PRV structure in planning process shows that not only reducing in lens maximum dose but also still save in position uncertainty till 3mm which add another benefit for using lens PRV in GBM patients.

Furthermore, there is no effect on target evaluation parameters (HI, CI, and PCI) for using the lens PRV instead of the lens.

## REFERENCES

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