Comparative planning study (IMPT vs VMAT) on sparing OARs important for neurocognition in gliomas

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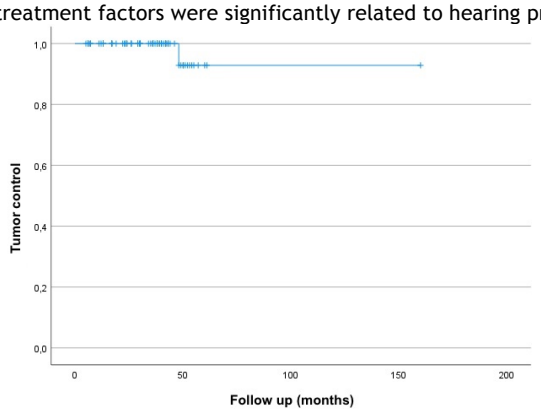
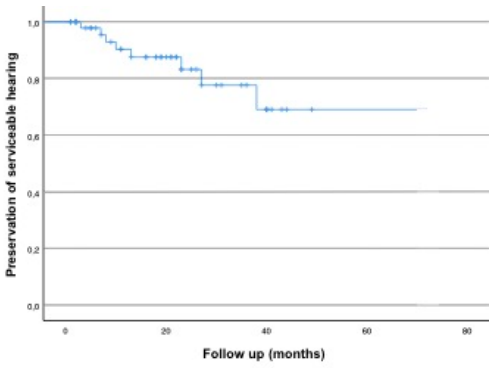
Materials and Methods
We retrospectively evaluated patients who underwent LINAC-based SRS for VS between 2015 to 2020. Patients were followed with clinical visits and MRI scans every 6 months for the first 3 years, then annually. Audiometry was performed before and after SRS treatment. Hearing preservation was analyzed in terms of maintenance of Gardner-Robertson grade and toxicity was reported according to the Common Terminology Criteria for Adverse Events (CTCAE)v4.0.

Results
78 patients with unilateral VS treated with SRS in our institution were included. Median tumor volume was 1,35cc (0,1-12,9 cc). Median radiation dose was 25Gy (12-30Gy). With a median follow up of 36 months, 3-year tumor control rate was 98,7%. 12 patients (15,38%) maintained serviceable hearing (Gardner- Robertson scale I-II) after SRS. Functional hearing preservation rate amounted to 90,2% 1 year after treatment and 69% after 3 years. Most frequent non- auditory complication was vertigo grade 1, presented in 16 patients (20,51%). There were no grade III-V complications (CTCAE). No clinical or SRS treatment factors were significantly related to hearing preservation and/or toxicity.





Conclusion
SRS can achieve high rates of long-term tumor control and acceptable hearing preservation with low rates of severe toxicity.

PO-1133 Comparative planning study (IMPT vs VMAT) on sparing OARs important for neurocognition in gliomas

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Purpose or Objective
Radiotherapy-induced neurocognitive decline affects 50-90% of adult glioma survivors. Several organs at risk (OARs) have been identified to play a role in neurocognitive functioning. Proton therapy is expected to outperform photon therapy in sparing many of these OARs from excess dose. In this study, we compared Volumetric Modulated Arc Therapy (VMAT) vs Intensity Modulated Proton Therapy (IMPT) for its OAR sparing capability in glioma patients.

Materials and Methods
In this in silico dosimetric comparison study, we included 10 glioma patients (grade II and III astrocytoma and oligodendroglioma) who were treated to a total dose of 54-60 GyRBE. Seven tumours were located in the left hemisphere, two in the right hemisphere and one in the brainstem. The OARs that could play a role in neurocognitive functioning (cerebellum anterior and posterior, ipsi- and contralateral thalamus, ipsi- and contralateral hippocampus, corpus callosum, supratentorial brain minus CTV, brain (minus CTV)) were delineated according to the EPTN atlas for contouring in neuro-oncology[1]. For each patient, both a VMAT (2 partial arcs) and robust IMPT (2-3 beams) treatment plan were optimized according to the same set of clinical dose constraints. Average and near-maximum (D2%) doses in 9 OARs were extracted from the planning system (Raystation and Eclipse). To evaluate the dose metrics of the IMPT plan, the nominal scenario

was used. To evaluate target coverage, D95% of the CTV was used in both treatment techniques. DVH metrics from both techniques were compared using a two-sided Wilcoxon rank-sum test with a p-value of <0,05 indicating significance.

Results

In total, 20 treatment plans were analysed (1 VMAT and 1 IMPT for each patient). A statistically significant reduction was established using IMPT in 6 out of 21 dose metrics in 3 out of 5 OARs important in neurocognitive functioning: Dmean supratentorial brain minus CTV (p<0,001), Dmean contralateral hippocampus (p=0,019), D40% contralateral hippocampus (p=0,001), Dmean brain (p=0,007), Dmean brain minus CTV (p< 0,001) and Dmean contralateral thalamus (p=0,002). The dose coverage (D95% CTV) was not statistically different between both groups (p=0,529).

Table 1: Dose metrics in GyRBE (OARs) and CTV coverage in IMPT and VMAT treatment plans

Organ at risk	Dose metric	VMAT	IMPT	P value
Brain	Dmean	24,7 (5,7)	17,5 (3,9)	0,007*
	$D_{2\%}$	56,9 (3,2)	57,6 (2,6)	0,279
Brain - CTV	Dmean	20,2 (4,4)	10,6 (2,7)	< 0,001*
	$D_{2\%}$	56,1 (3,1)	56,9 (2,6)	0,234
Supratentorial brain - CTV	Dmean	21,3 (4,8)	10,9 (2,9)	< 0,001*
Corpus Callosum	Dmean	36,7 (11,4)	28,5 (11,5)	0,089
	$D_{2\%}$	55,2 (5,3)	56,9 (3,4)	0,481
Hippocampus ipsilateral	Dmean	35,4 (18,9)	34,1 (21,4)	0,661
	$D_{40\%}$	39,2 (18,8)	37,0 (22,7)	1,000
Hippocampus contralateral	Dmean	18,6 (9,9)	4,8 (10,4)	0,019*
	$D_{40\%}$	21,5 (14,1)	4,4 (11,8)	0,001*
Thalamus ipsilateral	Dmean	49,6 (8,3)	42,8 (18,1)	0,912
	$D_{2\%}$	56,5 (3,3)	56,2 (4,8)	0,684
Thalamus contralateral	Dmean	36,5 (7,9)	16,6 (13,7)	0,002*
	$D_{2\%}$	48,5 (9,1)	40,1 (18,8)	0,529
Cerebellum anterior	Dmean	26,2 (14,3)	15,5 (15,7)	0,123
	$D_{2\%}$	40,0 (18,3)	34,7 (25,4)	1,000
Cerebellum posterior	Dmean	12,5 (9,1)	7,6 (9,1)	0,165
	$D_{2\%}$	32,2 (19,8)	29,1 (24,1)	0,739
Cerebellum	Dmean	14 (9,6)	7,2 (9,4)	0,075
	$D_{2\%}$	35, 5 (19,0)	34,8 (23,5)	1,000
CTV coverage				
CTV	$D_{95\%}$	55,8 (3,4)	56,3 (2,5)	0,529

*Doses are mean values over 10 patients for VMAT and IMPT per OAR, standard deviations between parentheses (SD). All doses are reported in GyRBE. Dmean: average dose to the organ at risk, D2%: dose to 2% of the volume. D40%: dose to 40% of the volume, D95%: dose to 95% of the volume. p-value < 0,05 was considered as statistically significant and is indicated with **

Conclusion

The use of IMPT resulted in important OAR sparing in this glioma patient population translating in a lower mean dose to the contralateral hippocampus, contralateral thalamus and supratentorial brain minus CTV, and a lower D40% to the contralateral hippocampus. To evaluate whether this translates into a clinical benefit for these patients, we will compare the ROCOCO Performance Scoring System scores[2] between both groups in a planned analysis.