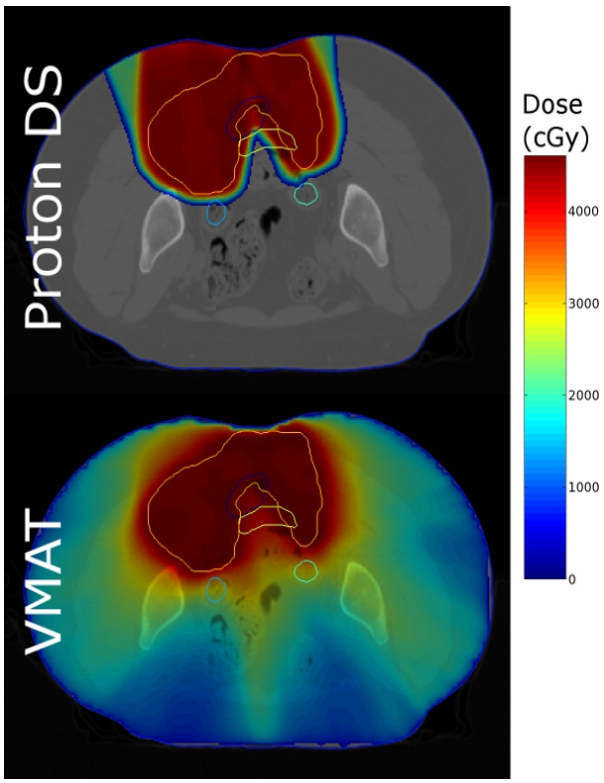

Conclusions: The study demonstrates the tissue sparing benefits of proton therapy over photon therapy for Ewings sarcomas in the pelvis and thoracic spine.

EP-1439

IMRT and IMPT of cervical cancer and effect of reduced margins

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Purpose/Objective: The objective of the study was to compare intensity modulated radiotherapy (IMRT) and intensity modulated proton therapy (IMPT) for locally advanced cervical cancer in terms of dose-volume parameters, dose coverage and conformity. Furthermore, to study the effect of reduced margins.

Materials and Methods: External beam radiotherapy planning of the pelvic region was carried out for 5 patients with locally advanced cervical cancer. Planning target volume (PTV) was defined by primary tumour, pelvic and regional lymph nodes. Dose prescription was 50.4 Gy in 28 fractions. PTV dose coverage criteria was set to D98% 95%. Two sets of treatment plans were prepared based on different CTV-PTV margins: clinical margin (7 mm L-R, 10 mm S-I, 15 mm A-P) and reduced margin (7 mm isotropic). The IMRT and IMPT plans were generated using the Eclipse treatment planning system. Dose-volume histograms (DVHs) were analyzed for the PTV and various organs at risk (OARs; rectum, bladder, bowel, sigmoideum and pelvic bone). Student's t-test was used for all statistical comparison.

Results: All IMRT and IMPT plans covered 98% of PTV with 95% isodose, so the dose prescription was well achieved. IMPT demonstrated the potential in sparing doses to OARs, where significant differences were seen compared to IMRT for many dose-volume parameters (table 1). Concerning the reduced margins, increased differences between IMPT and IMRT were seen for the bladder (data not shown). However, for the high dose regions in bowel and sigmoideum the potential sparing by IMPT was found to be less with reduced margins.

Table 1: Dose volume parameters for IMRT and IMPT of cervical cancer Clinical Margins (N=5)

OAR		IMRT (%)		IMPT (%)	
	Parameter	Mean±SD	P value	Mean±SD	Ratio
Rectum	V10 (%)	95.6±9.8	0.30	97.9±2.0	0.98
	V30 (%)	94.3±5.5	**<0.01**	79.6±7.4	1.18
	V45 (%)	76.6±7.0	**0.01**	64.9±7.0	1.18
Bladder	V10 (%)	100±0.0	**<0.01**	70.7±9.5	1.41
	V30 (%)	77.2±7.6	**<0.01**	52.8±8.1	1.46
	V45 (%)	49.8±9.1	**<0.01**	39.5±9.8	1.26
Sigmoideum	V10 (%)	100±0.0	0.13	98.5±2.5	1.02
	V30 (%)	98.5±2.5	**0.02**	85.5±11	1.15
	V45 (%)	80.3±12.4	**0.02**	68±19.9	1.18
Bowel	V10 (%)	75.7±12.0	**<0.01**	47.4±14.2	1.59
	V30 (%)	43.9±7.1	**<0.01**	24.7±9.0	1.77
	V45 (%)	21.2±4.6	**0.01**	15.7±6.0	1.35
	D195 cm^3 (%)	97.01±2.0	0.2	92.9±10.9	1.04
Pelvic Bone	V10 (%)	72.4±1.7	**<0.01**	58.9±6.5	1.22
	V30 (%)	42.4±2.5	**0.00**	24.5±2.0	1.73
	V45 (%)	13.8±1.6	**<0.01**	11.6±1.4	1.19
PTV	D98% (%)	95.6±0.5	**<0.01**	96.8±0.4	0.99
Body	D2cm^3 (%)	104.8±0.5	**<0.01**	103.2±0.5	1.01

Conclusions: IMPT has considerable potential to spare the OARs, while maintaining excellent planning target coverage, for patients with cervical cancer. Image guidance and adaptive strategies could open this therapeutic window further. Further studies on patients with paraaortic lymph node involvement are in progress.

EP-1440

Interfacing RayStation in native C++: a novel methodology to utilise research software in a clinical setting

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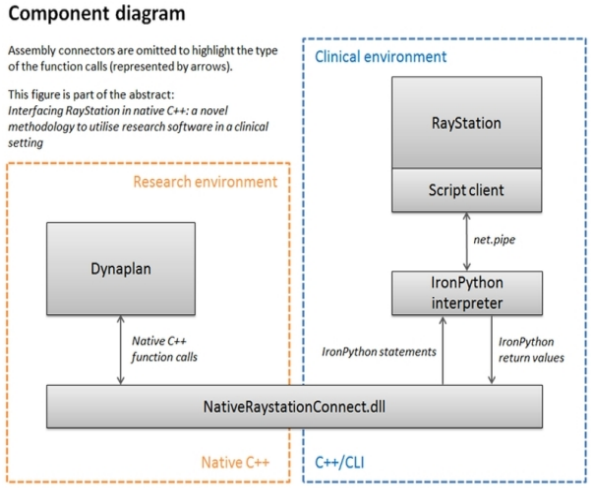
Purpose/Objective: Modern commercial treatment planning systems (TPS) become increasingly more flexible for research through the exposure of scripting APIs (Application Programming Interfaces). RayStation (RaySearch) even allows write access to the internal model in a controlled manner. However such APIs are limited to the structure of the TPS in terms of e.g. workflow and model assumptions. We have developed the in-house research TPS Dynaplan to facilitate the development of real-time interactive IMRT treatment planning. It is programmed in C++, tapping the power from parallel hardware architectures and optimised memory management. Often the development of in-house research software does not comply with medical device software standards like the software life cycle process (IEC 62304). We propose a solution that has the potential to mitigate the risks involved with in-house developed software by interfacing to the script client from RayStation.

Materials and Methods: RayStation provides a scripting API through IronPython, which is part of .NET (Microsoft). As IronPython cannot be accessed through native C++ code, we have developed an interface called NativeRaystationConnect (NRC) as DLL, which converts native C++ into managed

C++/CLI function calls. The interface connects to RayStation by identification of its process ID and setting up a pipe to its scripting client. The library handles the required memory conversions and communicates with a RayStation instance through direct IronPython calls. The NRC interface was tested by its integration in our in-house research TPS Dynaplan.
Results: A clinical case for a prostate treatment was imported from the RayStation database into Dynaplan through the NRC interface. After the generation of a treatment plan in Dynaplan, the respective leaf configurations were sent to RayStation (through the NRC interface) and incorporated into a new plan and beam set. Subsequently a dose calculation request was sent to RayStation. An automatic window focus change to RayStation allowed for clinical approval of the dose distribution, which in the meantime was also sent to Dynaplan.



Conclusions: We successfully developed a library to interface the RayStation scripting API through native C++, allowing a risk decrease for the use of research software in a clinical environment. We could show by example how the NRC interface can be used in Dynaplan by exploiting the synergy of scripted access to a certified TPS and the power of traditional programming models. The legal implication on in-house developed software used in combination with an API of a certified TPS will need to be further evaluated based on local and European legislation changes.

EP-1441

Evaluation of Eclipse Rapidplan for semi-automatic treatment planning of prostate radiation treatment

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Purpose/Objective: Quality of modulated treatment plans is highly dependent on the planner skill and experience. Plan optimization is also a time consuming process which involves several iteration cycles before an acceptable plan is achieved. Rapidplan (Varian Medical System, USA) is a semi-automated planning solution which promises to increase treatment planning efficiency and result in a more consistent plan quality as compared with individual manual optimization. The treatment planning process with Rapidplan relies on the creation of a model, obtained using high quality treatment plans previously optimized. A prostate model made available by Varian has been implemented in Eclipse (Varian Medical System, USA). The aim of this study was to compare the quality of plans created with the Eclipse prostate model and the model generated with plans from our institution with the manually optimized prostate plans.
Materials and Methods: In total 40 post-operative prostate plans were retrospectively used in this study. Patients were planned with a dose fractionation 33x2Gy. 30 out of these 40 plans were used to create an in-house prostate model. Varian's prostate model and our model were used to re-optimize ten prostate plans. The manual optimization was compared to the semi-automatic optimization obtained with the Varian and our prostate models. The comparison was done based on DVH parameters and MU. The target volume receiving 95% of the dose was compared between optimizations. The major OAR in postoperative prostate treatment is the rectum and at our institution it is paramount to achieve a high sparing of this OAR. The rectal volume receiving 40Gy (V40), 60 Gy (V60) and 65 Gy (V65) was compared between optimizations. Additionally the mean and max doses to the femoral heads were compared.
Results: Rapidplan was easy and fast to use and no re-optimization was required. The semiautomatic plans using the Varian prostate model reached a better PTV coverage respect to our plans (average V95 was 99.4% vs 97.2%). For the OAR, large dose differences were observed between Varian model optimized plans and our plans. Rectal V40, V60 and V65 were in average 90%, 40% and 14% lower for the plan optimized by us than the one optimized using the Varian model, but the maximal dose to the femoral heads was in average 6 Gy higher. Total MU was in average 20% lower for the semi-automated optimized plans.
Conclusions: Rapidplan is user friendly and requires less user input than manual optimization. The plan optimization and calculation was done at our station within 1 hour. Varian provides a prostate model which was developed by the Cancer Care Manitoba (Winnipeg – Canada) and it is based on the experience and treatment rationale in this clinic. We found that this model provided plans which are dosimetrically very different to what is currently expected and accepted in our clinic. Therefore our own model needed to be developed.

EP-1442

Investigating the impact of treatment delivery uncertainties for lung SABR: a pilot study

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Purpose/Objective: Advanced RT techniques require conservative approaches to be taken due to a lack of detailed knowledge about treatment delivery uncertainties. For example, safety margins are added to target volumes and in-