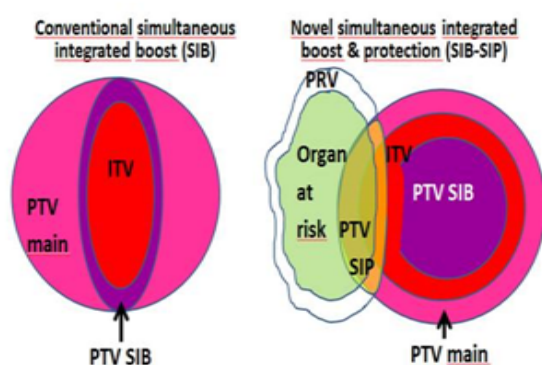


were chosen when closeness of the PTV to the bowel was intermediate and doses were 5 x 6.5/9.0/11.0 Gy to SIP/main/SIB PTV. 12 fraction regimens were preferred in patients with large contact interfaces to bowel OARs and doses were 12 x 3.5/4.0/5.0 Gy to SIP/main/SIB PTV. If in doubt, a plan for 5 fractions was created and if dose constraints were violated a new plan for 12 fractions was made. Original dose constraints for OARs for 12 fractions were recalculated using EQD2 (equivalent dose in 2 Gy fractions) with  $\alpha/\beta$  3 for late bowel toxicity in an attempt to achieve isototoxicity. Proton pump inhibitors (PPI) were prescribed prior to SBRT for at least 6 months after completion of therapy.

**Results:** Since 08/2013 25 patients with the SIB-SIP concept were treated with hepatic metastases, primary hepatic lesions, Klatskin tumours and pancreatic cancer (PDAC). Most often SIP-volumes were small compared to the main PTV and 14 patients could be treated with 5 fractions, whereas in 11 patients a 12 fraction regimen was preferred. Acute toxicity was < grade 2 in 23 patients. One patient with PDAC had grade 3 pain after the 1<sup>st</sup> of planned 5 fractions which did not re-occur after change to the 12-fraction-regimen single doses. One patient with PDAC had Forrest grade III gastric ulceration after 24/48 Gy (main PTV) despite prophylactic PPI intake. None of the patients developed late gastrointestinal complications  $\geq$  grade 2 after a median follow-up of 9 months and local control rate at 9 months was 81%. **Conclusions:** We here present a novel ICRU-type prescription technique for upper abdominal SBRT combining protection of bowel OARs with directed boost to the core regions of the lesion with favourable initial clinical tolerance and local tumour efficacy.



## PO-0780

Benefit of intra-fraction image-guidance for stereotactic radiotherapy and radiosurgery

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**Purpose/Objective:** The purpose of this study was to analyze intra-fractional positioning uncertainty for stereotactic radiotherapy and radiosurgery of cranial tumors, including primary brain tumors and metastatic disease. Specifically, we wish to determine if the use of intra-fractional image guided patient positioning verification is necessary during delivery of 'frameless' stereotactic radiotherapy and radiosurgery

(SRT/SRS) and non-coplanar radiation beams, and if positioning uncertainty is associated with overall treatment time.

**Materials and Methods:** The patients were treated on an accelerator-based stereotactic equipment (NovalisTx with micoMLC, Varian/BrainLab). Orthogonal radiographic treatment verification data was extracted for 288 consecutive patients and 1344 fractions, and were analyzed with respect to 3D translational and angular corrections once during treatment delivery of SRT/SRS (ExacTrac, BrainLab). The treatment position was adjusted using 6D corrections (Robotics, BrainLab). Association was investigated using Spearman signed rank test and p-values less than 0.05 were considered significant.

**Results:** The study shows that positioning corrections greater than 2 mm are required for ca. 6% of the beams (see Fig.1). Further, the magnitude of the translational corrections and the maximum angular deviations were both significantly associated with the delay time between the beams ( $p < 0.006$ ) (see Table 1). In addition, the maximum angular and translational deviations were associated ( $p < 0.001$ ).

Table 1. Spearman correlation coefficients for the treatment beams investigated.

Parameter	Association	Rho	Significance (2-tailed)
Lateral dev.	Long. dev.	-0.007	0.785
Vertical dev.	Long. dev.	-0.039	0.157
Lateral dev.	Vertical dev.	-0.012	0.672
Max angular dev.	Delay time	0.092	0.006
3D deviation	Delay time	0.376	0.000
3D deviation	Max angular dev.	0.174	0.000

**Conclusions:** We conclude that a subgroup of SRT/SRS patients may have considerable positioning error unless this is monitored and corrected during treatment, and that keeping the imaging and delivery times short is beneficial towards clinically relevant geographical misses.

## PO-0781

Clinical target volume in postoperative radiotherapy for gastric cancer: the interobserver variability

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**Purpose/Objective:** To identify the main pitfalls and challenges and their possible sources in clinical target volume

(CTV) delineation for postoperative gastric cancer (GC). The effect of a dedicated training course on interobserver variability in the CTV delineation among residents in radiation oncology was evaluated.

**Materials and Methods:** Twenty residents from several institutions delineated the CTV for the same case of postoperative GC before and after a training course on target volume definition. CTV was delineated on four planning computed tomography (CT) scans: the dome of the diaphragm, the anterior abdominal wall, the duodenal stump and the porta hepatis level. Participants were also asked to determine the most caudal scan of the CTV. The rough volume of the CTV for each participant was reconstructed from all requested planar contours. The reference contours were proposed by the senior radiation oncologist. Area of Intersection (AI) and Volume of Intersection (VI), defined as the overlap of delineated area/volume with respective reference area (RA)/ reference volume (RV), were computed using dedicated software for each participant. AI was calculated for each requested CT scan. The degree of agreement between the reference contours and participants' delineations was quantified using the Concordance Index (CI) for respective areas and volumes, defined as the percent ratio of the AI or VI to the RA or RV ( $AI/RA \cdot 100\%$  or  $VI/RV \cdot 100\%$ ). Additional analysis of the lower CTV border (distance from the reference level) was performed. The CIs for areas and volumes obtained before and after the course were compared using the Student t-test. A questionnaire was developed to gather data regarding the difficulties the participants faced during the CTV delineation before and after the course.

**Results:** The mean value of CI for all participants was the lowest for the dome of the diaphragm and for the duodenal stump (24% and 49% before the course, 35% and 61% after the course, respectively). The highest mean CI was recorded for the abdominal wall (73% before and 83% after the course). For all delineated CT scans, CI was higher after than before the course, although the differences were not statistically significant. Mean CI for the CTV volume was 49% before and 59% after the course, respectively,  $p = 0.17$ . The mean distance from the reference to the participants' lower CTV borders was 2.73 cm before and 2.0 cm after the course, respectively,  $p = 0.17$ . In a questionnaire, 75% of respondent indicated the elective nodal area as the main difficulty when contouring the CTV, particularly with regard to para-aortic, mesenteric and porta hepatis lymph nodes.

**Conclusions:** Elective nodal area is the main subjective difficulty faced in CTV delineation for postoperative GC, however the largest interobserver variability was shown for the dome of the diaphragm. The differences tended to decrease after the course.

PO-0782

Breast radiotherapy: invisible tattoos for external references (The BRITER study)

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**Purpose/Objective:** Conventional dark ink tattoos used for external references during breast radiotherapy can negatively impact patients' long term cosmetic outcomes, serve as a reminder of their diagnosis and treatment and be incorrectly identified in patients with dark skin tone. Fluorescent tattoos offer an innovative solution to overcome these limitations but have not previously been clinically tested. This study evaluates the efficacy of using fluorescent tattoos together with the impact on patient experience in those undergoing breast radiotherapy. The primary endpoint was inter-fraction reproducibility (population random error) determined using electronic portal imaging (EPI).

**Materials and Methods:** Prior to recruitment, extensive pilot work was performed to assess visibility of fluorescent inks with a selection of UV torches. Forty six patients receiving adjuvant radiotherapy for BC were randomised to receive either fluorescent (n=24) or conventional dark-ink tattoos (n=22). Tattoos were administered bilaterally and midline. EPI data was used to determine setup accuracy and compared between groups using a one sided t-test. Timing data was recorded at CT planning and treatment sessions to identify resource requirements. A validated body image scale (BIS) was completed at baseline (pre-treatment), 1 month and 6 months post planning scan to determine the impact of tattoo type on body image.

**Results:** Pilot work demonstrated that optimum torch and fluorescent ink selection was paramount for safe and effective application of this method. No adverse effects were reported and fluorescent tattoos were visible in 22 of 24 patients. Fluorescent tattoos could not be sufficiently visualised in two patients with sub-Saharan skin tone and they were re-tattooed with conventional dark ink. Random displacements for the fluorescent tattoo group were less than 2.8mm in the anterior-posterior and cranio-caudal directions ( $p = 0.001$ ;  $p = 0.009$  respectively). There were no statistically significant differences in random and systematic errors between the two groups. There was a modest increase in setup time (mean=1.4mins) associated with fluorescent tattoos. BIS scores were worse at 1 month in 50% of patients with dark ink tattoos compared to only 24% of patients with fluorescent tattoos (six month results available 2015).

**Conclusions:** The use of external reference fluorescent tattoos with optimum UV torches is an innovative alternative to using conventional dark ink for breast radiotherapy. EPI data suggests there is no significant difference in inter-fraction reproducibility. Analysis of body image data suggests that, for a proportion of breast radiotherapy patients, use of fluorescent tattoos can improve patient experience and enhance survivorship.