

Treatment planning of stereotactic radiosurgery for single brain metastases: impact of leaf width.

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Purpose/objective: Stereotactic radiosurgery of brain metastases requires highly conformal dose distributions. Besides beams setup, characteristics of the linear accelerator collimator may also play a role. In this study we compared the impact of leaf width on the dose outside the target for stereotactic radiosurgery of single brain metastases.

Materials / Methods: For 10 patients with one lesion, treatment plans were generated using two MLC types: Elekta Agility with 0.5cm leaf width and Elekta MLCi2 with 1cm leaf width. Two VMAT arcs were used, one coplanar arc and one non-coplanar arc (couch 90°). Five patients had a PTV volume $\leq 4 \text{ cm}^3$ with a prescription dose of 24Gy in 1 fraction, and 5 patients had a PTV volume between 4 and 14 cm^3 with a prescription dose of 18Gy in 1 fraction. All plans were required to fulfill clinical requirements: $V100\%D_{pres} > 95\%V_{PTV}$, $D0 < 150\%D_{pres}$ and OAR doses as low as possible and never above clinical constraints. The maximum dose in the PTV is kept the same per patient in both plans. The quality of the dose distribution outside the PTV was evaluated using the mean dose in two ring structures, adjacent to the PTV.

Results: The mean dose was evaluated in the first 2 rings of 5 mm around the PTV(table 1). The difference in mean dose for the small lesions($D_{pres}=24 \text{ Gy}$) of the first ring of 5 mm is 1.8 Gy in favor of the Agility and 0.9 Gy for the larger lesions($D_{pres}=18 \text{ Gy}$)also in favor of the Agility. The difference is smaller for the larger lesions (figure1). Also for the second ring of 5 mm, adjacent to the first ring, the difference is 1.1 Gy vs 0.8 Gy also in favor of the Agility.

	24Gy							18Gy					
	Ring5mm(Gy)			Ring10-5mm(Gy)				Ring5mm(Gy)			Ring10-5mm(Gy)		
Patient	MLCi1	Agility	Diff	MLCi1	Agility	Diff	Patient	MLCi1	Agility	Diff	MLCi1	Agility	Diff
1	12.2	10.0	2.2	5.6	4.6	1.0	6	12.4	10.9	1.5	5.5	4.7	0.8
2	12.9	10.9	2.0	6.3	5.3	1.0	7	14.6	13.8	0.8	4.5	3.8	0.7
3	11.9	10.4	1.5	5.6	4.8	0.8	8	13.5	12.3	1.2	7.6	6.2	1.4
4	19.9	17.9	2.0	5.4	4.0	1.4	9	14.5	13.8	0.7	5.2	4.6	0.6
5	16.5	15.1	1.4	8.4	7.1	1.2	10	13.3	12.9	0.4	7.2	6.7	0.5
mean	14.2	12.9	1.8	6.2	5.2	1.1	mean	13.7	12.7	0.9	6.0	5.2	0.8
SD	3.5	3.5	0.3	1.2	1.2	0.2	SD	0.9	1.2	0.4	1.3	1.2	0.4

Tabel 1: Mean dose in the rings around the PTV at 5 mm and 10 mm for small lesions (PTV volume $< 4 \text{ cm}^3$) and the larger lesion (PTV volume between 4 and 14 cm^3)

Conclusion: For the small lesions with a volume smaller than 4 cm^3 the Agility shows a steeper gradient in the two surrounding rings than the MLCi1. Therefore we recommend the use of the Agility for treating the smaller lesions.

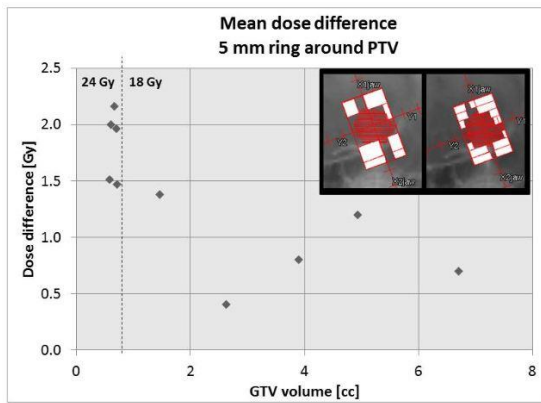


Figure 1: The mean dose difference in the first 5 mm ring around PTV. In the right upper corner the typical leaf setting for the Agility on the right and the MLCi1 on the left.