pelvis and head and neck, in lung instead, gamma pass rates were lower in 4/5 cases.

Conclusion: DC is a suitable tool for VMAT in vivo dosimetry. The pencil beam algorithm can be inaccurate in the presence of low-density inhomogeneities.

PO-0826

Benchmarking computed IDD curves for four proton treatment planning systems against measured data

J. Alshaikhi[1,2], D. D'Souza[2], C.G. Ainsley[3], I. Rosenberg[2], G. Royle[1], R.A. Amos[2]
[1]*University College London, Medical Physics & Biomedical Engineering, London, United Kingdom*
[2]*University College London Hospitals, Radiotherapy Physics, London, United Kingdom*
[3]*University of Pennsylvania, Roberts Proton Therapy Center, Philadelphia, USA*

Purpose or Objective: Accurate beam modelling is an essential function of a treatment planning system (TPS) to ensure that plans can be calculated that are deliverable within clinically acceptable tolerances. The purpose of this work is to evaluate the computed integral depth dose (IDD) curves of four commercially available proton TPSs, benchmarked against measured data. The four TPSs (EclipseTM, XiO®, Pinnacle3, RayStation®) were commissioned using pencil beam scanning data from the University of Pennsylvania (UPenn) facility.

Material and Methods: A water cube phantom (40cm3) was created in each TPS for calculation of IDD curves. Calculation grid size set to 1mm in all TPSs. Individual IDDs for 27 nominal energies, ranging from 100 to 226.7MeV, were calculated by integrating the calculated depth dose distributions. These were all benchmarked against measured data from UPenn, comparing the clinical range at 80% distal dose (D80), Bragg peak width between distal and proximal 80% (D80-P80), range at 0.5% (R0.5), and distal penumbra between D80 and R0.5. Gamma-index analysis with pass criteria of 1mm/1% was also used to compare computed and measured IDDs.

Results: Mean percentage of IDDs with >95% pass rate for 1mm/1% criteria were 96.7% (SD 4.9) for XiO®, 94.1% (SD 8.9) for EclipseTM, 95.4% (SD 8.6) for RayStation®, and 49.2 (SD 26.0) for Pinnacle3. Maximum differences between computed and measured IDD data are shown below. No correlation with nominal energy was observed.

	Maximum differences [mm]			
	Range 80% (D_{80})	Peak width (D_{80}-P_{80})	Distal penumbra (D_{80}-$R_{0.5}$)	Range 0.5% ($R_{0.5}$)
XiO®	0.1	0.1	0.2	0.2
Eclipse™	0.8	0.6	1.1	1.2
RayStation®	0.3	0.4	0.8	0.8
Pinnacle³	0.4	0.6	0.9	1.3

Conclusion: Characteristics of computed IDDs were compared to measured data for four commercially available TPSs. All were within clinically acceptable tolerances, with XiO showing the closest agreement. Differences observed were attributed to TPS specific beam modelling. Further investigation will assess the cumulative impact of these discrepancies on verified clinical treatment plans.

PO-0827

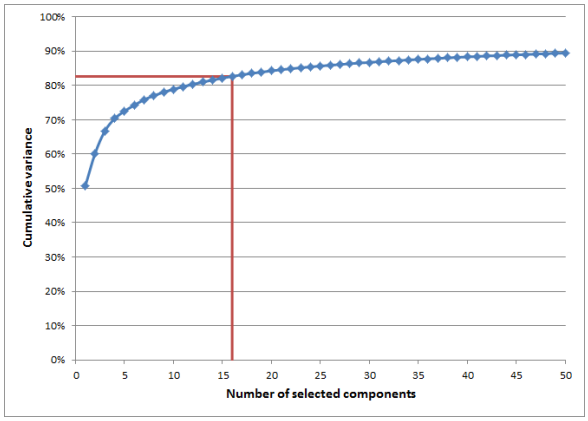
Principal component analysis for deviation detection in 3D in vivo EPID dosimetry

R.A. Rozendaal[1], B. Mijnheer[1], I. Olaciregui-Ruiz[1], P. Gonzalez[1], J.J. Sonke[1], A. Mans[1]
[1]*Netherlands Cancer Institute Antoni van Leeuwenhoek Hospital, Department of Radiotherapy Physics, Amsterdam, The Netherlands*

Purpose or Objective: One of the clinical issues our institute faces regarding in vivo EPID dosimetry is the number of raised alerts. For example, alerts are raised for 49% of the treatments in case of head-and-neck (H&N) VMAT treatments; an alert is raised when dosimetry results are found deviating according to statistics derived from the histogram of 3D γ-analysis results. These alerts are mostly found to be patient-related or attributable to limitations of our back-projection and dose calculation algorithm. After inspection, an intervention is considered for only 0.3% of the treatments. The purpose of this study is to develop a principal component analysis (PCA) based classification method to improve the specificity of our EPID dosimetry system. In particular, in contrast to our current classification method, PCA allows for the spatial distribution of γ-values to be taken into account for deviation detection.

Material and Methods: The input for PCA consisted of 3D γ-distributions (3%/3mm), one per treatment arc per fraction. In total, 2024 3D γ-distributions from 499 H&N VMAT treatment-plans were included. As an initial choice, components describing at least 1% of the variance were selected. The distribution of variances over the components was inspected to validate this choice. Using these components, new 3D γ-distributions were created by projecting each input 3D γ-distribution on only these components and then projecting the result to the original coordinate system of the 3D γ-distributions. If the selected components describe the original γ-distribution well, the new and original γ-distributions will be similar. This similarity was quantified by the root mean square (RMS) d of the difference between the two γ-distributions; a γ-distribution was marked as deviating when d exceeded a threshold. All true positive γ-distributions (n = 2) in the dataset, as identified by experienced medical physicists, were used to determine this threshold for identification of alerts.

Results: The first 16 components were each found to describe at least 1% of the variance; cumulatively, they account for 83% of the variance in the dataset. Figure 1 shows the cumulative variance accounted for as a function of selected components and indicates that the choice for selecting components is reasonable. After finding and applying the appropriate threshold for detecting the identified true positives, a drop in alert rate from 49% to of 11% was observed, corresponding to an increase in specificity from 0.51 to 0.89.



Conclusion: The PCA-based classification method presented in this study enhances the specificity of deviation detection in 3D in vivo EPID dosimetry of H&N VMAT from 0.51 to 0.89, compared to our current clinical γ-histogram based method. Before clinical implemention, a rigorous validation is required.

PO-0828

Dosimetric assessment of a second generation Multi-Leaf Collimator for robotic radiotherapy

P.H. Mackeprang[1], D. Schmidhalter[1], D. Henzen[1], M. Malthaner[1], D.M. Aebersold[1], P. Manser[1], M.K. Fix[1]
[1]*Division of Medical Radiation Physics and Department of Radiation Oncology Inselspital, Bern University Hospital, and University of Bern, Switzerland*