1, 2 and 6 due to air within the PTV_SIP volumes compared with the other patients. Safety of the plans was analysed from the absolute volume DVHs (dose to mL). The steepness of dose fall off could be read off by comparing the doses to the PRVs with those to the OARs. The constraints were respected for the corresponding OARs. All patients had local control at a median follow-up of 9 months and toxicity was low.

Conclusion: SIP-IMRT is shown to result in a median dose of ≥100% to PTV_Σ, to achieve high local control and low toxicity. Longer follow-up is required for verification of these results and a prospective clinical trial is currently testing this new approach in chest and abdomen SBRT.

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Heart structures sparing through volumetric modulated arc therapy in mediastinal Hodgkin lymphoma
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Purpose or Objective: Within the frame of further implementing a precise dose delivery in young patients with mediastinal Hodgkin lymphoma, heart sparing appears a crucial endpoint. Recent studies demonstrated a correlation between the occurrence of various late events (e.g. heart failure, myocardial infarction, valve disease) and the dose received by different cardiac substructures, giving insights into a complex mechanism of radiation-induced toxicity. The purpose of this study was to compare the dose received by these substructures either using an optimized multi-arcs volumetric arc therapy (VMAT) or classical 3D-CRT.

Material and Methods: We analyzed the plans of 14 patients (3 males and 11 females) with stage I-IIA mediastinal disease without axillary involvement, treated with involved site radiotherapy; 11 had a bulky presentation at diagnosis. In every patient, a deformable fusion was performed with a dedicated software (Velocity™, Varian) between the planning CT scan and the pre-radiotherapy contrast enhanced CT scan. The following structures were delineated: whole heart; left main, left descending, circumflex and right coronary arteries; aortic, pulmonary, mitral and tricuspid valves; right and left atria; right ventricle, left ventricle and inter-ventricular septum; left ventricular apex, mid cavity, base and lateral wall. Two experienced radiation oncologists contoured target volumes (CTV) and heart structures, after a training session with a cardiologist and a heart radiologist. 3DCRT was planned as AP-PA, while the VMAT approach consisted of multi non-coplanar arcs (the so-called butterfly technique). Mean and max dose received by the single substructures were compared by Student’s T test.

Results: Mean and max doses for the different cardiac structures, according to the technique used, are reported in table 1. Maximum dose resulted similar for almost all the structures except for the whole heart and the right ventricle, where VMAT gave higher doses (probably due to small hotspots in the PTV areas adherent to heart segments, mainly located in the lower anterior mediastinum). Conversely, a lower mean dose was delivered by using VMAT to all structures, reaching a strong significant difference for whole heart (p = 0.025), aortic valve (p=0.0001), mitral valve (p=0.049) and left atrium (p=0.0001). Most significant findings are illustrated in figure 1.
Interplay effect quantification of PBS lung tumour proton therapy with various fractionation schemes

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Purpose or Objective: This study aims to investigate how much fractionation, and the different delivery dynamics of higher dose-per-fraction deliveries, can influence the impact of interplay effects for PBS-based lung tumour treatments.

Material and Methods: For two example lung tumour cases (I and II), three-field 3D plans were calculated on a patient specific range-adapted ITV (rITV) using a spot spacing of 4mm orthogonal to the beam directions. 4D dose calculations were performed, simulating three different fractionation treatments with schemes of (A)2.5Gy×35fx, (B)5Gy×10fx and (C)13.5Gy×3fx, based on machine and delivery parameters of the Varian ProBeam system (lateral scanning speed of 5/20 mm/ms and energy switching time of 700 ms with layer-wise optimized dose rates). 1x- to 10x-layered and volumetric rescanning was simulated to mitigate residual motion effects. The final dose distributions for fractioned treatments were obtained once fractionation scheme (C) is used.

Results: For single fraction only delivery (shown by error bars with hollow markers in figure a), the normalized HIs are similar for the different fraction doses for both patients, with HI being typically 14/15% higher than the static for case I and II respectively. For the full treatments (solid markers), the normalized HIs of plans under scheme A and B are equal or better than for the static plan, with only ±1.2% variations as a function of starting phase. In addition, whereas for scheme C, HI is 2.5±2.6/4.8±2.3% (Case I/II) higher than the static case once combined with moderate rescanning (+5x).

Conclusions: The potential clinical benefits still need to be demonstrated in expanded cohorts, with prolonged long-term follow-up.

Development of a postoperative image-based treatment planning system for breast IOERT

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Purpose or Objective: One of the major limitations of IOERT is the lack of a postoperative image based treatment planning, in order to optimize the radiotherapy procedure. The aim of this study is to develop and introduce a postoperative image based treatment planning system for breast cancer IOERT.

Material and Methods: To obtain a postoperative image based treatment planning software, it is necessary to have a postoperative image which includes the anatomical modifications of the tumor bed after the surgery. To this end, a C-arm fluoroscopy system (Zeihm Vision-8000) was employed to obtain a series of 2D images which include the tumor bed together with the IOERT applicator and protection disk. In addition to the postoperative images, it is mandatory to have the complete isodose distributions for different combinations of applicator size/energy. To obtain this data, Monte Carlo simulation was employed. The LIAC IORT accelerator was simulated by MCNPX code and then, isodose distributions were extracted using mesh tally inside a water phantom. To develop a graphical treatment planning software, a graphical user interface (GUI) was prepared by in house program written with MATLAB. At first, the postoperative image is imported to the program. Then, the corresponding isodose distribution file is loaded to the program. Then, the user will specify the applicator edge and program registers the isodose curves to the postoperative image. In order to evaluate the performance accuracy of the implemented postoperative image based treatment plans and delivered dose to the patient, in vivo dosimetry was used. To this end, the delivered dose to the surface of tumor bed was measured by Gafchromic EBT2 film.

Results: The result of postoperative imaging and corresponding treatment planning is shown in Fig. 1.