aS1200 EPID (24 arcs). The plans were created in Eclipse v13.6, and calculated with the AAA13.6 algorithm.
For each linac, the dosimetric output was calibrated to within 0.3%, and the beam flatness and symmetry was confirmed to be within specs (103% and 101%, respectively). The two verification systems were calibrated according to vendor instructions. Treatment plans were verified with PD according to our clinical practice, and the same acquired EPID image was analyzed with FZ within the SunCHECK software.
The measured dose was compared to the predicted dose using the gamma analysis method with 3 precision levels: Γ 3%/3 mm (3% dose difference and 3 mm DTA), Γ 2%/2 mm and Γ 1%/1 mm (global normalization, dose threshold 10%). To pass the analysis, the pass rate (points with Γ ≤1) should be ≥95% for Γ 3%/3 mm and Γ 2%/2 mm, and ≥90% for Γ 1%/1 mm.

Results

For both methods and both machines/EPIDs, all arcs passed the Γ 3%/3 mm analysis used in clinical routine. With stricter criteria, there is a number of arcs where one method passes while the other fails, as shown in Figure 1. There is a tendency of more arcs passing with FZ than with PD.

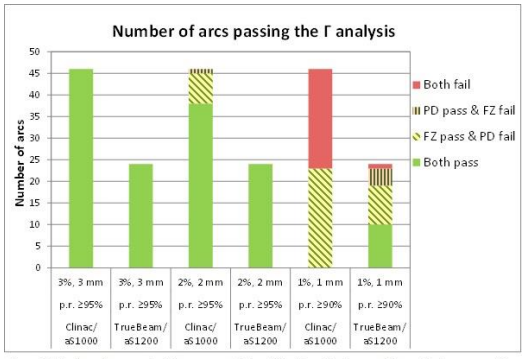

Figure 1: Number of arcs passing the gamma analysis with both methods, one of the methods or none of the methods, for various precision levels and pass rate settings.

The numbers of arcs that pass with one method but fail with the other were compared using Pearsons x^2 test under the null hypothesis that "FZ pass & PD fail" is equally probable to "PD pass & FZ fail". The difference is statistically significant for measurements performed with Clinac/aS1000, as presented in Table 1.

Table 1: Pearsons x^2 comparison of numbers of arcs that pass one method but fail the other

Precision Level	Machine/EPID	FZ pass & PD fail	PD pass & FZ fail	Significant ?
Γ 2%/2 mm	Clinac/aS1000	7	1	Yes (p = 0,03)
Γ 1%/1 mm	Clinac/aS1000	23	0	Yes (p = 0,00)
Γ 1%/1 mm	TrueBeam/aS1200	9	4	No (p = 0,17)

The average Γ pass rate is higher with FZ than with PD for all precision levels (Figure 2), but the difference is not statistically significant. However, it's worth noting that most arcs have a higher pass rate with FZ than with PD.

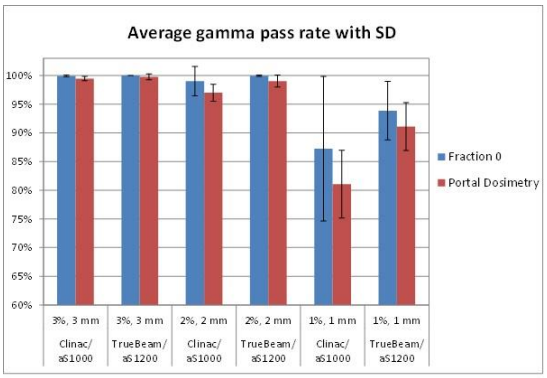

Figure 2: Average gamma pass rate with 1 standard deviation for various precision levels and pass rate settings.

Conclusion

Regardless of precision level, there's no significant difference between the average gamma pass rates from the two methods. For the criteria used in clinical routine, the two methods appear equivalent.
For the more stringent criteria there is a number of arcs where one method passes while the other fails, with a tendency of more arcs passing with FZ than with PD. This may be caused by the different approach to absolute calibration of the EPID. Future work will include 2D phantom measurements to determine which method corresponds better to the actual dose delivered.

EP-1770 Investigation of Electronic Portal Imaging Based In-Vivo Dose Verification for Prostate SBRT

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Purpose or Objective

The main purpose was to investigate electronic portal imaging based new in-vivo dosimetry tool iViewDose (Elekta AB, Stockholm, Sweden) for SBRT prostate cancer treatment in clinical use.

Material and Methods

The study was performed on Versa HD linear accelerator (Elekta AB, Stockholm, Sweden) and feasibility of iViewDose Version 1.0.1 tool was analyzed for prostate SBRT plans in clinical use. To validate this new quality assurance system in clinical facilities, fifteen prostate cancer patients were selected and iViewDose based in-vivo EPID dosimetry was performed. Treatment plans were generated with RayStation treatment planning system (RaySearch Lab., Stockholm, Sweeden) and dose prescribed as 36.5 Gy in five fraction. For all SBRT patient, three dimensional gamma analysis results were evaluated. Additionally, measured and calculated dose in reference point (DRP) for CTV, rectum, bladder and femur heads were compared for all fraction.

Results

According to measurement results, mean gamma analysis (γ%≤1) passing rate of fifteen patient was found as 95.58% for γ3D (criteria: 3% global dose difference/3 mm distance to agreement, threshold 50%). Additionally, mean DRP difference between measurement and calculated in treatment planning system for CTV, rectum, bladder, left and right femur heads were found as 1.97%, 10.04%, 18.318%, 3.19% and 4.56%, respectively. Maximum dose differences were found in rectum and bladder reference point due to the high dose gradient in these region. However, in medium and low dose gradient region measurements were compatible in 1% with calculated dose in treatment planning system.

Conclusion

iViewDose EPID-based in vivo dosimetry software provides an efficient safety check on the accuracy of dose delivery

during radiotherapy facilities. This is especially important in SRS/SBRT modalities which employ higher therapeutic doses in daily fraction.

EP-1771 Measuring the influence of magnetic fields on the dose distributions of clinical electron beams

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Purpose or Objective

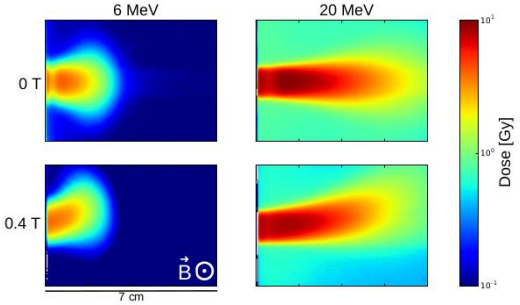
MRI-Linacs are a fast-growing area of cancer radiotherapy. To date only MRI-Linac photon beams have been investigated. However, radiotherapy quality can be improved for a wide range of clinical indications by using electron beams alone or in combination with photon beams. The objective of this work is to investigate the dosimetric impact of a magnetic field with different field strengths and orientations on therapeutic electron beams for three beam energies. For this purpose, an experimental setup for measuring dose distributions of clinical electron beams generated by a conventional linac in the presence of a magnetic field is established.

Material and Methods

A permanent magnet device was used to generate a magnetic field surrounding a solid water slab phantom. The magnetic field including maximal field strength B_{max} was varied by moving the permanent magnet banks and by insertion of focusing steel cones. Electron beams (6, 12 and 20 MeV) from a clinical linear accelerator (Varian Clinac 2100C) were incident perpendicular (transverse setup) and parallel (inline setup) to the main magnetic field direction. The magnet device was placed at a source to isocenter distance of 150 cm and the electron beams were collimated to a circle of 1 cm diameter and a square of 1.5 cm side length, respectively. Gafchromic EBT3 film was placed inside the homogeneous slab phantom, parallel to the beam (transverse setup) and perpendicular to the beam (inline setup) to measure two-dimensional dose distributions. Reference conditions with zero magnetic field were established by using identical collimation in an aluminum frame setup.

Results

As expected, for the transverse setup, substantial deflection of the electron beam was observed in the magnetic field, as indicated in figure (1). Consequently, a shift of lateral dose profiles and shift in distal dose fall-off (R50 up to -5 mm) was measured for all three electron beam energies. For the inline setup, focusing of electron beams was observed in magnetic fields compared to the zero field reference setup. An increase of measured dose of up to 100% (6 MeV beam, 0 vs. 0.7 T magnetic field) was shown, yielding a steeper lateral penumbra for a given dose level (FWHM -1.5 mm in 2 cm depth).



Conclusion

Propagating in a magnetic field, substantial deflection (transverse setup) and focusing (inline setup) of all measured electron beams was observed. The inline setup shows steeper lateral penumbra of electron fields and thus the potential for enhanced plan quality for electron treatments.

EP-1772 MLC parameters evaluation in a RT-dedicated MC environment (PRIMO) from static fields to VMAT plans

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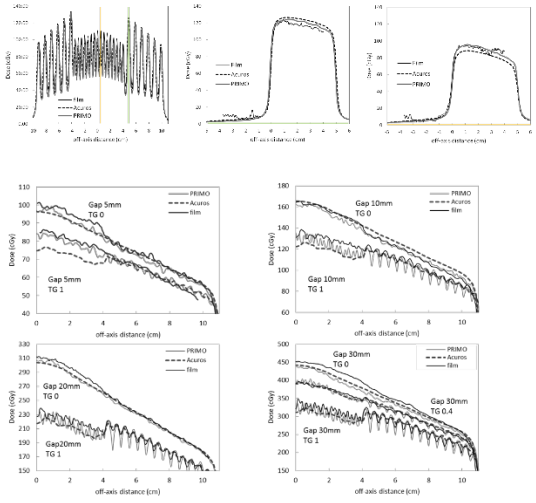
Purpose or Objective

PRIMO is a graphical environment for MonteCarlo (MC) simulations based on the Dose Planning Method (DPM), a fast MC algorithm specifically built for the simulation of the deposited dose in radiotherapy. The objective of this work was to validate the beams calculated by DPM against the ones from our Linac EDGE (Varian) and to compare PRIMO with the clinical algorithm Acuros (Varian) and film measurements with particular focus on the MLC parameters.

Material and Methods

In a first phase a full characterization of the 10MV FFF beam was performed. Then the 120 HD MLC modeling, particularly the Tongue and Groove effect, was investigated with two types of tests: static MLC fields in different settings and MLC plans configured in 'dynamic fence patterns'. These dynamic tests were planned with increasing leaf-ends, gap size and degree of TG effect. The dose distributions were measured using the IBA MultiCube phantom with GafChromic films positioned horizontally at 10cm depth. Finally a set of four clinical plans was selected from our database. All VMAT plans were optimized with 10MV FFF beam in Eclipse and calculated with Acuros. The DICOM files (plan, structures and images) were imported in PRIMO. DPM was used to calculate dose distribution in patients. The dose distributions were compared in terms of gamma analysis within BODY and PTV.



Results

Concerning the MLC modelling, static fields showed a good agreement between Acuros, PRIMO and film measurements, with slight differences in transmitted dose (Fig1). The comparison between dose profiles for the