The remaining dosimetric parameters were affected only up to 1% by other planning factors except for increasing the margin between PTV and multi leaf collimators (MLC) edge (range, 1-3 mm) (1-7% difference). The best CI was seen with 9 static fields compared with DCA regardless of number of arcs used (2% difference). CI improved with the following - decreasing PTV to MLC margin (up to 10% difference), increasing number of static fields (1-2% difference), using 10 MV FFF (2% difference) and with arc length & table spread for irregular shaped targets (1% difference).

Patient study
Similar results were obtained with all techniques. Total mean number of MUs were 3144, 3166, 3121 for D3CA, D4CA and 9 static fields plans respectively. The mean CI was 2.3, 2.1 and 2.2 using D3CA, D4CA and 9 static field plans respectively. The normal tissue mean doses were 1.3% for all three techniques.

Conclusion: All evaluated radiosurgical plans were acceptable for clinical use. The technique was chosen based on delivery efficiency and dose to normal brain. 10 MV FFF was more efficient and more conformal. D4CA delivers lower dose to a larger volume of the brain compared to 9 static fields which delivers higher dose to a smaller volume. The MLC margin is a compromise between CI and doses to the PTV. To conclude 4DCA 10MV FFF was chosen for clinical use, the MLC margin depends on the target volume.

EP-1707
Tomotherapy dose painting hypofractionated treatments on GBM based on DW-MRI: a feasibility study, M. Orlandi1, A. Botti1, E. Cagni1, L. Orsingher1, R. Sghedoni1, C. Patrizia1, C. Iotti1, M. Iori1
1Arcispedale S. Maria Nuova, Fisica Medica, Reggio Emilia, Italy

Purpose or Objective: To investigate the feasibility in Tomotherapy (HT) of a hypofractionated DP (Dose Painting) treatment on GBM (Glioblastoma Multiforme) cancer patients using ADC maps derived from DW-MRI.

Material and Methods: Five patients, who underwent GBM radiotherapy, were retrospectively considered, prescribing a dose escalated from 25 to 50 Gy in 5 fractions. The objective was that at least the 95% of the CTV received at least 25 Gy. DPBN dose prescription maps were generated from ADC-MRI, registered with planning CT, for each patient. The ADC pixel values (mm^2/s) within the CTV were converted to dose values (Gy) using the equation Eq. 1 where Dmin and Dmax are the minimum and maximum total dose of prescription (25-50 Gy). Imin and Imax are the minimum and maximum significative values of ADC selected on the basis of the ADC differential histogram, inside the CTV region.

Then it was necessary to discretize each DPBN maps in 9 isodose levels (Deveau et al., Acta Oncol. 2010) in order to obtain a corresponding DPBC map. The final DPBC map was realized minimizing, with an iterative process, the difference between DPBN and DPBC, evaluated by means of Quality Factor (QF) (Vanderstraeten et al., Phys. Med. Biol. 2006). The QF is, defined as in Eq. 2 and Eq. 3 where \( i \) is the \( i \)-th voxel. Then plans were optimized on a standard HT TPS and a TPS Dose Distribution (TDD) was obtained. For each patient the TDD was compared with the prescribed DPBN using a Qi distribution, defined as the ratio of TDD and DPBN. The quality of the treatment plans was evaluated in term of QF and Q0.9-1.1, that represents the volume of the CTV in which the Qi ranges from 0.9 to 1.1. Eventually the delivery of the DP plans was assessed with Octavius system (PTW).

Results:Fig. 1 reports the different distributions obtained for Patient 1.

Table 1 shows quantitative DVH and quality analysis of the CTVs, mean values OAR Dmax for all five patients, and y results for the DQA performed. The constraints for the OAR were respected in all the five plans as well as the coverage of the CTVs with the minimum prescribed dose of 25 Gy. The QF ranges from 0.126 to 0.176, while the mean value of Q0.9−1.1 was 68% ± 7%. The delivery time ranges from a minimum of 38.3 minutes to a maximum of 63.6 minutes. All DQA performed are within the acceptance criteria with a mean value of y of 87.4%.

Conclusion: Our results provides the feasibility of a ADC-based dose painting treatment in GBM cancer patients, respecting dose constraints to OAR and minimum target coverage. The plans obtained are deliverable, even if there is some concern about the HT delivery time. Clinical studies should be conducted to evaluate toxicities and tumor response of such a strategy.

EP-1708
Re-irradiation of pelvic sidewall disease: comparing normalisation techniques for stereotactic RT M. Llewelyn1, E. Wells2, N. Bhuvana3, A. Taylor1
1Royal Marsden NHS Foundation Trust, Department of Gynaecology, London, United Kingdom
2Royal Marsden NHS Foundation Trust, Department of Radiotherapy, London, United Kingdom

Purpose or Objective: Management of pelvic sidewall recurrence in gynaecological cancer is a challenging clinical scenario with only 10-20% 5-year survival. For patients previously treated with radiotherapy, salvage surgery has high morbidity and outcomes are poor. Recent radiotherapy advances including stereotactic radiotherapy provide the opportunity for more effective salvage techniques. Systematic assessment is required to determine optimal treatment approaches. The aims of this study were: (1) To determine target and OAR dose targets for pelvic re-irradiation (2) To compare ICRU 83 normalisation and prescription (ICRU) to the stereotactic radiosurgery convention of prescribing to a covering isodose
allowing maximum doses of ~125% (SRS) using both fixed field IMRT and VMAT techniques.

Material and Methods: A systematic literature search was undertaken to assess pelvic re-irradiation outcomes and cumulative dose constraints for organs at risk including bowel, bladder and rectum were derived. Dosimetric assessment was undertaken for 10 patients treated for recurrent gynaecological cancer assuming prior pelvic radiotherapy of 50 Gy (EQD2). Plans were produced to deliver 30Gy in 5 fractions using ICRU-fixed, ICRU-VMAT, SRS-fixed and SRS-VMAT techniques. Doses to GTV, PTV and OAR were compared and conformity index measured for each technique.

Results: All 50 plans met the planning objectives for PTV and GTV coverage. PTV volume ranged from 10 - 99 cc (mean 38 cc). Mean GTV dose with ICRU-fixed and ICRU-VMAT was 30.1Gy; with SRS-fixed and SRS-VMAT it was 30.4 Gy, increasing the EQD2 to 40 Gy to 48.4 Gy. Conformity index was ICRU-fixed 1.19, ICRU-VMAT 1.10, SRS-fixed 1.04 and SRS-VMAT 1.05. All bladder and rectal targets were met for all plans except one patient with bladder involvement. The dose limiting structure was bowel with mean Dmax 27 Gy (range 13-33 Gy), D2cc 21 Gy (13-30), D5cc 17 Gy (7-27) and no significant differences between techniques. Dose targets were exceeded for 3 patients with no correlation to PTV volume, only proximity of GTV to bowel.

Conclusion: Re-irradiation is a valuable option for treating sidewall recurrence and can be delivered within acceptable dose constraints with both normalisation techniques. SRS type normalisation increases mean GTV doses by 21% (EQD2) compared to ICRU normalisation without increasing OAR doses. Using our proposed bowel tolerances of Dmax 31 Gy, compared to ICRU normalisation without increasing OAR dose constraints with both normalisation techniques. SRS-VMAT in comparison with IMRT technique improves efficacy of plan delivery for equivalent plan quality. The decreased number of monitor units allows to deliver a single fraction faster, so it to reduce the probability of intrafraction motion.

EP-1710
Use of FFF beams for SBRT treatments: impact of the size of the PTV?

L. Vieillerive1, S. Bessieres1, M. Ouali2, C. Lanaspeze3
1 Institut Claudius Regaud, Radiophysique, Toulouse, France
2 Université Paul Sabatier, Toulouse, France
3 Institut Claudius Regaud, Statistiques, Toulouse, France

Purpose or Objective: Flattening filter free (FFF) beams are most frequently utilized for treatments where higher fraction doses need to be delivered, including hypofractionated stereotactic body radiation therapy (SBRT). There are various treatment modalities now available for SBRT: conventional static fields, dynamic conformal arc (DCA) or Volumetric Modulated Arc Therapy (VMAT). In the present study, we wanted to obtain some criteria for a conscious choice of the employment of FFF beams and of the DCA or RA technique depending the size of the PTV.

Material and Methods: Treatment planning was carried out using version 11 of Eclipse (Varian, Palo Alto, CA, USA) with Analytical Anisotropic Algorithm (AAA). All plans were designed for a Varian TrueBeam STx linear accelerator (Varian Medical Systems) equipped with a high definition Millenium multi-leaf collimator (HDMC). Twenty four PTVs from 1.52 cm3 to 445.24 cm3 were studied. For each PTV, DCA and VMAT plans were prepared utilizing two flattening filter free beams of 6 MV (FFF) and 10 MV (10FFF) and two nonflattened beams of nominal energy 6 and 10 MV (6FFF, 10FFF). For a meaningful comparison, all DCA and RA plans satisfied 100% of the prescription dose to at least 98% of the PTV. Parameters such as conformity index, gradient index, healthy tissue mean dose, number of monitor units, beam on time (BOT) were used to quantify obtained dose distributions. A friedman and spearman’s rho test were performed in order to establish statistical significance.

Results: The data indicate no significant differences between conformity with flattened beams and those using unflattened beams for VMAT technique. For DCA technique, it is notable that 6FFF tends to be slightly better than 6FF beams and even for large volumes. As PTV volume increases, 10FFF is less suitable for DCA technique and forward planning becomes more challenging and inappropriate. The MUs in the FFF plans were always greater than in FF plans. Dose to healthy tissues were reduced for all PTV sizes for FFF beams, except for the DCA 10FFF for large PTV volume. The BOT for FFF beams is much lower. DCA was found to be more appropriate for small PTV and VMAT for medium and large PTV. The MUs were significantly different between techniques. VMAT plans generated larger number of MU compared to DCA.

Conclusion: The plans developed with flattened and unflattened beams look very similar in terms of conformity index. FFF beams provide a better sparing of OAR except for