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JOINT AAPM | COMP MEETING

Manual normal tissue objectives (mNTO) for brain metastases using non-coplanar VMAT and HyperArc techniques

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ABSTRACT

Purpose: HyperArc generally provides steeper dose gradients for multiple brain metsastases (mets). For a single brain met, utilizing a two-orthogonal arc VMAT technique with optimal mNTO is an alternative to HyperArc. The purpose of this study was to determine the best mNTO values based on the dose distribution for Brain mets SRS.

Methods: HyperArc in Eclipse remains the preferred solution for multiple brain mets due to its superior automation and steeper gradients. However, if HyperArc is unavailable, or only single brain Lesion, utilizing a two orthogonal arc VMAT technique with optimal mNTO is a clinical alternative to HyperArc. Our previous ways to reduce intermediate dose for two orthogonal arc VMAT was using three rings around the gross target volume. In order to match our previous practice on Brain mets SRS with three rings. We optimized mNTO instead of three rings to get the same dose distribution.

Results: 10 patients with brain metastases with different lesion volumes, receiving 15Gy-22Gy prescriptions were re-planned with HyperArc, two orthogonal arc VMAT with three rings, and two orthogonal arc VMAT with mNTO without rings. Two orthogonal arc VMAT with three rings, mNTO without rings, vs. HyperArc for single-Lesion SRS were planned and compared for isodose distribution, gradient index, planning speed, treatment time. mNTO with varying priority, distance from target border, start dose, end dose, and dose fall-off values were tested and optimal mNTO was determined.

Conclusion: mNTO with a priority of 100, a fall-off of 0.5 mm^{-1}, distance from target border: -0.5mm to 0mm; start dose: 100%; and end dose: 20% – 30; is the most effective alternative for achieving radiosurgical quality dose fall-off in standard VMAT.

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INTRODUCTION

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Background: HyperArc in Eclipse remains the preferred solution for multiple brain mets due to its superior automation and steeper gradients. However, if HyperArc is unavailable, or only single brain Lesion, utilizing a two orthogonal arc VMAT technique with optimal mNTO is a clinical alternative to HyperArc. Our previous ways to reduce intermediate dose for two orthogonal arc VMAT was using three rings around the gross target volume. In order to match our previous practice on Brain mets SRS with three rings. We optimized mNTO to get the same dose distribution.

METHODS AND MATERIALS

Methods: 10 patients with brain metastases with different lesion volumes, receiving 15Gy-22Gy prescriptions were re-planned with HyperArc, two orthogonal arc VMAT with three rings, and two orthogonal arc VMAT with mNTO without rings. mNTO with varying priority, distance from target border, start dose, end dose, and dose fall-off values were tested and optimal mNTO was determined.

RESULTS

Result: Two orthogonal arc VMAT with three rings, mNTO without rings, vs. HyperArc for single-Lesion SRS were planned and compared for isodose distribution, gradient index, planning speed, treatment time. mNTO allows the planner to strictly define the intermediate dose region. For two orthogonal arc VMAT plans, which have less geometric diversity than 4–5 arc plans, 0.5 mm^{-1} fall-off setting is critical for reducing the Gradient Index (GI) and is the most effective way to minimize V12Gy in healthy brain. Distance from target border of -0.5mm solves the issue for irregular small tumor shape; for regular tumor shape, distance from target border of 0 mm can be used.

DISCUSSION

Discussion: Using Manual Normal Tissue Objectives in the Eclipse Treatment Planning System for single-isocenter, two-arc Volumetric Modulated Arc Therapy (VMAT) for brain metastases is to minimize healthy brain tissue exposure (V12Gy) and maximize dose fall-off gradients without compromising target coverage. Highly similar dosimetric results can be achieved with mNTO in a standard VMAT plan by using specific high-priority and steep-fall-off settings. To mimic HyperArc's rapid dose fall-off and high conformity for a single brain metastasis, we can use the following Manual NTO configuration as shown in Figure 1. The Dose distributions are almost identical in comparison with three rings (left) and with mNTO (right) as shown in Figure 2.

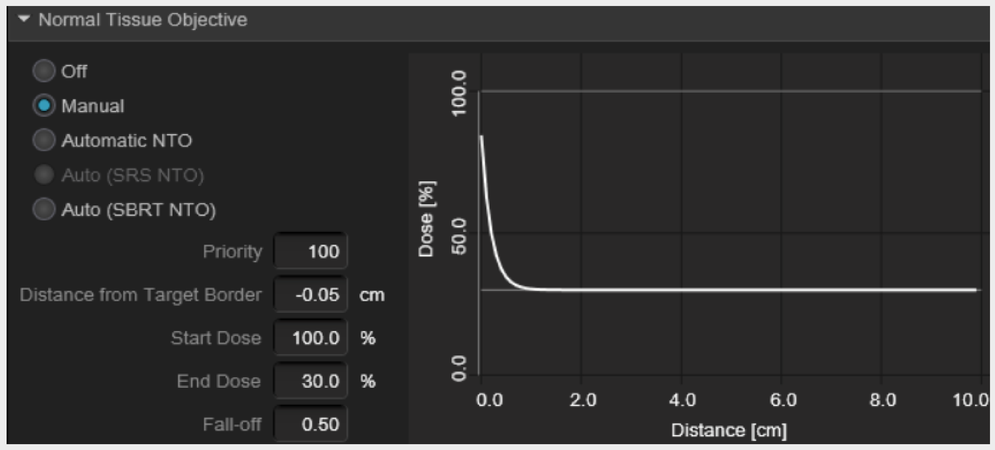

Figure 1. Manual Normal Tissue Objectives in the Eclipse Treatment Planning System .

CONCLUSIONS

Conclusion: mNTO with a priority of 100, a fall-off of 0.5 mm^{-1}, distance from target border: -0.5mm to 0mm; start dose: 100%; and end dose: 20% – 30; is the most effective alternative for achieving radiosurgical quality dose fall-off in standard VMAT.

REFERENCES

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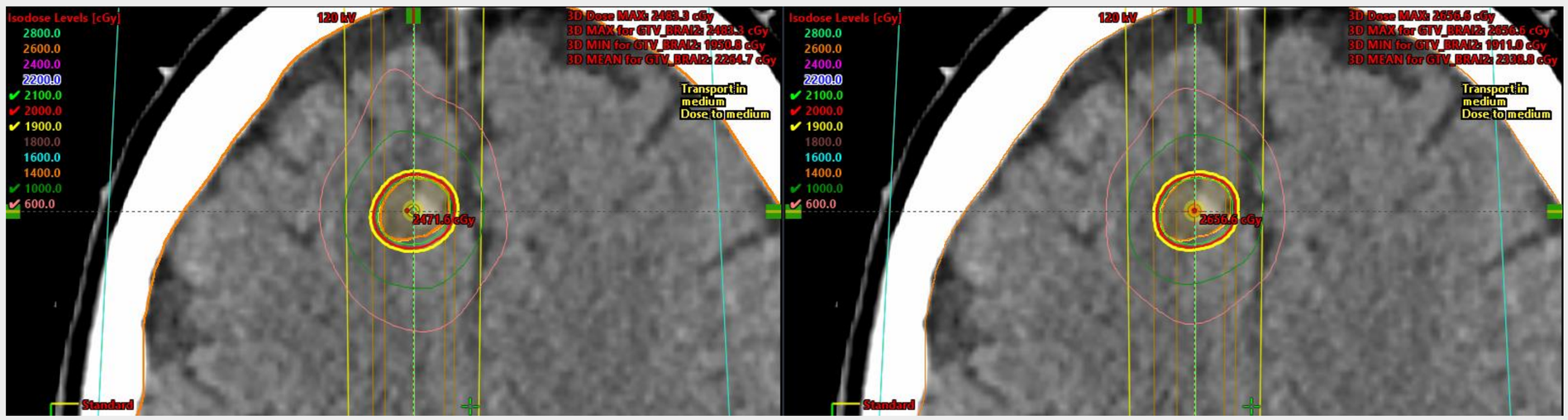

Figure 2. The Dose distribution comparison with three rings (left) and with mNTO (right)