Results: The results of the HTT showed an overall three dimensional accuracy of 0.76 mm (SD0.46 mm) for the frameless technique, 0.87 mm (SD0.44 mm) for the frame-based technique. The mean 3D setup error of the frameless approach before 6DOF correction was 1.91 mm (SD1.25 mm). The rotational errors were larger in the longitudinal direction (0.23°±0.90°) compared to the lateral (-0.09°±0.70°) and vertical (0.10°±0.63°) respectively (p<0.05).

The mean 3D intrafraction shift was 0.58 mm (SD0.42 mm) and comparable to frame-based techniques. The intrafractional rotational errors were comparable, (0.01°±0.35°), 0.03° (SD0.3°) and 0.03° (SD0.3°) for the vertical, longitudinal and lateral, respectively.

Conclusions: On the basis of phantom studies, the frameless technique showed comparable overall accuracy to the frame-based approach. The immobilization characteristics of the frameless mask approach are comparable to the invasive head ring used during frame-based positioning. With proper immobilization and x-ray verification images, frameless radiosurgery can be delivered with high accuracy whilst avoiding the minimal invasive invasive frame-based technique, and can be considered to be a reliable alternative for SRS treatments.

PO-0885 Implementation and validation of Pinnacle for stereotactic body radiotherapy with a flattening filter free linac.
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Purpose/Objective: In the past two years, there has been a growing interest in using flattening filter free (FFF) linear accelerators. By removing the flattening filter a higher dose rate and a relative reduction of the out-of-field dose can be achieved. This could be an asset for stereotactic body radiotherapy (SBRT) where a high dose per fraction is delivered and a shorter treatment time is desired. The aim of this study was to evaluate and compare SBRT using FFF vs. flattening filtered (FF) beams optimized with the SmartArc algorithm in Pinnacle (Philips Medical Systems).

Materials and Methods: Eight patients with lung metastases were planned using SBRT with a fractionation of 54 Gy in three fractions. Plans were normalized to 95% of the prescribed dose covering 95% of the target volume. 99% of the target should receive >90% of the prescribed dose. The maximal dose allowed was set to 150%. All patients were planned on a TrueBeam (Varian Medical Systems) linac with high definition multileaf collimator using a 6 MV photon beam with FF and with FFF. The maximal dose rate was set to 600 MU/min with FF and 1400 MU/min with FFF. The plans were calculated on Pinnacle version 9.2 using three volumetric modulated arcs (VMAT). Evaluation criteria of the plans was based on mean lung dose, lung volume covered by 95% of the prescribed dose could be reduced with FFF beams. No significant differences in MU were observed between FF and FFF beams. Nevertheless, the estimated delivery time could be reduced by a factor >2 with the FFF beams.

Conclusions: Both FF and FFF VMAT beams planned in Pinnacle were able to achieve the target and organ constraints for SBRT lung metastases. FFF beams accomplished additional dose sparing for lung and reduced dose to the normal tissue. Furthermore, the irradiation time could be drastically reduced due to the high dose rate of FFF beams. This could potentially limit the dosimetric errors associated with intra-fraction organ and patient motion during treatment.

PO-0886 Privacy-preserving, multi-centric machine learning across hospitals and countries: does it work?
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Purpose/Objective: To show that privacy-preserving machine learning across different hospitals and countries, without patient data ever leaving the hospital, is technically feasible and yields the same results as conventional centralized learning.

Materials and Methods: A test network of 5 hospitals in the Netherlands, Belgium and Germany has been installed. It consists of one publicly hosted gateway node plus local nodes installed at the radiation oncology department of each hospital. Since data is stored in different systems and languages, the infrastructure automatically translates the local data into a common data model represented by ontologies (NCI Thesaurus plus custom extensions). The communication between gateway and the hospitals is encrypted according to industry standards and all access to the infrastructure is validated based on username and password. The local nodes extract, de-identify and standardize the local patient data as well as manage access to it. Distributed machine learning algorithms are deployed across all centers (local algorithm) and the gateway (master algorithm) to learn a model to predict survival in lung cancer patients treated with radiotherapy. Only the local algorithms have access to the patient data. They generate aggregated results that are being sent to the master algorithm, which analyzes the results and updates the local algorithms with new information until the learning is complete and a final model is created by the master algorithm. Only trusted algorithms are deployed and all traffic between the gateway and the hospital is handled and audited by the infrastructure.

Distributed Learning Flow:

Results: We distributed a test dataset of 322 anonymized patients unequally across all centers, applied a distributed support vector machine and compared the results to a conventional support vector machine applied to the entire dataset centrally. Both approaches produced the exact same results in terms of model coefficients and area under the receiver operation characteristic curve (AUC>0.77). The distributed algorithm converged after 550 iterations with an execution time of two hours, compared to an execution time of less than one minute for the conventional method.

Conclusions: Privacy-preserving learning without patient data ever leaving the hospital is technically feasible and enables multi-site, cross-country machine learning. It yields identical results compared to conventional centralized learning. It requires a distributed learning approach which comes with a minor penalty in execution time. But in exchange, we think that the data privacy and security improvements of the infrastructure make it more attractive to hospitals compared to centralized environments that require the hospital to give up control of the infrastructure.

PO-0887 Pencil beam scanning using a new dedicated nozzle for proton beam delivery
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Purpose/Objective: Proton therapy has several advantages over conventional radiotherapy. The use of compensators to achieve a homogeneous and superior dose distribution distally has a severe side