J. Liu[1], L. ZHU[1], S. Li[1], S. Gao[1], J. Yan[1], L. Xie[1], Z. Hou[2], X. Zhou[1], B. Liu[1]
[1]Nanjing Drum Tower Hospital- Medical School of Nanjing University, The Comprehensive Cancer Centre, Nanjing, China ; [2]School of Biological Sciences and Medical Engineering, Southeast University, State Key Laboratory of Bioelectronics

Purpose or Objective
To compare the dosimetric differences between helical tomotherapy (HT) and seven-field intensity-modulated radiotherapy (7F-IMRT) in the pelvic irradiation of patients with cervical cancer.

Material and Methods
Twenty-five patients with cervical cancer who received pelvic external bean radiation therapy by HT from March 2015 to October 2017 were retrospectively studied. Total dose of 4600 to 5000 cGy was delivered in 23 to 25 equal fractions. The 7F-IMRT planning was inversely carried out for comparison using Pinnacle^3 9.10 planning system according to the original computed tomographic simulation data of each patient. Dose to target volumes, organs at risk, homogeneity, and conformity indexes were evaluated for each case according to the dose volume histogram.

Results
1) For planning target volumes (PTV) in HT vs. 7F-IMRT, average conformity index (CI) was 0.898 ± 0.017 vs. 0.834 ± 0.013 ($P < 0.001$) and average homogeneity index (HI) was 0.062 ± 0.012 vs. 0.109 ± 0.019 ($P < 0.001$), both of which were significantly higher in HT planning than in IMRT planning. The maximal doses of 1% and 2% target volume (D_1, D_2) in HT group were lower than those in IMRT group ($P < 0.001$), while mean dose (D_{mean}), and minimal doses of 95% and 98% target volume (D_{95}, D_{98}) were higher than IMRT group ($P = 0.048$, $P = 0.015$, $P < 0.001$). 2) For OARs, HT had superior organ sparing advantages. The maximal dose (D_{max}), D_{mean}, V_{30} and V_{40} of small bowel, colon, rectum and bladder in HT group were all significantly lower than IMRT group ($P < 0.001$, $P < 0.001$, $P < 0.001$, $P = 0.001$). V_{50} was slightly lower in HT group without statistical difference ($P = 0.13$). As for femoral head, V_{25}, D_5, D_{mean} and D_{max} in HT group were lower than those in IMRT group ($P < 0.001$). The treatment linac outputs of HT were significantly higher than those of the IMRT group.

Dosimetric comparison for PTV parameters between HT and 7F-IMRT (x±s)

	CI	HI	D_{mean}(Gy)	D_1(Gy)	D_2(Gy)	D_{95}(Gy)	D_{98}(Gy)
HT	0.898±0.017	0.062±0.012	50.25±2.00	51.19±2.12	50.99±2.11	48.68±1.95	47.85±1.98
7F-IMRT	0.834±0.013	0.109±0.019	50.47±1.97	52.44±2.18	52.34±2.19	48.39±1.86	47.03±1.81
P	*P* < 0.001	*P* < 0.001	*P* = 0.048	*P* < 0.001	*P* < 0.001	*P* = 0.015	*P* < 0.001

Dosimetric comparison for OARs between HT and 7F-IMRT (x±s)

Organs	Project	V_{30}(%)	V_{40}(%)	V_{50}(%)	D_{mean}(Gy)	D_{max}(Gy)
Small bowel	HT	12.08±9.67	4.80±5.84	1.37±2.95	19.42±5.04	50.35±4.56
	7F-IMRT	15.11±11.84	5.64±6.46	1.56±3.49	20.38±5.22	51.31±3.71
	P	*P* < 0.001	*P* = 0.001	*P* = 0.130	*P* < 0.001	*P* < 0.001
Colon	HT	18.72±11.30	11.00±8.73	2.96±3.97	20.26±5.34	51.11±2.15
	7F-IMRT	22.48±11.95	11.82±1.64	3.14±4.04	21.19±5.63	52.30±2.24
	P	*P* < 0.001	*P* = 0.006	*P* = 0.051	*P* < 0.001	*P* < 0.001
Rectum	HT	80.58±19.76	55.70±17.56	15.93±16.90	40.61±5.44	51.14±2.10
	7F-IMRT	96.70±7.72	85.07±13.41	25.85±24.99	45.59±3.63	52.51±2.46
	P	*P* < 0.001	*P* < 0.001	*P* = 0.006	*P* < 0.001	*P* < 0.001
Bladder	HT	68.99±12.73	52.84±11.40	23.26±19.86	39.10±3.31	51.67±2.06
	7F-IMRT	79.17±9.02	60.03±9.32	23.69±19.60	40.44±2.86	53.13±2.17
	P	*P* < 0.001	*P* < 0.001	*P* = 0.309	*P* < 0.001	*P* < 0.001

Note: PTV: planning target volume; CI: conformity index; HI: homogeneity index; D_{mean}: mean dose; D_1, D_2: the maximal doses of 1% target volume (D_1) and 2% target volume (D_2); D_{95}, D_{98}: the minimal doses of 95% target volume (D_{95}) and 98% target volume (D_{98}); HT: helical tomotherapy; 7F-IMRT : seven-field intensity-modulated radiotherapy; OARs: organs at risk

Conclusion
HT achieved better conformity, uniformity and OARs protection than IMRT. The treatment outputs were higher for the HT group compared with the IMRT group indicating less beam utilization. As a conclusion, HT showed dosimetric advantages and great promise in the clinical application of image-guided radiotherapy in patients with cervical cancer.

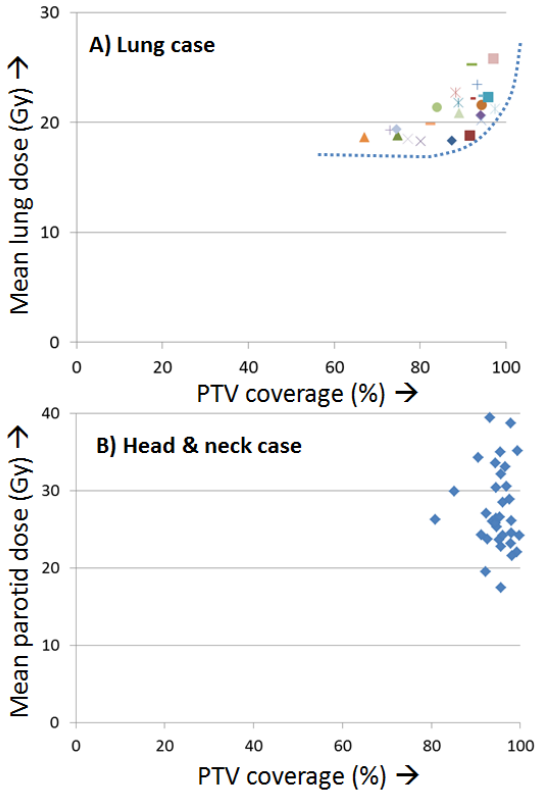
EP-1854 Application of a tool for bulk treatment plan evaluation in advanced treatment planning training

M. Van Herk[1], N. Burnet[2], N. Dinapoli[3], G. Meijer[4], U. Nestlé[5], D. Van den Bongard[4], M. Stock[6]
[1]Christie Hospital NHS, Divison of Molecular & Clinical Cancer Sciences, Manchester, United Kingdom ; [2]The University of Manchester, Divison of Cancer Sciences, Manchester, United Kingdom ; [3]Agostino Gemelli University Polyclinic Foundation, Polo Oncology and Hematology Sciences, Rome, Italy ; [4]University Medical Center Utrecht, Department of Radiotherapy, Utrecht, The Netherlands ; [5]Medical Center - University of Freibur, Department of Radiation Oncology, Freiburg, Germany ; [6]EBG MedAustron GmbH, Division of Medical Physics, Wiener Neustadt, Austria

Purpose or Objective
Hands-on training and group review is an essential part of learning how to create a good treatment plan. In an international training course, students tackled challenging study cases each day and 3 selected plans were reviewed together. So far, by necessity, plan selection was performed rather qualitatively by the faculty. It is the purpose of this work to develop and test a tool for bulk plan evaluation – applied in the context of training. The system aims to evaluate all plans, extract statistics in terms of target coverage and organ at risk (OAR) sparing, illustrate compromises made, and select most interesting plans for review and group discussion.

Material and Methods
98 students worked in pairs on 48 treatment planning systems provided by 5 vendors for 4 complex cases: locally advanced breast cancer with involved internal mammary lymph nodes, locally advanced lung cancer, bilateral oropharyngial cancer and meningioma. Dose cubes (RTDose files) were collected for all finalized plans - albeit finalized in limited time and often on unfamiliar planning systems. These were then loaded into the tool and processed. For selected structures, DVHs and previously defined DVH parameters were re-calculated. By plotting parameters for target coverage against OAR dose, plan quality could be estimated taking trade-offs into account. In addition, by highlighting plan-parameter combinations where the parameter is clinically acceptable and/or reasonable close to the best plan, the 'winner' could be selected, i.e., the plan with most highlights.

Results
23 plans were collected for the breast case, 23 for the lung case, 34 for the head and neck case, and 29 for the meningioma case. All plans could be read, although student identification was sometimes difficult. Students often modified structures as part of the planning process, showing the importance of evaluating against identical structures. Some planning systems showed significant differences in coverage of superficial PTVs, which was mainly due to differences in dose grid voxel assignment at the patient surface (up to 2 mm). Most but not all cases showed a Pareto-front like trade-off of PTV coverage versus OAR dose for different planners (Fig. 1). The qualitative selected best plan never coincided with the best plan based on quantitative analysis of all parameters. General observations were that recently introduced automatic planning tools tended to perform quite well under time constraints, and different planning systems excelled at different cases.



Conclusion

In conclusion, it is feasible and useful to collect and compare plans in bulk in a teaching situation, as it allows selection of good plans taking trade-offs into account and can be used to illustrate behaviour of different planners and treatment planning systems. It also allows individual participants to benchmark their results to the others. Lastly, it gives important feed-back to the faculty on the complexity of the study cases.

EP-1855 Retrospective review of brain dose from cranial stereotactic radiosurgery treatments of metastases

T. Kairn[1], Y. Ikeda[2], M. West[2], D. Schlect[2], S. Crowe[1]
[1]Royal Brisbane and Women's Hospital, Radiation Oncology- Cancer care Services, Herston, Australia ; [2]Genesis Care, Genesis Cancer Care Queensland, Auchenflower, Australia

Purpose or Objective

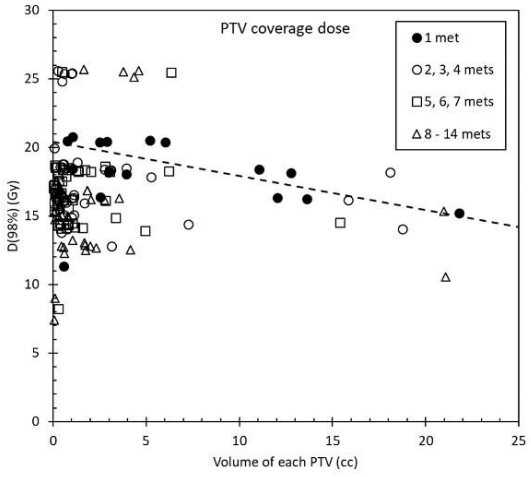
The planning and delivery of cranial stereotactic radiosurgery (SRS) treatments is changing. New treatment planning and delivery technologies are extending the numbers of lesions that can be treated using linacs without shifting the patient position. In order to understand the potential benefits or relative limitations of these new "single-isocentre" techniques, it is important to understand the plan quality achievable using older, more-established techniques, for comparison. This study therefore investigated achievable SRS treatment plan quality, in terms of dose to planning target volumes (PTVs) and to healthy brain tissue, using a retrospective analysis of cranial metastasis treatment plans.

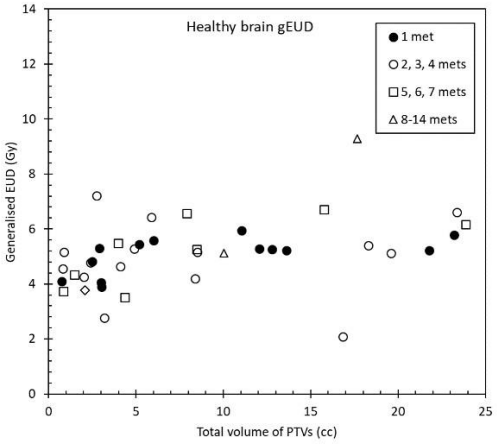
Material and Methods

In-house Treatment and Dose Assessor (TADA) software was used to evaluate 60 single-fraction stereotactic radiosurgery treatment plans, 46 of which were identified as involving multiple metastases. All treatments were planned using a multiple-isocentre technique (one isocentre per metastasis), with the Brainlab iPlan treatment planning system, for delivery using a linac equipped with a Brainlab m3 microMLC (Brainlab AG, Munich, Germany). Having previously established that iPlan's pencil beam algorithm provides a useful worst-case estimate (slight over-estimate) of the out-of-field dose, we used DICOM dose files exported from the planning system to calculate fractionation-insensitive generalised equivalent uniform doses (gEUDs) for brain structures with PTVs subtracted, while also evaluating the dose to the PTVs and other relevant structures.

Results

For cases with one metastasis, the PTV coverage dose trended downward with increasing metastasis volume (Figure 1), conforming with the established local practise of optimising prescription doses to minimise dose to the healthy brain, which would otherwise increase with increasing metastasis volume. Prescribed PTV doses were generally lower for multiple metastases cases, and similarly followed the trend of decreasing with increasing PTV volume (Figure 1). The effects of this careful optimisation of prescription dose are apparent in the comparatively low brain doses that were produced by these treatment plans, even for relatively large PTV volumes (Figure 2).





Conclusion

The results of this retrospective analysis of cranial SRS treatment plans provide a valuable example of the plan quality that can be achieved using a multiple-isocentre technique, and may therefore stand as a useful baseline for comparing the results of single-isocentre treatment planning techniques, in the future.

EP-1856 Dose escalation potential for hypofractionated radiotherapy in locally advanced pancreatic cancer