≤1mm. The shorter treatment delivery was superior for three patterns, while the longer treatment was preferred in the case of temporal displacement of the prostate.

Conclusion: The treatment time for extreme hypofractionation of prostate cancer is reduced to less than half the time per fraction by combining FFF-technique with VMAT. The treatment plan quality was preserved for the FFF beams. Finally, a shorter beam-on time also seems advantageous for the majority of prostate motion patterns investigated.

PO-0856
Clinical and dosimetric issues of VMAT craniospinal irradiation for paediatric medulloblastoma

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Purpose or Objective: With increased 5 years survival of children with medulloblastoma, optimization of radiotherapy treatment to avoid iatrogenic sequelae has become a primary issue. Clinical and dosimetric characteristics of VMAT Craniospinal Irradiation (CSI) were studied and compared with the 3DCRT technique in use since 1997 at our institution with excellent clinical results. The impact of a setup error on dose distribution was also studied.

Material and Methods: CT images of 8 pts that received CSI at our institution (23.4 Gy in 13 fractions) were used for the dosimetric study. For each patient, a standard 3DCRT treatment and a VMAT were planned. PTV dosimetric objectives for treatment planning were: D95% >95%, D100% >90%, D5% <107%. The resulting DVHs were analyzed considering: conformity index (CI) and homogeneity index (HI) for PTV, mean dose (Dmean) and D2% for OARs (small bowel, kidneys, heart, liver, stomach, lenses, thyroid, lungs) and V2Gy of non target tissues as an integral dose index. The data were then compared using paired Student's t test. The dependence of dose indexes on patient size was evaluated. A 3 mm longitudinal error in patient setup was simulated for both techniques to evaluate dosimetric impact in the junction region.

Results: Dosimetric objectives were always met. All VMAT treatment plans had better HI and CI independently of patient size. Dmean and D2% of heart and thyroid were significantly lower with VMAT. On average, for heart Dmean was 9.8±3.4 Gy and 6.3±1.0 Gy, and D2% was 20.3±4.1Gy and 10.4±1.7 Gy, for 3DCRT and VMAT respectively, while for thyroid Dmean was 18.2±1.2 Gy and 13.8±1.8 Gy, and D2% was 20.4±1.2 Gy and 17.4±2.0 Gy, for 3DCRT and VMAT respectively. On the contrary, lung dose was higher with VMAT: on average Dmean was 1.8±0.9 Gy for 3DCRT and 3.5±0.8 Gy for VMAT. A 3 mm gap at field junction level resulted in an underdosage of about 20% for VMAT and 50% for 3DCRT, while a 3 mm overlap gave rise to a hotspot on the spine up to 30% for VMAT and 70% for 3DCRT. V2Gy was about 3 times higher for VMAT.

Conclusion: VMAT allowed to achieve a more conformal and homogeneous dose distribution, with greater sparing of most OARs. Considering the risk of iatrogenic cardiopathy, hypothyroidism or secondary tumors to the thyroid, the dose reduction obtained with VMAT was significant. The clinical effect of the increased lung dose is not yet predictable, since absolute dose values were extremely low. VMAT implies a higher MU value for the delivery of the prescribed dose, possibly increasing the risk of secondary tumors. This is an important factor when dealing with pediatric pts. In VMAT, overdosage areas are greatly reduced with respect to 3DCRT, particularly in the junction region. The analysis of simulated gaps and overlaps shows that field junctions are less critical for VMAT, nevertheless junction moving is still mandatory to avoid potentially dangerous hot or cold spots. Partially supported by Associazione Italiana per la Ricerca sul Cancro (AIRC)

PO-0857
GTV-based prescription and Monte Carlo treatment planning in Cyberknife treatments for lung lesions

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Purpose or Objective: GTV-based prescription has been proposed as a possible recipe for Monte Carlo treatment planning in Cyberknife SBRT treatments for lung lesions (Lacornerie et al., 2014, [1]). The feasibility of this approach was investigated comparing Ray-Tracing algorithm (Effective Path Length method, EPL) and Monte Carlo (MC) dose calculation.

Material and Methods: A group of 40 consecutive patients from July to October 2015, treated with Cyberknife SBRT using an advanced target tracking system (Lung Optimized Treatment, LOT) was considered. Primary lung cancers and metastatic pulmonary lesions, different tumor size (small: V<14cc, large: V>65cc) and locations (totally air-surrounded, partially air-surrounded), prescription dose and fractionation schemes were included in the group. Treatment plans were optimized using RT algorithm (RT plans), with prescription isodose line of 80% providing 95% PTV coverage (PTV = GTV + 5mm), and re-calculated with MC algorithm (1x1x1 mm3 dose grid, uncertainty=1%), using the same beam angles and monitor units (MCrecalc plans). Dose parameters for RT and MCrecalc plans were evaluated for both GTV, PTV and OARs, in relation to tumor size and position. On a subset of 5 patients, MCrecalc plans were normalized to the isodose line encompassing the 95% of the GTV volume (MCnorm plans) and compared to MC-optimized plans, with dose prescribed to the same isodose line (MCopt plans).

Results: Difference between RT and MCrecalc plans in average percentage volume covered by the prescribed dose for GTV and PTV is 13.5% (RT: 99.6%, MC: 86.1%) and 41.8% (RT: 96.8%, MC: 55.0%) respectively. Dose parameters referred to GTV (Dmean, D50, D98, D2) have a lower variation compared with PTV parameters: excluding D2, D50 shows the lowest variability for the analyzed group. Concerning OARs, difference in V20, V10, V5 for lungs (ipsilateral and contralateral) is 0.6%, 1.4% and 3.4%, respectively.

Table 1

Average difference RT - MC$_{recalc}$				
GTV	V$_{DosePrescCovered}$	D$_{mean}$	D$_{50}$	D$_{98}$	D$_2$
all	13.5%	8.2%	7.9%	13.9%	5.1%
small	15.6%	9.8%	9.3%	17.4%	5.7%
medium	8.6%	5.3%	5.4%	6.9%	4.3%
large	11.8%	4.2%	3.9%	6.6%	2.2%
air-surrounded					
totally	14.2%	3.2%	3.0%	7.5%	0.8%
partially	12.8%	9.6%	9.3%	15.4%	6.5%
PTV	V$_{DosePrescCovered}$	D$_{mean}$	D$_{50}$	D$_{98}$	D$_2$
all	41.8%	12.9%	12.5%	24.6%	5.3%
small	50.8%	16.1%	15.9%	30.3%	6.1%
medium	26.4%	7.2%	6.6%	14.3%	4.2%
large	14.9%	4.0%	3.3%	10.2%	1.7%
air-surrounded					
totally	39.1%	6.6%	6.0%	18.2%	0.9%
partially	41.4%	14.4%	14.0%	26.1%	6.7%
Lungs	V$_{20}$	V$_{10}$	V$_5$		
average	0.6%	1.4%	3.4%		
max	1.5%	7.2%	22.7%		

Average difference RT,MC$_{recalc}$,MC$_{norm}$,MC$_{opt}$					
MC$_{recalc}$-RT		MC$_{norm}$-RT		MC$_{opt}$-RT	
D$_{50}$	D$_{mean}$	D$_{50}$	D$_{mean}$	D$_{50}$	D$_{mean}$
-12.8%	-13.7%	0.4%	-0.5%	9.3%	8.3%

MCnorm and MCopt have a value of GTV D50 and Dmean comparable to the RT plan and higher than the MCrecalc plan. At the same time, MCnorm plans could not always be accepted referring to OARs dose constraints respect and target dose conformity (see Fig.1). Results are reported in Table 1.
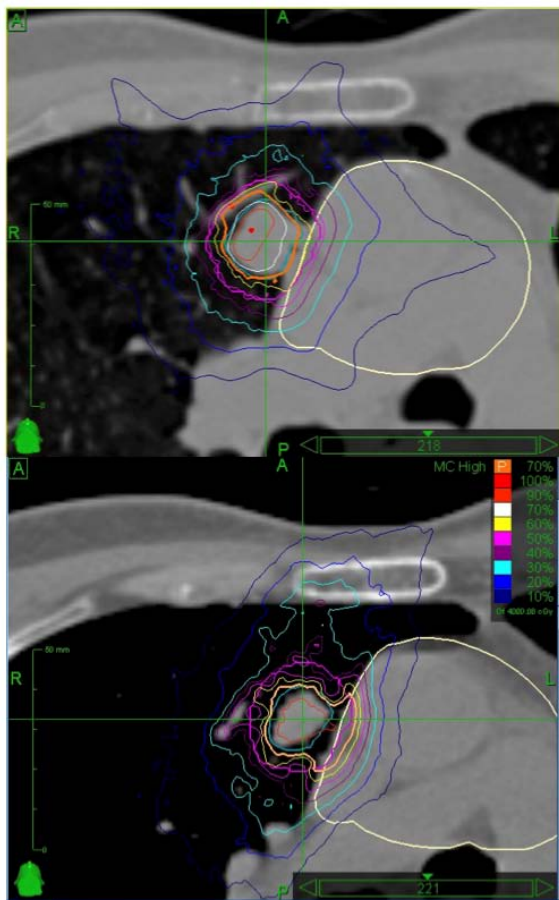

Figure 1. MC$_{opt}$ (up) and MC$_{norm}$ (down) plans for a lung lesion near the heart. GTV and PTV are contoured as a green and purple lines, respectively. Although volume coverage is obtained, dose constraint on the heart (D$_{1cc}$< 22Gy) is not respected in MC$_{norm}$plan.

Conclusion: Lower variation of GTV dose parameters compared with PTV, when both RT and MCrecalc treatment plans are evaluated, suggests that GTV should be used for dose normalization and reporting instead of PTV. According to van der Voort van Zyp et al. (2010, [2]), a different prescription dose could be adopted, depending on lesion size and location. Moreover, MCopt plans need to be implemented, adopting a different prescription dose based on GTV D50 and Dmean values [1], as MCnorm plans could not guarantee appropriate target coverage and OARs sparing. Further multivariate analysis is mandatory to determine if there are correlations between the variables (size and location of the lesions, type of tracking adopted) considered for plan comparisons.

PO-0858
Development of dysphagia optimised IMRT for head and neck cancer treatment in the DARS trial
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Purpose or Objective: To develop a dysphagia optimised IMRT (Do-IMRT) technique comparing fixed-field IMRT with VMAT for treatment of head and neck cancer in the DARS clinical trial (CRUK/14/014), which is a phase III randomised multicentre study of Do-IMRT versus standard IMRT (S-IMRT).

Material and Methods: Six oropharynx cases were outlined and planned according to the DARS trial QA guidelines. CTVs were outlined using a volumetric approach with a 10mm GTV-CTV expansion. Pharyngeal constrictor muscles (PCM) were also delineated. The dose levels prescribed were 65 Gy to the primary site and involved nodes and 54 Gy to the elective volume in 30 fractions. Plans were produced according to both arms of the trial using both fixed-field IMRT and VMAT (RapidArc) with an Eclipse treatment planning system (version 11). In the experimental Do-IMRT arm, the aim was to achieve a mean dose of less than 50 Gy to the superior and middle PCMs, excluding the CTV receiving 65 Gy (PlanSMPCM), and less than 20 Gy to the similarly edited inferior PCM (PlanIPCM). These constraints were prioritised over coverage of the PTV receiving 54 Gy (PTV_5400) but not the PTV receiving 65 Gy (PTV_6500). In the S-IMRT arm no attempt was made to reduce PCM doses. Plans were assessed for their clinical acceptability and DVH statistics compared.

Results: Using fixed-field IMRT for Do-IMRT, it was not possible to achieve clinically acceptable plans in terms of both PTV_5400 95% isodose coverage and homogeneity whilst achieving the PCM constraints. However, using VMAT for Do-IMRT a PlanSMPCM mean dose of less than 50 Gy was achieved in all cases, reduced by 8 Gy on average compared to S-IMRT. PlanIPCM mean doses of less than 20 Gy were achieved in the majority of cases, reduced by 30 Gy on average compared to S-IMRT. Do-IMRT plans had decreased but acceptable dose homogeneity and 95% isodose coverage was maintained, only compromising in the region where PCMs and PTV_5400 overlap (as shown in the example in figure 1). Other OAR (spinal cord, brainstem and parotids) doses were increased for Do-IMRT but critical OAR constraints were still achieved in all cases. The results are summarised in table 1.

Figure 1: Dose distribution (colour wash displays 95-107% of 54 Gy) of transverse slice showing PTV_5400 (blue) coverage using S-IMRT (left) compared to Do-IMRT (right), where