Improved planning efficiency in multiple brain lesion SRS VMAT cases using Eclipse scripting

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PURPOSE

To determine if scripting could improve treatment planning efficiency for multiple brain lesion stereotactic radiosurgery (SRS) volumetric arc therapy (VMAT) cases by reducing planning time commitment.

INTRODUCTION

With increased complexities, medical dosimetrists have been required to adapt and improve treatment planning efficiency on a multitude of levels.

Eclipse scripting offers planning automation with the flexibility of direct editing at the hands of individual departments, offering an opportunity to effectively improve planning efficiency.

Highly complex plans, like multiple brain lesion SRS VMAT cases, can improve dose delivery and clinical outcomes; the problem, however, is that these cases require an extensive time commitment to create optimization structures (OSs) and add multiple objectives to the optimizer, leading to decreased treatment planning efficiency.

Researchers tested the hypotheses that using Eclipse Scripting Application Programming Interface (ESAPI) will improve treatment planning efficiency for multiple brain lesion SRS cases while preserving plan quality by reducing the total contouring time, reducing the optimizer preparation time, reducing the total number of optimizations, and reducing the overall planning time.

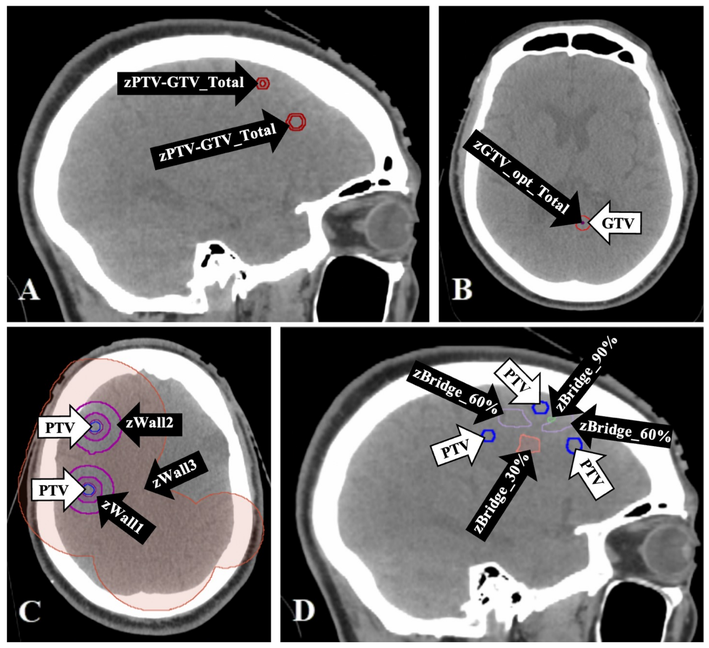
MATERIALS AND METHODS

This study was a retrospective analysis of 3 anonymized cases: case 1 had 5 brain lesions, case 2 had 9 brain lesions, and case 3 had 13 brain lesions.

The SRS script used in this study was developed by a certified medical dosimetrist primarily for multiple brain lesion SRS cases.

The SRS script performed 4 primary functions:

1) Created 4 OSs
2) Imported suggested objectives for these OSs into the plan's optimizer based on the prescription dose
3) Imported all prescription metrics to the plan's optimizer
4) Assigned normal tissue objective (NTO) parameters



Structure	Objective	Dose (%)	Volume (%)	"a" parameter	Priority
PTVs	Lower	100	100	NA	120
		105	99	NA	120
	Upper	140	0	NA	50
zPTV-GTV_Total	Lower	100	99	NA	100
	Upper	117.5	0	NA	90
zGTV_opt	Lower	135	100	NA	100
zWall3	Upper gEUD	25	NA	20	50
zWall2		55	NA	40	50
zWall1		85	NA	30	50
zBridge_30%	Upper gEUD	25	NA	25	50
zBridge_60%		55	NA	40	50
zBridge_90%		85	NA	35	50

Abbreviations: PTV, planning target volume; NA, not applicable; gEUD, generalized equivalent uniform dose

MATERIALS AND METHODS (Continued)

All cases were completed by a total of 9 treatment planners with experience in multiple brain lesion SRS treatment planning. Each participant completed 2 plans per case, 6 plans in total, for a total of 27 plan comparisons with and without the SRS script.

Total contouring time, optimizer preparation time, total number of optimizations, and total planning time were compared for the 27 plan comparisons.

Total Contouring Time

Defined as the time each planner spent contouring both in the external beam planning workspace and the contouring workspace

Optimizer Preparation Time

Defined as the time measured from when the planner opened the optimizer for the first time and ended to when the planner clicked *Start VMAT Optimization*

Total Number of Optimizations

Defined as the amount of completed optimizations needed to complete the plan

Overall Planning Time

Defined as the time measured from when the planner started working on the plan, either by copying the original plan, going into the contouring workspace, or opening the SRS script, to when the planner copied the plan and labeled it *FINAL*

Clinical Acceptability/Plan Quality

Defined as whether or not the plan met the participating institution's prescription dose metrics for both targets and organs at risk (OAR)

RESULTS

Total Contouring Time

The mean total contouring time without the SRS script was 11.3 minutes while the mean total contouring time with the SRS script was reduced to 2.8 minutes (a 75.1% reduction). The paired T-test showed statistically significant differences ($P < 0.001$).

Optimizer Preparation Time

The mean optimizer preparation time without the SRS script was 7.7 minutes while the mean optimizer preparation time with the SRS script was reduced to 2.1 minutes (a 72.3% reduction). The WSR test showed statistically significant differences ($P < 0.001$).

Total Number of Optimizations

The mean total number of optimizations without the SRS script was 3.1 while the mean total number of optimizations with the SRS script was reduced to 2.7 (a 13.3% reduction). The WSR test did not show statistically significant differences ($P = 1.333$).

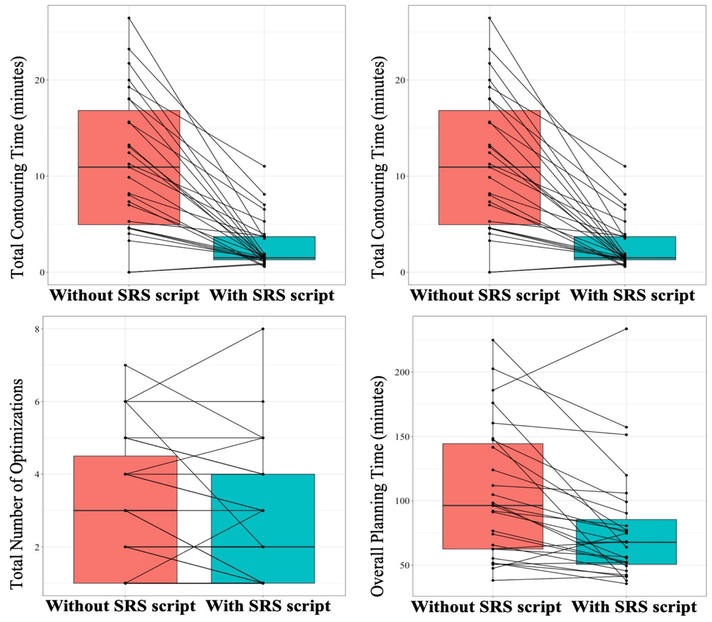
Overall Planning Time

The mean overall planning time without the SRS script was 105.1 minutes while the mean overall planning time with the SRS script was reduced to 77.9 minutes (a 25.9% reduction). The WSR test showed statistically significant differences ($P < 0.001$).

RESULTS (Continued)

Clinical Acceptability/Plan Quality

The target and OAR dose metrics for all plans were within tolerance of the participating institution's prescription dose metrics.



Time metric	With the SRS script		Without the SRS script		Negative Ranks	Positive Ranks	Tied Ranks	Effect Size	P-Value Adjusted
	Mean	Med	Mean	Med					
Total contouring time	2.8	1.5	11.3	10.9	2	25	0	1.67	< 0.001
Optimizer preparation time	2.1	1.7	7.7	6.9	0	27	0	2.29	< 0.001
Total number of optimizations	2.7	2	3.1	3	1	1	25	0.23	0.133
Overall planning time	78	67.8	105.1	96.4	3	24	0	0.60	< 0.001

Abbreviations: Med, median; SRS, stereotactic radiosurgery.

CONCLUSION

There was a substantial improvement in planning efficiency using Eclipse scripting for OS contouring and optimizer preparation as well as overall planning time.

The results imply that planners reduce their planning time commitment when using the SRS script for contouring optimization structures.

The use of the SRS script did not compromise plan quality and clinical acceptability.

Inconsistent results for total number of optimizations may be a result of planner preference in optimization strategies.

Limitations included the involvement of a single institution only, the limited sample size of patients and treatment planners, and the design of the SRS script for multiple lesion SRS cases only.

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